



TENDER DOCUMENT

Septage Management of Chas Town, Jharkhand including:

1. Procurement of equipments and provision of services for collection and transportation of Septage from Households;
2. Supply, Construction, installation, testing and commissioning of Septage Treatment Plant at Chas Town; and
3. Operation and Maintenance of the above system for 10 years including public outreach activities and collection of User Charges from Consumers.

April 2017



**Jharkhand Urban Infrastructure
Development Company Limited**

**3rd FLOOR, PRAGATI SADAN, KUTCHERY
CHOWK**

RANCHI 834 002, JHARKHAND.

**PH: +91 651 2225872, E-MAIL:
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SEPTAGE MANAGEMENT OF CHAS TOWN, JHARKHAND

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JHARKHAND URBAN INFRASTRUCTURE DEVELOPMENT COMPANY LIMITED

3rd FLOOR, PRAGATI SADAN, KUTCHERY CHOWK
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CIN: U45200JH2013SGC00175

NATIONAL COMPETITIVE BIDDING

Tender Reference No:- JUIDCO/NIT/ Chas Septage/1162/2017/76

Date: 13.04.17

e-Procurement Notice

IMPORTANT INFORMATION

1	Name of work	Septage Management of Chas Town, Jharkhand - including: A) Procurement of equipments and provision of services for collection and transportation of septage from households; B) Supply, construction, installation, testing and commissioning of septage treatment plant at Chas Town; and C) Operation and maintenance of the above system for 10 years including public outreach activities and collection of user charges from consumers.
2	Estimated cost	Construction (1 yr):- Rs. 913.45 Lakhs Operation & Maintenance (10 yr):- Rs. 2774.30 Lakhs Total:- Rs. 3687.75
3	Bid Security in Rs. Lakhs	Rs. 18.30 Lakhs
4	Cost of Bid Document	Rs. 25,000.00
5	Time of completion	1 year of construction comprises 9 months of construction and 3 months of defect liability period including one month of trail run and 10 years of O&M post DLP
6	Date of e-publication of tender	17/04/17 at 16.00 Hrs.
7	Document downloading start Date	17/04/17 at 16.00 Hrs.
8	Start date for seeking clarification	17/04/17
9	End date for seeking clarification	23/04/17
10	Pre bid meeting date, Time & Venue	24/04/17 on 11.00 Hrs. at conference hall, JUIDCo Ltd, Pragati Sadan, Near Kutchery Chowk, Ranchi -834001.
11	Document downloading end date	08/05/17 at 17.00 Hrs.
12	Bid submission Start date*	17/04/17 at 16.00 Hrs.
13	Bid submission end date	08/05/17 at 17.00 Hrs.
14	Last day for the submission of Bid Security, cost of bid document	09/05/17 at 17.00 Hrs
15	Bid opening date (online)	09/05/17 at 17.30 Hrs.

Other details can be seen in the bidding documents.

Bid security 2% of Bid amount.

[*bid submission start date shall be one day after pre bid meeting date (if applicable).
Except Sunday, 2nd & 4th Saturday and GOJ holiday.]

Note: Bid security will be a fixed sum rounded off to the nearest one thousand Rupees.

1. Cost of bidding document for a non-refundable fee as indicated shall be in the form of Demand Draft of any **Scheduled Indian Bank**, payable at **Ranchi** in favour **Managing Director, of Jharkhand Urban Infrastructure Development Company Ltd (JUIDCO)**.
2. Bids must **be** accompanied by Security amount specified as mentioned in table, payable at **Ranchi** and drawn in favour of **Managing Director, Jharkhand Urban Infrastructure Development Company Ltd, Ranchi** Bid security will have to be in **anyone of the forms as specified in the bidding document** and shall have to be valid for 45 days beyond the validity of the bid.
3. Cost of bidding document and Bid Security shall be deposited in the office of the Chairman Cum Managing Director Manager, JUIDCo, e-Procurement Cell, **Jharkhand Urban Infrastructure Development Company Ltd (JUIDCO)** on all working days between **17.04.17 to 09.05.17 up to 17.00 Hrs** either by registered post /Speed post or by hand. Only those applications will be entertained where cost of bidding document and bid security is received before **17.00 Hrs. on 09.05.17**. JUIDCO will not be held responsible for the 1postal delay, if any, in the delivery of the document or non-receipt of the same.
4. Tenderer(s) shall upload Scanned copy in PDF format/Digitally Signed copy of his/her Valid DD, Bid Security, Credit Facility, TIN, PAN, Five Years Audited Turnover, Character Certificate, Work Experience, Partnership Deed or Article of Association / Memorandum , Undertakings, Affidavits, E.P.F.etc.
5. Bids shall be submitted online on the website <http://jharkhandtenders.gov.in>.
6. Uploaded documents of successful bidder will be verified with the original before signing the agreement. The successful bidder has to provide the originals to the concerned authority on receipt of such a letter, which will be sent though registered post or speed post or delivered by hand.
7. Bidders in order to participate in the bidding process have to get 'Digital Signature Certificate (DSC)' as per Information Technology Act-2000 to participate in online bidding. This certificate will be required for digitally signing the bid. Bidders can get the above mentioned digital Signature certificate from any approved vendors (CCA). Bidders, who already possess valid Digital Certificates, need not procure new Digital Certificate.
8. Bidders have to submit their bids online in electronic format with Digital Signature. Bids without Digital Signature will not be accepted. No bid will be accepted in Physical Form.
9. A pre-bid meeting shall be held as scheduled above in table in the office of **Jharkhand Urban Infrastructure Development Company Ltd (JUIDCO) Conference hall/General**

Manager (W & P) to clarify the issues and to answer questions on any matter that may be raised at that stage as stated in Clause 9.2 of the 'Instructions to Bidders' of the bidding document. **

Complete bid document is available on website <http://Jharkhandtenders.gov.in> & <http://juidco.jharkhand.gov.in>.

**Sd/-
General Manager (W&P)
Jharkhand Urban Infrastructure Development Company Ltd.
Ranchi.**

SECTION – 1
INSTRUCTION TO BIDDER (ITB)

Section 1: Instructions to Bidders

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A. GENERAL

1. Scope of Bid

- 1.1 The Employer i.e. JUIDCo (named in appendix to ITB) invites bids for the construction and O&M of works (as defined in these documents and referred to as “the works”) detailed in the table given in IFB. The bidders may submit bids for works detailed in the table given in IFB.
- 1.2 The successful bidder shall be expected to complete the works by the intended completion date specified in the Contract data.
- 1.3 Throughout these bidding documents, the terms ‘bid’ and ‘tender’ and their derivatives (bidder/ tenderer, bid/tender, bidding/tendering, etc.) are synonymous.

2. Source of Funds

The project is being funded by AMRUT (Atal Mission for Rejuvenation and Urban Transformation), MoUD, GoI. 100% of capital cost will be obtained through grant from AMRUT. This will be provided through the Escrow Account. The O&M cost will be borne by the Govt. of Jharkhand and the user charges to be collected from the users.

3. Eligible Bidders

- 3.1. This invitation for Bids is open to all bidders.
- 3.2. All bidders shall provide in Section 2, Forms of Bid and Qualification Information, a statement that the Bidder is neither associated, nor has been associated, directly or indirectly, with the Consultant or any other entity that has prepared the design, specifications and other documents for the Project or being proposed as Project Manager for the Contract. A firm that has been engaged by the Employer to provide consulting services for the preparation or supervision of the works, and any of its affiliates, shall not be eligible to bid.

4. Qualification of the Bidder

- 4.1. All bidders shall provide in Section 2, Forms of Bid and Qualification Information, a preliminary description of the proposed work method and schedule, including drawings and charts, as necessary. The proposed methodology should include programme of construction backed with equipment planning and deployment duly supported with broad calculations and quality assurance procedures proposed to be adopted justifying their capability of execution and completion of work as per technical specifications, within stipulated period of completion.
- 4.2 Deleted
- 4.3 All bidders shall include the following information and documents with their bids in Section 2:
 - (a) copies of original documents defining the constitution or legal status, place of registration, and principal place of business; written power of attorney of the signatory of the Bid to commit the Bidder;

- (b) total monetary value of construction work performed for each of the last five years.
- (c) experience in works of a similar nature and size for each of the last five years, and details of works underway or contractually committed; and the name and address of Employers who may be contacted for further information on these contracts;
- (d) major items of construction equipment proposed to carry out the Contract;
- (e) qualifications and experience of key site management and technical personal proposed for Contract;
- (f) reports on the financial standing of the Bidder, such as profit and loss statements and auditor's reports for the past five years;
- (g) evidence of access to line (s) of credit and availability of other financial resources facilities (10% of contract value), certified by the Bankers(not more than 3 months old)
- (h) undertaking that the bidder will be able to invest a minimum cash upto 25% of contract value of work, during implementation of work.
- (i) authority to seek references from the Bidders's bankers;
- (j) information regarding any litigation, current or during the last five years, in which the Bidder is involved, the parties concerned, and disputed amount;
- (k) proposals for subcontracting components of the works amounting to more than 10 percent of the Bid Price (for each, the qualifications and experience of the identified sub-contractor in the relevant field should be annexed); **and for all specialized nature of work & new engineering methodology work irrespective of the amount.**
- (l) the proposed methodology and program of construction, backed with equipment planning and deployment, duly supported with broad calculations and quality control procedures proposed to be adopted, justifying their capability of execution and completion of the work as per technical specifications within the stipulated period of completion as per milestones (for all contracts over Rs.2.5 Crore).

4.4 Bids from Joint ventures are acceptable.

4.4.1 Joint Venture partners would be limited to two (including the lead partner)

4.4.2 One of the partners, who is responsible for performing a key in contract (lead partner of the JV) management or executing and operation of proposed contract, shall be nominated as being in charge during Bidding periods and in the event of successful Bid, during contract execution. The partner in charge shall be authorized to incur liabilities and receive instructions for and on behalf of the partner(s) of the Joint Venture. This authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all partners.

4.4.3 All the partners of Joint Ventures shall be, jointly and severally liable, during the Bidding process and for the execution and operations of proposed works in contract in accordance with the contract terms, and a statement of this affect shall be included in the authorization. The Bid shall be signed so as to legally bind all the partners, jointly and severally.

Bid security and performance guarantee, as required, will be furnished by the lead partner in Joint Venture.

4.4.4. Qualifying criteria for Joint Venture

Joint Venture must comply with the following requirements: -

(i) The Joint Venture must satisfy collectively the criteria for this purpose the following data of each member of the Joint Venture may be added together to meet the collective qualifying criteria.

- (a) Annual Turnover (Cl. 4.5.A.2(a) of ITB)
- (b) Particular Construction Experience. (Cl. 4.5.A.2(b) of ITB)
- (c) Personal Capabilities. (Annexure II)
- (d) Equipment Capabilities. (Annexure I)
- (e) Financial Capabilities [Cl.4.3(g) & Cl.4.3(h) of ITB]

(ii) The each partner shall meet the following qualifying criteria in proportion to the partnership in JV but not less than 30%.

- (a) Annual Turnover. (Cl. 4.5.A.2(a) of ITB)
- (b) Particular Construction Experience. (Cl. 4.5.A.2(b) of ITB)
- (c) Financial Capabilities. [Cl. 4.3 (g) & 4.3 (h) of ITB]

4.4.5 A copy of the Joint Venture Agreement (JVA) entered into the between the partner shall be submitted with the application. Alternatively, a letter of Intent to execute a JVA in the event of successful Bid shall be signed by all partner(s) and submitted with the application together with a copy of the proposed agreement. The JVA shall include among other things a Joint Venture's objectives and proposed management structure, the contribution of each partner to the Joint Venture operation, the commitment of the partner to Joint Venture in the event of the default or withdrawal of any partner an arrangement for providing the required indemnities:

- (i) Stepping into the shoes of the existing partner(s) of JV with all liabilities of the existing partners from the beginning of the contract.
- (ii) With the prior approval of the Employer.
- (iii) Notwithstanding demarcation or allotment of work between two JV partner(s), JV shall be liable for non-performance of the whole contract irrespective of their demarcation or shared of work.

In case of successful Bid being accepted by Employer the payments under the contract will only be made to the lead partner of JV.

4.4.6 Joint Venture Agreement shall contain a Clause to the effect that there shall be a separate JV Bank Account (distinct from the Bank Account of the individual partners) to which the individual partner shall contribute their share / or working capital.

Joint Venture Agreement shall also contain a Clause to the effect that the financial obligations of the JV shall be discharged through the said JV Bank Account only and also all the payments received or paid by the Employer by the JV shall be through that Account alone.

4.5 A. 1. Technical Qualification Criteria

The Bidder shall provide evidence (certified by the relevant and respective Employer) that during last 5 years preceding the bid submissions:

SL No.	Parameter
(a)	Bidder or any one JV Partner should have satisfactorily completed construction and operation for 5 years of 100 KLD Sewage treatment plant/ package treatment plants on EPC basis.
(b)	Bidder or its nominated JV partner has satisfactorily completed 2 Years of O&M for Solid waste management of capacity 25 TPD or Contractors having experience of 2 years of carrying out cleaning of septic tank or sewer line using Vacuum Sucker Empanelled with ULBs

2. Financial Qualification Criteria

To qualify for award of the contract, each bidder in its name **must** have in the last five years as referred to in Appendix.

- a) achieved a minimum annual financial turnover (in all classes of civil engineering construction and O&M works as per scope) amount indicated in Appendix in any one year (usually not less than one and a half times the estimated cost of the project);
- b) satisfactorily completed (not less than 90% of contract value), as a prime contractor (or as a nominated subcontractor, where the subcontract involved execution of all main items of work described in the bid document, provided further that all other qualification criteria are satisfied) at least :-

(I) **Experience in last 5 Years**

(i) Three similar works each of value not less than **Rs 5.0 Crores** including experience of O&M of 2 years for sewage or effluent treatment plant or solid waste management.

OR

(ii) Two similar works each of value not less than **Rs 7.5 Crores** including experience of O&M of 2 years for sewage or effluent treatment plant or solid waste management.

OR

(iii) One similar works of value not less than **Rs 10.0 Crores** including experience of O&M of 2 years for Water treatment plant/ sewage or effluent treatment plant or solid waste management.

4.5. B. Each bidder should further demonstrate

(a) Availability (either owned or leased or by procurement against mobilization advances) of the following key and critical equipment for this work as per the **Annexure I**.

The bidders should, however, undertake their own studies and furnish with their bid, a detailed construction planning and methodology supported with layout and necessary drawings and calculations (detailed) as stated in clause 4.3(C) above to allow the Employer to review their proposals. The numbers, types and capacities of each plant/equipment shall be shown in the proposals along with the cycle time for each operation for the given production capacity to match the requirements.

(b) Availability for this work of personnel with adequate experience as required; as per **Annexure-II**.

(c) Liquid assets and/or availability of credit facilities of no less than amount indicated in Appendix (credit lines/letter of credit/certificates from Banks for meeting the funds requirements etc.-usually the equivalent of the estimated cash flow for 3 months in peak construction period.)

4.5.C. **To qualify for a package of contracts made up of this and other contracts for which bids are invited in the NIT/IFB**, the bidder must demonstrate having experience and resources sufficient to meet the aggregate of the qualifying criteria for the individual contracts.

4.6 Sub-contractors' experience and resources shall not be taken into account in determining the bidder's compliance with the qualifying criteria except to the extent stated in 4.5(A) above.

4.7. Bidders who meet the minimum qualification criteria will be qualified only if their available bid capacity is more than the total bid value. The available bid capacity will be calculated as under:

Assessed Available Bid capacity = (A*N*2-B)

where

A = Maximum value of civil engineering works executed in any one year during the last five years (updated to the price level of the year indicated in Appendix) taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of the works for which bids are invited.

B = Value (updated to the price level of the year indicated in Appendix) of existing commitments and on-going works to be completed during the next **1 year** (period of completion for construction/O&M period of the works for which bids are invited)

Note: The statements showing the value of existing commitments and on-going works as well as the stipulated period of completion remaining for each of the works listed should be countersigned by the **Engineer in Charge / Executive Engineer/ Employer.**

- 4.8. Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:
- made misleading or false representations in the forms, statements and attachments in proof of the qualification requirements; and/or
 - record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.; and/or
 - participated in the previous bidding for the same work and had quoted unreasonable bid prices (**too High or too Low**) and could not furnish rational justification to the Employer.

5. One Bid per Bidder

- 5.1. Each bidder shall submit only one bid for one package. A bidder who submits or participates in more than one Bid (other than as a subcontractor or in cases of alternatives that have been permitted or requested) will cause all the proposals with the Bidder's participation to be disqualified.

6. Cost of Bidding

- 6.1. The bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will in no case be responsible and liable for those costs.

7. Site Visit

- 7.1. The Bidder, at the Bidder's own responsibility and risk is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

B. BIDDING DOCUMENTS

8. Content of Bidding Documents

- 8.1. The set of bidding documents comprises the documents listed below and addenda issued in accordance with Clause 10:

Section	Particulars	Volume No.
	Notice Inviting Bid /	I
1	Instruction to Bidders	
2	Qualification Information, and other Forms	
3	Conditions of Contract	
4	Contract Data	II
5	Technical Specifications	
6	Form of Bid	III
7	Securities and other forms	
8	Drawings	IV
9	Documents to be furnished by bidder	V

- 8.2. Each of the Volumes I, II, III, IV will be available online on website <http://jharkhandtenders.gov.in> for bidder(s). Documents to be submitted by the bidder(s) in compliance to section 2 will be prepared by him and submitted online as per instruction given in addendum to ITB.
- 8.3. The bidder is expected to examine carefully all instructions, conditions of contract, contract data, forms, terms, technical specifications, bill of quantities, forms, Annexes and drawings in the Bid Document. Failure to comply with the requirements of Bid Documents shall be at the bidder's own risk. Pursuant to clause 26 hereof, bids which are not substantially responsive to the requirements of the Bid Documents shall be rejected.

9. Clarification of Bidding Documents

- 9.1. A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing or by cable (hereinafter "cable" includes telex, facsimile and email) at the Employer's address indicated in the invitation to bid. The Employer will respond to any request for clarification which is received earlier than 15 days prior to the deadline for submission of bids. Copies of the Employer's response will be forwarded to all purchasers of the bidding documents, including a description of the enquiry but without identifying its source.
- 9.2 Pre-bid meeting
- 9.2.1. The bidder or his official representative is invited to attend a pre-bid meeting which will take place at the address, venue, time and date as indicated in appendix.

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- 9.2.2. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.
- 9.2.3 The bidder is requested to submit any questions in writing or by cable (**cable as defined in 9.1**) to reach the Employer not later than one week before the meeting.
- 9.2.4. Minutes of the meeting, including the text of the questions raised (without identifying the source of enquiry) and the responses given will be transmitted without delay to all purchasers of the bidding documents. Any modification of the bidding documents listed in sub-Clause 8.1 which may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to Clause 10 and not through the minutes of the pre-bid meeting.
- 9.2.5. Non-attendance at the pre-bid meeting will not be a clause for disqualification of a bidder.

10. Amendment of Bidding Documents

- 10.1. Before the deadline for submission of bids, the Employer may modify the bidding documents by issuing addenda.
- 10.2. Any addendum thus issued shall be part of the bidding documents and shall be communicated in writing or by cable to all the purchasers of the bidding documents. Prospective bidders shall acknowledge receipt of each addendum in writing or by cable to the Employer. The Employer will assume no responsibility for postal delays.
- 10.3. To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may, at his discretion, extend as necessary the deadline for submission of bids, in accordance with Sub-Clause 20.2 below.
- 10.4. Any Such amendments / corrigendum / clarification has to be approved by Principal Secretary, UD&HD, GOJ.

C. PREPARATION OF BIDS

11. Language of the Bid

11.1. All documents relating to the bid shall be in the English language.

12. Documents Comprising the Bid

12.1. The bid shall be submitted by the bidder online as per instruction contained in addendum to ITB.

12.2. Bidder shall submit bid online.

12.3. Following documents, which are not submitted with the bid, will be deemed to be part of the bid.

Section	Particulars	Volume No.
	Notice Inviting Tender (NIT)	Volume I
1	Instruction to Bidders	
3	Conditions of Contract	
4	Contract Data	
5	Specifications	Volume II
8	Drawings	Volume IV

13. Bid Prices

13.1. The contract shall be for the whole works as described in Sub-Clause 1.1. based on the priced Bill of Quantities submitted by the Bidder.

13.2. The bidder shall fill in rates in figures only as the rate in words will be generated automatically in the BOQ template. Items for which no rate or price is entered by the bidder will not be paid for by the Employer when executed and shall be deemed covered by the other rates and prices in the Bill of Quantities.

13.3. All duties, taxes, and other levels payable by the contractor under the contract, or for any other cause shall be included in the rates, prices and total Bid Price submitted by the Bidder.

13.4.* The rates and prices quoted by the bidder shall be fixed for the duration of the Contract and shall not be subject to adjustment on any account.

14. Currencies of Bid and Payment

14.1. The unit rates and the prices shall be quoted by the bidder entirely in Indian Rupees. All payment shall be made in Indian Rupees.

15. Bid Validity

- 15.1. Bids shall remain valid for a period not less than 180 days after the bid submission end date specified in **Clause 20**. A bid valid for a shorter period shall be rejected by the Employer as non-responsive. In case of discrepancy in bid validity period between that given in the undertaking pursuant to clause 12.1 (v) and the Form of Bid submitted by the bidder, the latter shall be deemed to stand corrected in accordance with the former and the bidder has to provide for any additional security that is required.
- 15.2. In exceptional circumstances, prior to expiry of the original time limit, the Employer may request that the bidders may extend the period of validity for a specified additional period. The request and the bidders' responses shall be made in writing or by cable. A bidder may refuse the request without forfeiting his bid security. A bidder agreeing to the request will not be required or permitted to modify his bid, but will be required to extend the validity of his bid security for a period of the extension, and in compliance with Clause 16 in all respects.
- 15.3 Bid evaluation will be based on the bid prices without taking into consideration the above correction.

16. Bid Security

- 16.1. The Bidder shall furnish, as part of his Bid, a Bid security in the amount as shown in column 4 of the table of IFB for this particular work. This bid security shall be in favour of Employer as named in Appendix and may be in one of the following forms:
- (i) Receipt in challan of cash deposit in the Govt. Treasury in India.
 - (ii) Deposit-at-call receipt from any of the Scheduled Bank situated **within the territory of India**.
 - (iii) Indian Post Office/**Fixed Deposit**/National Savings Certificates duly endorsed by the competent Postal Authority in India.
 - (iv) Bank Guarantee from any Scheduled Indian Bank from any of the branches of Scheduled Bank situated within the territory of India in the format given in Section 8.
 - (v) Fixed deposit receipt, a certified cheque or an irrevocable letter of credit, issued by any scheduled Indian Bank approved by the Reserve Bank of India.
- 16.2. Bank guarantees (and other instruments having fixed validity) issued as surety for the bid shall be valid for 45 days beyond the validity of the bid.

- 16.3. Any bid not accompanied by an acceptable Bid Security and not secured as indicated in Sub-Clauses 16.1 and 16.2 above shall be rejected by the Employer as non-responsive.
- 16.4. The Bid security of unsuccessful bidders will be returned within 28 days of the end validity period specified in sub-Clause 15.1.
- 16.5. The Bid security of the successful bidder will be discharged when the bidder has signed the Agreement and furnished the required Performance Security.
- 16.6. The Bid security may be forfeited
- (a) if the Bidder withdraws the Bid after Bid opening during the period of Bid validity;
 - (b) if the Bidder does not accept the correction of the Bid Price, pursuant to Clause 27; or
 - (c) in the case of a successful Bidder, if the Bidder fails within the specified time limit to
 - (i) sign the Agreement; or
 - (ii) furnish the required Performance Security.

17. Alternative proposals by Bidders

- 17.1. Bidders shall submit offers that fully comply with the requirements of the bidding documents, including the conditions of contract (including mobilization advance or time for completion), basic technical design as indicated in the drawing and specifications. Conditional offer or alternative offers will not be considered further in the process of tender evaluation.

18. Format and Signing of Bid

- 18.1 The bidder shall submit the bids as per addendum to instruction to bidder.
- 18.2. Instruction to Bidders(for SBD contract) to be followed. Bid submitted online has to be digitally signed by the bidder.
- 18.3 Bidders shall follow the Method of submission of bid as mentioned in Instruction to Bidders(for SBD contract)

D. SUBMISSION OF BIDS (online)

19. (A) Instructions & documents to be furnished for online bidding
- 19.1 **Guidelines for online submission of bids can be downloaded from the website <http://jharkhandtenders.gov.in>**
- 19.2 Interested bidders can download the bid from the website <http://jharkhandtenders.gov.in>
- 19.3 Bidders in order to participate in the bidding process have to get 'Digital Signature Certificate (DSC)' as per Information Technology Act-2000 to participate in online bidding. This certificate will be required for digitally signing the bid. Bidders can get the above mentioned digital signature certificate from any approved vendors. Bidders, who already possess valid Digital Certificates, need not procure new Digital Certificate.
- 19.4 Bidders have to submit their bids online in electronic format with digital Signature. Bids without digital signature will not be accepted. No proposal will be accepted in physical form.
- 19.5 Bids will be opened online as per time schedule mentioned in the Invitation for Bids (IFB).
- 19.6 Bidders should be ready with the scanned copies of cost of documents & bid security as specified in the tender document. Before submission of bids online, bidders must ensure that scanned copies of all the necessary documents have been attached with bid.
- 19.7 Bidders have to produce original Demand Draft towards cost of Bid Document & bid security as mentioned in the Invitation for Bids (IFB) to the **Nodal Officer**, e-Procurement Cell during the period & time as mentioned in the I.F.B. failing which bid will not be accepted. The details of cost of documents, bid security specified in the tender documents should be the same as submitted online (scanned copies), otherwise bid will summarily be rejected.
- 19.8 Uploaded documents of successful bidder will be verified with the original before signing the agreement. The successful bidder has to provide the originals to the concerned authority.
- 19.9 The department will not be responsible for delay in online submission of bids due to any reason, what so ever.
- 19.10 All required information for bid must be filled and submitted online.
- 19.11 Other details can be seen in the bidding documents.

19.12 Only online withdrawal or modification of bids, if any, in pursuance of relevant clauses of the SBD is acceptable.

19. (B)Details of documents to be furnished for online bidding

- 19.1. Scanned copies of the following documents to be up-loaded in .pdf format on the website <http://jharkhandtenders.gov.in> in technical bid folder.
- i. D.D. towards cost of Bid Document.
 - ii. Bid security in the form specified in Section-8 of SBD.
 - iii. Qualification information and supporting documents as specified in Section-2 of SBD.
 - iv. Certificates, undertakings, affidavits as specified in Section-2.
 - v. Any other information pursuant to Clause-4.2 of ITB.
 - vi. Undertakings that the bid shall remain valid for the period specified in Clause-15.1 of ITB.
- 19.2. Scanned copies of the following documents to be up-loaded on the website <http://jharkhandtenders.gov.in> in financial bid folder.
- 19.2.1. Form of bid has specified in Section-6 in pdf format.
- 19.3. Duly filled in & digitally signed BOQ.
- 19.4. Uploaded documents of successful bidder will be verified with the original before signing the agreement. The successful bidder has to provide the originals to the concerned authority on receipt of such a letter, which will be sent through registered post or speed post or delivered by hand.
- 19.5. Each uploading shall be digitally signed by the bidders.

20. Deadline for Submission of the Bids

- 20.1. Bidders shall follow the Method of submission of bid as mentioned in NIT/IFB.
- 20.2. The Employer may extend the deadline for submission of bids by issuing an amendment in accordance with **Clause 10**, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will then be subject to the new deadline.

21. Late Bids

- 21.1. Any Bid received by the Employer after the deadline prescribed in Clause 20 will be returned to the bidder.

22. Modification and Withdrawal of Bids

- 22.1. Bidders may modify or withdraw their bids by giving notice in writing before the deadline prescribed in Clause 20 or pursuant to Clause 23.
- 22.2. Bidders shall follow the Method of submission modification & withdrawal of bid as mentioned in Instruction to Bidders (for SBD contract)
- 22.3. No bid may be modified after the deadline for submission of Bids except in pursuance of Clause 23.
- 22.4. Withdrawal or modification of a Bid between the deadline for submission of bids and the expiration of the original period of bid validity specified in Clause 15.1 above or as extended pursuant to clause 15.2 may result in the forfeiture of the Bid security pursuant to Clause 16.

E. BID OPENING AND EVALUATION

23. Bid Opening

- 23.1 The Employer will open all the Bids submitted online including modification made pursuant to Clause 22, in the manner specified in Clause 20 and 23.3. In the event of the specified date of Bid opening being declared a holiday for the Employer, the Bids will be opened at the appointed time and location on the next working day. A notice for the same shall be posted on the website.
- 23.2. Withdrawn bids shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to clause 22 shall not be opened.
- 23.3 “Technical bid” shall be opened first. The amount, form and validity of the bid security furnished with each bid will be announced. If the bid security furnished does not conform to the amount and validity period as specified in the Invitation for Bid (ref. Column 4 and paragraph 3), and has not been furnished in the form specified in Clause 16, the said bid shall be out rightly rejected /and processed further.
- 23.4.(i) Subject to confirmation of the bid security by the issuing bank, the bids accompanied with valid security will be taken up for evaluation with respect to the Qualification Information and other information furnished in Part I of the bid pursuant to clause 12.1.
- (ii) After receipt of confirmation of the bid security, the bidder will be asked in writing/e-mail (usually within 10 days of opening of the Technical Bid) to clarify or modify his technical bid, if necessary, with respect to any rectifiable defects.
- (iii) The bidders will respond by e-mail in not more than 7 days of issue of the clarification letter, which will also indicate the date, time and venue of opening of the Financial Bid (usually on the 21st day of opening of the Technical bid)
- (iv) Immediately (usually within 3 or 4 days), on receipt of these clarifications the Evaluation Committee will finalize the list of responsive bidders whose financial bids are eligible for consideration.
- 23.5. If, as a consequence of the modifications carried out by the bidder in response to sub-clause 23.4, the bidders desire to modify their financial bid, they will submit the modification online before the opening of the financial bid as intimated in the clarification letter (refer sub-clause 23.4).
- 23.6. At the time of opening of “Financial Bid”, the names of the bidders found responsive in accordance with Clause 23.4(iv) will be announced. The bids of only these bidders will be opened. The remaining bids will remain unopened. The responsive Bidders’ names, the bid prices, the total amount of each bid, any

discounts, Bid Modifications and withdrawals, and such other details as the Employer may consider appropriate, will be announced by the Employer at the opening. Any Bid price or discount, which is not read out and recorded will not be taken into account in Bid Evaluation.

- 23.7. In case bids are invited in more than one package, the order for opening of the "Financial Bid" shall be that in which they appear in the "Invitation For Bid".
- 23.8. The Employer shall prepare minutes of the Bid opening, including the information disclosed to those present in accordance with Sub-clause 23.6.

24. Process to be Confidential

- 24.1 Information relating to the examination, clarification, evaluation, and comparison of Bids and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced. Any effort by a Bidder to influence the Employer's processing of Bids or award decisions may result in the rejection of his Bid.

25. Clarification of Financial Bids

- 25.1. To assist in the examination, evaluation, and comparison of Bids, the Employer may, at his discretion, ask any Bidder for clarification of his Bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing or by cable, but no change in the price or substance of the Bid shall be sought, offered, or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Bids in accordance with Clause 27.
- 25.2. Subject to sub-clause 25.1, no Bidder shall contact the Employer on any matter relating to his bid from the time of the bid opening to the time the contract is awarded. If the bidder wishes to bring additional information to the notice of the Employer, it should do so in writing.
- 25.3. Any effort by the Bidder to influence the Employer in the Employer's bid evaluation, bid comparison or contract award decisions may result in the rejection of the Bidders' bid.

26. Examination of Bids and Determination of Responsiveness

- 26.1. During the detailed evaluation of "Technical Bids", the Employer will determine whether each Bid (a) meets the eligibility criteria defined in Clause 3 and 4; (b) has been properly signed; (c) is accompanied by the required securities and; (d) is substantially responsive to the requirements of the Bidding documents. During the detailed evaluation of the "Financial Bid", the responsiveness of the bids will be

further determined with respect to the remaining bid conditions, i.e., priced bill of quantities, technical specifications, and drawings.

- 26.2. A substantially responsive “Financial Bid” is one which conforms to all the terms, conditions, and specifications of the Bidding documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any substantial way the scope, quality, or performance of the Works; (b) which limits in any substantial way, inconsistent with the Bidding documents, the Employer’s rights or the Bidder’s obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other Bidders presenting substantially responsive Bids.
- 26.3. If a “Financial Bid” is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.

27. Correction of Errors

- 27.1. “Financial Bids” determined to be substantially responsive will be checked by the Employer for any arithmetical errors. Errors will be corrected by the Employer as follows:
- (a) where there is a discrepancy between the rates in figures and in word, the rate in words will govern; and
 - (b) where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.
- 27.2. The amount stated in the “Financial Bid” will be corrected by the Employer in accordance with the above procedure and the bid amount adjusted with the concurrence of the Bidder in the following manner:
- (a) If the Bid price increases as a result of these corrections, the amount as stated in the bid will be the ‘bid price’ and the increase will be treated as rebate;
 - (b) If the bid price decrease as a result of the corrections, the decreased amount will be treated as the ‘bid price’. Such adjusted bid price shall be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount the Bid will be rejected, and the Bid security may be forfeited in accordance with Sub-clause 16.6(b)

28. Deleted.

29. Evaluation and Comparison of Financial Bids

- 29.1. The Employer will evaluate and compare only the Bids determined to be substantially responsive in accordance with Sub-Clause 26.2.

29.2 In evaluating the Bids, the Employer will determine for each Bid the evaluated Bid Price by adjusting the Bid Price as follows:

- (i) making any corrections for errors pursuant to clause 27; or
- (ii) making an appropriate adjustments for any other acceptable variations, deviations; and
- (iii) making appropriate adjustments to reflect discounts or other price modifications offered in accordance with Sub-Clause 23.6

In the financial bid, bidder should propose the Capital grant and O&M fee as given in format for financial bid.

The Financial Proposal of all the Bidders shall be evaluated based on the following formula:

Financial Support required from ULB =Capital Grant plus over all O&M Fee

- i. For the purpose of evaluation, O&M Fees(Rs per KL) shall mean the sum of present value of the amount (Rs per KL)quoted by the Bidder for the respective financial years multiplied by Volume of water in respective year in KL/day multiplied by 365 days, for 10 years.

O&M Fees= Σ {Present value of the amount of O&M Fees (Rs per KL) for 10 years} \times Volume of water (KL/day) \times 365

- ii. In case the Bidder does not quote amount of O&M Fees for any financial year the same will be taken as zero.

The present value of O&M Fees quoted by the Bidder shall be discounted at 10% (Say) would be used for final evaluation.

The present value (PV) of O&M Fees would be computed as

$$PV = O\&M1/(1.10)^1 + O\&M2/(1.10)^2 + O\&M3/(1.10)^3 + O\&M4/(1.10)^4 + O\&M5/(1.10)^5 + O\&M6/(1.10)^6 + O\&M7/(1.10)^7 + O\&M8/(1.10)^8 + O\&M9/(1.10)^9 + O\&M10/(1.10)^{10}$$

O&M1, O&M2, O&M3, O&M4, O&M5, O&M6, O&M7, O&M8, O&M9 and O&M10 are the Annual O&M Fees required during year1,year2, and up to year10.

The evaluation of successful bidder shall be as under:

Total quoted cost for construction of the project (CAPEX) : X

NPV for O&M component: Y

Total cost of the project, Z = X + Y

The lowest total cost (Z) quoted by the bidder shall be selected.

Sample calculation of the price Bid evaluation is enclosed as **Annexure III**

- 29.3 The Employer reserves the right to accept or reject any variation or deviation. Variations and deviations and other factors, which are in excess of the requirements of the bidding documents or otherwise result in unsolicited benefits for the Employer shall not be taken into account in Bid evaluation.
- 29.4 The estimated effect of the price adjustment conditions under Clause 47 of the Conditions of Contract, during the period of implementation of the Contract, will not be taken into account in Bid evaluation.
- 29.5 If the Bid on the successful Bidder is seriously unbalanced in relation to the Engineer's estimate of the cost of work to be performed under the contract, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the Employer may require that the amount of the performance security set forth in clause 34 be increased at the expense of the successful Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract.
- 29.6 A bid which contains several items in the Bid Quantities which are unrealistically priced low and which cannot be substantiated satisfactorily by the bidder, may be rejected as non-responsive.
- 30. Deleted.**

F. AWARD OF CONTRACT

31. Award of Criteria

31.1. Subject to Clause 30, the Employer will award the Contract to the Bidder whose Bid has been determined

- (i) to be substantially responsive to the bidding documents and who has offered the lowest evaluated Bid Price in accordance with the Clause no 29.2 ITB and Sample calculations enclosed as for **Annexure III**; and
- (ii) to be within the available bid capacity adjusted to account for his bid price which is evaluated the lowest in any of the packages opened earlier than the one under consideration. In no case, the contract shall be awarded to any bidder whose available bid capacity is less than the evaluated bid price, even if the said bid is the lowest evaluated bid. The contract will in such cases be awarded to the next lowest bidder at his evaluated bid price.

32. Employer's Right to accept or Reject any Bid or all Bids along with blacklisting for concealing any fact. In case the Bidder (By itself or in a Consortium or JV) is found to have been debarred or blacklisted by Union Government or any State Government or any Undertaking /PSU of the Union Government or any State Government.

32.1. Notwithstanding Clause 31, the Employer reserves the right to accept or reject any Bid to cancel the bidding process and reject all bids, at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders of the grounds for the Employer's action.

32.2 Bidder would give an undertaking mentioning all the ongoing projects in detail. If it is found that any bidder has not mentioned even one ongoing project the bid will be rejected, if due to this the Bid capacity gets manipulated.

32.3 After Award of contract, if the Bidder is found to have concealed any fact relevant to projects, the Employer may blacklist the Bidder or Bidders within 180 days, with due process as -

- i) 3 Years Blacklisting for the Project Cost Rs. 2.50 Crore to Rs. 10.00 Crore
- ii) 5 Years Blacklisting for the Project Cost above Rs. 10.00 Crore to Rs. 100.00 Crore
- iii) 10 Years Blacklisting for the Project Cost above Rs. 100.00 Crore

33. Notification of Award and Signing of Agreement

- 33.1. The Bidder whose Bid has been accepted will be notified of the award by the Employer prior to expiration of the Bid validity period by cable, telex or facsimile confirmed by registered letter. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") will state the sum that the Employer will pay the contractor in consideration of the execution, completion, and maintenance of the Works by the contractor as prescribed by the contract (hereinafter and in the contract called the "Contract Price").
- 33.2. The notification of award will constitute the formation of the Contract, subject only to the furnishing of a performance security in accordance with the provisions of Clause 34.
- 33.3. The Agreement will incorporate all agreements between the Employer and the successful Bidder. It will be signed by the Employer and sent to the successful Bidder, within 28 days following the notification of award along with the Letter of Acceptance. Within 21 days of receipt, the successful Bidder will sign the Agreement and deliver it to the Employer.
- 33.4. Upon the furnishing by the successful Bidder of the Performance Security, the Employer will promptly notify the other Bidders that their Bids have been unsuccessful.

34. Performance Security

- 34.1. Within 21 days of receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Employer a Performance security in any of the forms given below. The performance security shall be of two types. First one shall be for an amount equivalent to 3% of the Capital cost plus additional security for unbalanced Bids in accordance with clause 29.5 of ITB and Clause 52 of Conditions of Contract. The second one shall be for an amount equivalent to 3% of O&M cost of two years and shall be submitted with revised amount after every two years.

A bank guarantee from any of the branches of Scheduled Bank situated within **territory of India** in the form given in Section 8; or Certified Cheque/Bank Draft as indicated in Appendix.

- 34.2. If the performance security is provided by the successful Bidder in the form of a Bank Guarantee, it shall be issued from any of the branches of Scheduled Bank situated within **territory of India**.
- 34.3. Failure of the successful Bidder to comply with the requirements of Sub-Clause 32.1 shall constitute grounds for cancellation of the award and forfeiture of the Bid Security.

35. Advance Payment and Security

35.1. The Employer will provide an Advance Payment on the Contract Price as stipulated in the Conditions of Contract, subject to maximum amount, as stated in the Contract Data.

36. Deleted.

37. Corrupt or Fraudulent Practices

37.1. The Employer will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question and will declare the firm ineligible, either indefinitely or for a stated period of time, to be awarded a contract with National Highways Authority of India/State PWD and any other agencies, if at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for the contractor, or in execution.

37.2. Furthermore, Bidders shall be aware of the provision stated in Sub-Clause 23.2 and Sub-Clause 59.2 of the Conditions of Contract.

38. Information Provided by the Employer/Bidders Due Diligence

38.1 Each Bidder is solely responsible for conducting its own independent research, due diligence, and any other work or investigations and for seeking any other independent advice necessary for the preparation of Bids, negotiation of agreements, and the subsequent delivery of all services to be provided by the Bidder that has been successful in the bidding process (the "Successful Bidder").

38.2 No representation or warranty, express or implied, is made and no responsibility of any kind is accepted by the Employer or its advisors, employees, consultants or agents, for the completeness or accuracy of any information contained in the Bidding Documents or the Response to Questions Document, or provided during the bidding process or during the term of the Contract. The Employer and its advisors, employees, consultants and agents shall not be liable to any person or entity as a result of the use of any information contained in the Bidding Documents or the Response to Questions Document, or provided during the bidding process or during the term of the Contract.

38.3 Bidders shall not rely on any oral statements made by the Employer or its advisors, employees, consultants or agents.

38.4 All Bidders shall, prior to submitting their Bid, review all requirements with respect to corporate registration and all other requirements that apply to companies that wish to conduct business in the Employer's country. The Bidders are solely responsible for all matters relating to their legal capacity to operate in the jurisdiction to which this bidding process applies.

APPENDIX to ITB

Clause Reference with respect to
Section-I

Name of the Employer is **JHARKAND URBAN INFRASTRUCTURE DEVELOPMENT COMPANY LIMITED, RANCHI**

1. [Cl. 1.1]
2. The last five years' turnover (Contractor to submit the turnover statements duly signed by Chartered Accountant)
 - 2012- 2013
 - 2013- 2014
 - 2014- 2015
 - 2015-2016
 - 2016-2017

3.	This average annual financial turn over amount is Rs 5531.62 Lakhs	[Cl.4.5A.2(a)]	
	(In words Rupees: Five thousand five hundred thirty-one lakhs and sixty-two thousand only)		
4.	Value of work is Rs 3687.75 Lakhs	[Cl.4.5A.2(b)]	
	(In words Rupees: Three thousand six hundred eighty-seven lakhs and seventy-five thousand only)		
5.	The Bidder shall provide evidence (certified by the relevant and respective Employer) that during last 5 years preceding the bid submissions:		
	SL No.	Parameter	
	(a)	Bidder or any one JV Partner should have satisfactorily completed construction and operation for 5 years of 100 KLD Sewage treatment plant/ package treatment plants on EPC basis.	[Cl.4.5A.1]
	(b)	Bidder or its nominated JV partner has satisfactorily completed 2 Years of O & M for Solid waste management of capacity 25 TPD or Contractors having experience of carrying out cleaning of septic tank or sewer line using Vacuum Sucker Empanelled with ULBs	[Cl.4.5A.1]
6, 7 and 8 Deleted			
9.	Liquid Assets and/or availability of credit facility is 368.77 Lakhs.....	[Cl. 4.5B(C)]	
10.	Price level of the financial year 2016-17.	[Cl. 4.7]	
11.	* The pre-bid meeting will take place at Jharkhand Urban Infrastructure Development Company Ltd., 3rd Pragati Sadan	[Cl.9.2.1]	

	(RRDA Building), Kutchery Chowk, Ranchi-834001 (Address of the venue) on 24.04.17 at 11.00 Hrs. (time and date)	
12.	The Technical bid will be opened at the office of the General Manager , 3rd Pragati Sadan (RRDA Building), Kutchery Chowk, Ranchi-834001 on 09.05.17 at 17.30 Hrs.	[Cl .23.1.]
13.	Address of the Employer- Managing Director, Jharkhand Urban Infrastructure Development Company Ltd., 3rd Pragati Sadan (RRDA Building), Kutchery Chowk, Ranchi-834001.	
14.	<p>Identification :</p> <p>Bid for Detailed procurement of equipment construction of septage treatment plant and other allied structures, collection and transportation of septage from every house hold, treatment of septage at SeTP including operation and maintenance of above system for Chas Town for a period of 10 Years including construction as per scope of work under Urban Development Department Jharkhand.</p> <p>(Name of Contract)</p> <p>Bid reference No. JUIDCO/NIT/ Chas Septage/1162/2017/76 Date: 13.04.17</p> <p>Do not open before 09.05.17 at 17.30 Hrs (time and date)</p>	[C1. 19.2(b)]
15.	The bid should be submitted online latest by 09.05.17 upto 17.00 Hrs (date and time)	[Cl. 20.1(a)]
16.	The Technical bid will be opened at the office of the General Manager , 3rd Pragati Sadan(RRDA Building), Kutchery Chowk, Ranchi-834001 on 09.05.17 at 17.30 Hrs.	[Cl.23.1]
17.	The Bank draft in favour of Managing Director, Jharkhand Urban Infrastructure development Corporation Ltd., Ranchi , Payable at - Ranchi.	[C1.34.1]
18.	Deleted	

ANNEXURE-I

List of Key Plant & Equipment to be deployed on Contract work
[Reference C1. 4.5 (B) (a)]

Sl.	Type of Equipment*	Maximum age (in Years) as on 01/01/2017	Equipment Required Min
During Construction			
1	Dozer	5	1
2	Front end Loader	5	1
3	Smooth Wheeled Roller	5	1
4.	Water Tanker	5	5
5.	Concrete Mixes with Integral Weigh Batching facility	5	2
6.	Steel Propping	5	As per Equipment
7.	Pooclane/JCB	5	1
8.	Transit Mixer	5	1
9.	Tipper or Truck (or Tractor)	5	3
10.	Generator	5	2
11.	Bar Cutting Machine	5	2
12.	Bar Bending Machine	5	2
13.	Welding Machine	5	2
14.	Vibrator (Niddle)	5	2
15.	Vibrator (Surface)	5	2
16.	Steel Plate with fitting	5	2000sft.
17.	Staging Pipe (Acrow) with fitting	5	1000 Nos.
During O&M			
1.	Vacuum Suction Machines with Tankers and tractor	New	25 nos. of 4 cum capacity**

Note*: Above mentioned equipments are minimum requirement and not limited to above numbers. Contractor may increase (but not reduce) as per requirement for the smooth construction activities.

** Slight modification in capacity and numbers may be allowed as per Bidder's design on approval of Employer.

			ANNEXURE-II
List of Key Personnel to be deployed on Contract Work			
[Reference C1.4.5 (B) (b)]			
A. Staff Requirements During Construction Phase			
Sl. No.	Personnel	Qualification	No. of personnel
1	Project Manager	B.E. Civil + 15 Years Exp. (5 years as Manager)	01 (One)
2	Site Engineer	Diploma Civil + 7 Years Exp. (5 years in Sewerage and STP works)	01 (One)
3	Plant Engineer	Diploma Mech. + 7 Years Exp.	01 (One)
4	Billing Engineer cum Quantity Surveyor	B.E. Civil + 5 Years Exp. Or Diploma Civil + 7 years Exp.	01 (One)
5	Material Engineer and Quality Control	B.E. Civil + 7 Years Exp.	01 (One)
6	Electrical Engineer	Diploma Electrical + 7 years Exp.	01 (One)
Total			6
B. Staff Requirements During Operation & Maintenance Phase			
Sl. No.	Personnel	Qualification	No. of personnel
1	Plant Manager	Diploma (Civil) + 10 years experience of running STP (5 years as Manager)	1 (One)
2	Chemist	B.Sc in Chemistry + 5 years of experience in Lab/Testing	1 (One)
3	Electrician/Mechanic/Fitter	ITI + 5 years of experience	1 (One)
4	Operator cum Guard	5 years of experience	1 (One)
5	Billing Operator and Consumer Complaint Receiver	Graduate with Diploma in Computers + 2 years of Billing experience	1+1 (Two)
6	Driver and Helper-cum- cleaner for Suction Machine	2 years of experience	1+1 no. for each of the 25 vacuum suckers (Thirty)
Total			56

Note*: Above mentioned staffs are minimum requirement and not limited to above personnel/numbers and contractor may increase (but not reduce) as per requirement for the smooth construction activities.

ANNEXURE-III
[Reference Cl. 29.3 and 31.1 (i)]

Sample Calculation for Price Bid Evaluation

Sample Calculation for the Bid Evaluation to establish L1 contract for award of contract is enclosed as Table below

SECTION – 2

QUALIFICATION INFORMATION

QUALIFICATION INFORMATION

The information to be filled in by the bidder in the following pages will be used for purposes of post qualification as provided for in Clause 4 of the Instructions to Bidders. This information will not be incorporated in the Contract.

1. For Individual Bidders

1.1. Constitution or legal status of Bidder

[Attach copy]

Place of registration: _____

Principal place of business: _____

Power of attorney of signatory of Bid

[Attach]

- 1.2. Total value of construction and O&M Works (sewerage and septage sector) performed in the last five years** (in Rs. Million)
- | |
|-------------------------|
| 2012- 2013 |
| 2013- 2014 |
| 2014- 2015 |
| 2015- 2016 |
| 2016- 2017 |

1.3.1. Work performed as prime contractor, work performed in the past as a nominated JV partners will also be considered provided the JV partners involved execution of all main items of work described in the bid document, provided further that all other qualification criteria are satisfied (in the same name) on works of a similar nature over the last five years. **

Project Name	Name of The Employer*	Description of work	Contract No.	Value of Contract (Rs crore)	Date of issue of work order	Stipulated Period of completion	Actual date of completion*	Remarks Explaining Reasons for delay& work Completed

* Attach certificate(s) from the Engineer(s)-in-Charge/EE from any Department / ULBs/RDA etc.

** immediately preceding the financial year in which bids are received.

ß Attach certificate from Chartered Accountant

#1.3.2. Capacities of work executed as prime contractor, work performed in the past as a nominated JV Partners, will also be considered provided the JV partners involved execution of all main items of work described in the bid document, provided further that all other qualification criteria are satisfied (in the same name and style) in the last five years**(only those projects are too presented which are required to satisfy the eligibility criteria.

Year	Name of the work	Name of the Employer*	Capacities of work performed @		Remarks* (indicate contract Ref)
			Capacities of STP (MLD)	Capacities of SWM Works (TPD)	
2012-2013					
2013-2014					
2014-2015					
2015-2016					
2016-2017					

1.4 Information on Bid capacity (works for which bids have been submitted and works which are yet to be completed) as on the date of this bid.

(A) Existing commitments and on-going works:

Description of works	Place & State	Contract No.	Name & Address of Employer	Value of Contract (Rs Cr)	Stipulated Period of Completion	Value of Works* remaining To be completed (Rs Cr)	Anticipated date of completion
1	2	3	4	5	6	7	8

* Attach certificate(s) from the Engineer(s)-in-Charge/EE/Employer

@ the item of work for which data is requested should tally with that specified in ITB clause 4.5 A.1.

** immediately preceding the financial year in which bids are received .

Delete, if prequalification has been carried out

(B) Works for which bids already submitted:

Description Of work	Place & State	Name & Address of Employer	Estimated value of Works (Rs Cr)	Stipulated period of completion	Date when decision is expected	Remarks If any
1	2	3	4	5	6	7

1.5 Availability of key items of Contractor's Equipment essential for carrying out the Works (including Execution and O&M) [ref. Clause 4.5(B)(a). The Bidder should list all the information requested below. Refer also to Sub Clause 4.3(d) of the Instructions to Bidders.

Item of Equipment	Requirement		Availability Proposals			Remarks (from whom to be purchased)
	No.	Capacity	Owned/Leased to be procured	Nos./Capacity	Age/Condition	

1.6 Qualifications and experience of key personnel required for administration and execution and O&M of the Contract [Ref. Clause 4.5(B)(b)]. Attach biographical data. Refer also to sub Clause 4.3 (e) of instructions to Bidders and Sub Clause 9.1 of the Conditions of Contract.

Position	Name	Qualification	Year of Experience (General)	Years of experience in the Proposed position
For Construction Phase				
Project manager				
Etc...				
For Operational Phase				
Note Please add line as per requirement				

1.7. Proposed sub-contracts and firms involved. [Refer ITB Clause 4.3(k)]

Sanctions of the Works	Value of Sub-contract	Sub-contractor (Name & Address), Contact Details	Experience in similar Work

*1.8. Financial reports for the last five years: balance sheets, profit and loss statements, auditors' reports (in case of companies/corporation), etc. List them below and attach copies.

1.9. Evidence of access to financial resources to meet the qualification requirements:

Cash in hand, lines of credit, etc. List them below and attach copies of support documents.

1.10. Name, address, and telephone, telex, and fax numbers of the Bidders' bankers who may provide references if contacted by the Employer.

1.11. Information on litigation history in which the Bidder (both Lead and JV partners) is involved.

Lead and JV Partners	Employer	Cause of Dispute	Amount involved	Remarks showing Present Status

1.12. Statement of compliance under the requirements of Sub Clause 3.2 of the instructions to Bidders. (Name of Consultant engaged for project preparation is **)

1.13. Proposed work methods and schedule. The Bidder should attach descriptions, drawings and charts as necessary to comply with the requirements of the Bidding documents. [Refer ITB Clause 4.1 & 4.3 (1)]

1.14. Programme

1.15. Quality Assurance Programme

2. Additional Requirements.

2.1. Bidders should provide any additional information required to fulfill the requirements of Clause 4 of the Instructions to the Bidders, if applicable.

- (i) Affidavit
- (ii) Undertaking
- *** (iii) Update of original pre qualification application
- *** (iv) Copy of original pre qualification application
- *** (v) Copy of pre qualification letter
- (vi) Copy of letter of association in the form of agreement with subcontractor for the work defined or for any specialize / new engineering methodology work.

** Fill the Name of Consultant.

*** Delete, if pre qualification has not been carried out.

**SAMPLE FORMAT FOR EVIDENCE OF ACCESS TO OR
AVAILABILITY OF CREDIT FACILITIES**

(Clause 4.2 (i) OF ITB)

BANK CERTIFICATE

This is to certify that M/s. _____ is a reputed Company with a good financial standing.

If the contract for the work, namely _____ is awarded to the above firm, we shall be able to provide overdraft/credit facilities to the extent of Rs. _____ to meet their working capital requirements for executing the above contract during the contract period.

(Signature) Name of Bank
Senior Bank Manager Address
of the Bank

AFFIDAVIT

1. I, the undersigned, do hereby certify that all the statements made in the required attachments are true and correct.

2. The undersigned also hereby certifies that neither our firm M/S _____ have abandoned any work of **Jharkhand Urban Infrastructure Development Company Ltd., Ranchi, Jharkhand** or any contract awarded to us for such work have been rescinded, during last five years prior to the date of this bid.

3. The undersigned hereby authorize(s) and request(s) any bank, person, firm or corporation to furnish pertinent information deemed necessary and requested by the Department to verify this statement or regarding my (our) competence and general reputation.

4. The undersigned understand and agrees that further qualifying information may be requested, and agrees to furnish any such information at the request of the Department/Project implementing agency.

(Signed by an authorized Officer of the Firm)

Title of officer

Name of Firm

DATE

UNDERTAKING

I, the undersigned do hereby undertake that our firm M/s _____
_____ would invest minimum cash up to 25% of the value of the work
during implementation of the Contract.

(Signed by an Authorized Officer of the Firm)

Title of Officer

Name of Firm

DATE

SECTION – 3
GENERAL CONDITIONS OF CONTRACT

General Conditions of Contract

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GENERAL CONDITIONS OF CONTRACT

A. GENERAL

1. Definitions

- 1.1 Terms which are defined in the Contract data are not also defined in the Conditions of Contract but keep their defined meanings. Capital initials are used to identify defined terms.

The Adjudicator/ Arbitrator synonymous with (Dispute Review Expert) is the person appointed jointly by the Employer and the contractor to resolve disputes in the first instance, as provided for in clause 24 and 25. It is to be conducted under the rules of Indian Arbitration and Conciliation Act, 1996 (26 of 1996) any statutory modifications or re-enactment thereof.

Bill of Quantities means the priced and completed Bill of Quantities forming part of the Bid.

The **Completion Date** is the date of completion of the Works as certified by the Engineer in accordance with Sub clause 55.1.

The **Contract** is the contract between the Employer and the Contractor to execute, complete and maintain the Works. It consists of the documents listed in Clause 2.3 below.

The **Contract Data** defines the documents and other information which comprise the Contract.

The **Contractor** is a person or corporate body whose Bid to carry out the Works has been accepted by the Employer.

The **Contractor's Bid** is the completed Bidding document submitted by the Contractor to the Employer and includes Technical and Financial bids.

The **Contract Price** is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

Days are calendar days; **months** are calendar months.

A **Defect** is any part of the Works not completed in accordance with the Contract.

The **Defects Liability Period** is the period named in the contract Data and calculated from the date of completion of Construction.

The **Employer** is **CMD, (Jharkhand Urban Infrastructure Development Company), Ranchi, Jharkhand** - who will employ the contractor to carry out the Works and monitor the capital works (construction phase and DLP). A tripartite agreement shall be signed between the main employer JUIDCo, the contractor and the ULB (Urban Local Body) of that town before the commencement of O&M works. Through this agreement, the ULB shall perform the role of employer during the O&M phase.

The **Employer's representative** will be the General Manager, concerned to be notified by the Employer. The Employer's representative will act on behalf of Employers.

The **Engineer** is the person named in the Contract Data Awarding contract on behalf of Employer (or any other competent person appointed and notified to the contractor to act in replacement of the Engineer) who is responsible for supervising the Contract,

administering the Contract, certifying payments due to the Contractor, issuing and valuing Variations to the Contract, awarding extensions of time & valuing the compensation events.

Equipment is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

The **Initial Contract Price** is the Contract Price listed in the Employer's Letter of Acceptance.

The **Intended Completion Date** is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the Contract Data. The Intended Completion date may be revised only by the Engineer by issuing an extension of time.

Materials are all supplies, including consumables, used by the contractor for incorporation in the Works.

Plant is any integral part of the Works which is to have a mechanical, electrical, electronic or chemical or biological function.

The **Site** is the area defined as such in the Contract Data.

Site Investigation Reports are those which were included in the Bidding documents and are factual interpretative reports about the surface and the sub-surface conditions at the site.

Specification means the Specification of the Works included in the Contract and any modification or addition made or approved by the Engineer.

The **Start Date** is given in the Contract Data. It is the date when the Contractor shall commence execution of the works. It does not necessarily coincide with any of the Site Possession Dates.

A **Subcontractor** is a person or corporate body who has a contract with the Contractor to carry out a part of the work in the Contract which includes work on the Site.

Temporary Works are works designed, consulted, installed, and removed by the contractor which are needed for construction or installation of the Works.

A **Variation** is an instruction given by the Engineer, which varies the works.

The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the Contract Data.

The **ULB** is Urban Local Body of a town - which under this contract is Chas Municipal Corporation / Nagar Parishad.

2. Interpretation

- 2.1 In interpreting these Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Engineer will provide instructions clarifying queries about the Conditions of Contract.
- 2.2 If sectional completion is specified in the Contract Data, references in the Conditions of Contract to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion date and Intended Completion date for the whole of the works).

- 2.3 The documents forming the Contract shall be interpreted in the following order of priority:
- (1) Agreement
 - (2) Letter of Acceptance, notice to proceed with the works
 - (3) Contractor's Bid
 - (4) Contract Data
 - (5) Conditions of Contract including Special Conditions of Contract
 - (6) Specifications
 - (7) Drawings
 - (8) Bill of Quantities and
 - (9) Any other document listed in the Contract Data as forming part of the Contract including IFB & ITB.

3. Language and Law

- 3.1 The language of the Contract and the law governing the contract are stated in the Contract Data.

4. Engineer's Decisions

- 4.1 Except where otherwise specifically stated, the Engineer will decide contractual matters between the Employer and the Contractor in the role representing the Employer.

5. Delegation

- 5.1 The Engineer may delegate any of his duties and responsibilities to other people after notifying the Contractor and may cancel any delegation after notifying the Contractor.

6. Communications

- 6.1 Communications between parties which are referred to in the conditions are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract act).

7. Sub-Contracting

- 7.1 The Contractor may sub-contract any portion of work, up to a limit specified in Contract Data, with the approval of the Engineer but may not assign the Contract without the approval of the Employer in writing. Sub-contracting does not alter the Contractor's obligations. Maximum number of Sub Contractor will be two and they will have to meet all qualifying criteria in the ratio of work allotted. Peripheral works will only be permitted for sub-contracting and major works not to be considered. Peripheral works will not include work of High yield Tube well/Intake well/ Infiltration well/ Water Treatment Plant/ Pump machinery/ ESR/ UGR/Rising and Distribution main etc.

8. Other Contractors

- 8.1 The Contractor shall cooperate and share the site with other contractors, public authorities, utilities, and the Employer between the dates given in the Schedule of other Contractors. The contractors shall as referred to in the Contract Data, also provide facilities and services for them as described in the Schedule. The Employer may modify the schedule of other contractors and shall notify the contractor of any such modification.

9. Personnel

- 9.1 The Contractor shall employ the key personnel named in the Schedule of Key Personnel as referred to in the Contract Data to carry out the functions stated in the Schedule or other personnel approved by the Engineer. The Engineer will approve any proposed replacement of key personnel only if their qualification, abilities, and relevant experience are substantially equal to or better than those of the personnel listed in the schedule.
- 9.2 If the Engineer asks the Contractor to remove a person who is a member of the Contractor's staff of his work force stating the reasons the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.

10. Employer's and Contractor's Risks

- 10.1 The Employer carries the risks which this Contract states are Employer's risks, and the contractor carries the risks which this Contract states are Contractor's risks.

11. Employer's Risks

- 11.1 The Employer is responsible for the expected risks which are (a) in so far as they directly affect the execution of the Works in India, the risks of war, hostilities, invasion, act of foreign enemies, rebellion, revolution, insurrection or military or usurped power, civil war, riot commotion or disorder (unless restricted to the Contractor's employees), and contamination from any nuclear fuel or nuclear waste or radioactive toxic explosive; or (b) a cause due solely to the design of the Works, other than the Contractor's design.

12. Contractor's Risks

- 12.1 All risks of loss or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract other than the excepted risks are the responsibility of the Contractor.

13. Insurance

- 13.1 The Contractor shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period, in the amounts and deductibles stated in the Contract data for the following events which are due to the Contractor's risks:
- a) Loss of or damage to the Works, Plants and Materials;
 - b) Loss of or damage to Equipment;

-
- (c) Loss of or damage of property (except the Works, Plant, Materials and Equipment) in connection with the Contract; and
 - (d) Personal injury or death.
- 13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Engineer for the Engineer's approval before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.
- 13.3 If the Contractor does not provide any of the policies and certificates required, the Employer may affect the insurance which the Contractor should have provided and recover the premiums the Employer has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.
- 13.4 Alterations to the terms of insurance shall not be made without the approval of the Engineer.
- 13.5 Both parties shall comply with any conditions of the insurance policies.
- 14. Site Investigation Reports**
- 14.1 The Contractor, in preparing the Bid, shall rely on any site investigation reports referred to in the Contract data, supplemented by any information available to the Bidder.
- 15. Queries about the Contract Data**
- 15.1 The Engineer will clarify queries on the Contract Data.
- 16. Contractor to Construct the Works**
- 16.1 The Contractor shall construct and install the Works in accordance with the Specification and Drawings.
- 17. The Works to be completed by the Intended Completion date**
- 17.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the programme submitted by the Contractor, as updated with the approval of the Engineer, and complete them by the Intended Completion Date.
- 18. Approval by the Engineer**
- 18.1 The Contractor shall submit Specifications and Drawings, showing the proposed Temporary works to the Engineer, who is to approve them if they comply with the Specifications and Drawings etc.
- 18.2 The Contractor shall be responsible for design of Temporary Works.
- 18.3 The Engineer's approval shall not alter the Contractor's responsibility for design of the Temporary Works.
- 18.4 The Contractor shall obtain approval of Engineer to the design of the Temporary Works where required.
- 18.5 All drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Engineer before their use.
-

19. Safety

19.1 The Contractor shall be responsible for the safety of all activities on the Site.

20. Discoveries

20.1 Anything of historical or other interest or of significant value unexpectedly discovered on the site is the property of the Employer. The Contractor is to notify the Engineer of such discoveries and carry out the Engineer's instructions for dealing with them.

21. Possession of the Site

21.1 The Employer shall give possession of all parts of the site to the Contractor.

22. Access to the Site

22.1 The Contractor shall allow the engineer and any person authorized by the Engineer access to the Site, to any place where work in connection with the contract is being carried out or is intended to be carried out and to any place where materials or plant are being manufactured/ fabricated /assembled for the works.

23. Instructions

23.1 The Contractor shall carry out all instructions of the Engineer pertaining to works which comply with the applicable law where the site is located.

23.2 The Contractor shall permit the Employer to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the Employer, if so required by the Employer.

24. Deleted.

25. Deleted.

26. Deleted.

B. TIME CONTROL

27. Programme

27.1 Within the time stated in the Contract Data the Contractor shall submit to the Engineer for approval a Programme showing the general methods, arrangements, order, and timing for all the activities in the Works along with monthly cash flow forecast.

27.2 An update of the Programme shall be a programme showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work including any changes to the sequence of the activities.

27.3 The Contractor shall submit to the Engineer, for approval, an updated Programme at intervals no longer than the period stated in the Contract data. If the Contractor does not submit an updated Programme within this period, the Engineer may withhold the amount stated in the Contract Data from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Programme has been submitted.

27.4 The Engineer's approval of the Programme shall not alter the Contractor's obligations. The Contractor may revise the Programme and submit it to the Engineer again at any time. A Revised Programme is to show the effect of Variations and Compensation Events.

28. Extension of the Intended Completion Date

28.1 The Engineer shall extend the Intended Completion Date if a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining work and which would cause the Contractor to incur additional cost.

28.2 The Engineer shall decide whether and by how much to extend the Intended Completion date within 21 days of the Contractor asking the Engineer for a decision upon the effect of a Variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

28.3 The Engineer shall within 14 days of receiving full justification from the contractor for extension of Intended Completion Date refer to the Employer his decision. The Employer shall in not more than 21 days communicate to the Engineer the acceptance or otherwise of the Engineer's decision. The contractor will have to extend the date of Performance Security according to new Intended completion date (validity date of Bank Guarantee etc)

29. Deleted

30. Delays Ordered by the Engineer

30.1 The Engineer may instruct the Contractor to delay the start or progress of any activity within the Works.

31. Management Meetings

31.1 Either the engineer or the Contractor may require the other to attend a management meeting. The business of a management meeting shall to review the plans for remaining work and to Deal with matters raised in accordance with the early warning procedure.

31.2 The Engineer shall record the business of management meetings conducted at least once in a month to review progress of work / plan for completion of remaining works and is to provide copies of his record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken is to be decided by the Engineer either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

32. Early Warning

32.1 The Contractor is to warn the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price or delay the execution of works. The Engineer may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate is to be provided by the Contractor as soon as reasonably possible.

- 32.2 The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Engineer.

C. QUALITY CONTROL

33. Identifying Defects

- 33.1 The Engineer shall check the Contractor's work and notify the Contractor of any defects that are found. Such checking shall not affect the Contractor's responsibilities. The Engineer may instruct the Contractor to search for a Defect and to uncover and test any work that the Engineer considers may have a Defect.

34. Tests

- 34.1 If the Engineer instructs the Constructor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples.

35. Correction of Defects

- 35.1 The Engineer shall give notice to the contractor of any Defects before the end of the Defects Liability Period, which begins at completion and is defined in the Contract Data. The defects Liability Period shall be extended for as long as defects remain to be corrected.
- 35.2 Every time notice of a defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Engineer's notice.

36. Uncorrected Defects

- 36.1 If the contractor has not corrected a Defect within the time specified in the Engineer's notice, the Engineer will assess the cost of having the Defect corrected, and the Contractor will pay this amount.

D. COST CONTROL

37. Bill of Quantities

- 37.1 The Bill of Quantities shall contain items for the construction, installation, testing, and Commissioning work etc. to be done by the Contractor.
- 37.2 The Bill of Quantities is used to calculate the Contract Price. The Contractor is paid for the quantity of the work done at the rate in the Bill of Quantities for each item. Cost of Project is to be controlled by controlling the quantities of work mentioned in the Bill of Quantities.

38. Changes in the Quantities

- 38.1 If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than 25 percent provided the change exceeds 1% of initial Contract Price, the Engineer shall adjust the rate to allow for the change, duly considering.

- (a) Justification for rate adjustment as furnished by the contractor,
- (b) Economics resulting from increase in quantities by way of reduced plant, equipment, and overhead costs,
- (c) Compensation events.

38.2 The Engineer shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 10 percent, except with the Prior approval of the Employer.

38.3 If requested by the Engineer, the Contractor shall provide the Engineer with a detailed cost breakdown of any rate in the Bill of Quantities.

39. Variations

39.1 All Variations shall be included in updated Programmes produced by the Contractor.

40. Payments for Variations

40.1 The Contractor shall provide the Engineer with a quotation (with breakdown of unit rates) for carrying out the Variation when requested to do so by the Engineer. The Engineer shall assess the quotation, which shall be given within seven days of the request or within any longer period stated by the Engineer and before the Variation is ordered.

40.2 If the work in the Variation corresponds with an item description in the Bill of Quantities and if, in the opinion of the Engineer, the quantity of work above the limit stated in Sub Clause 38.1 or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of Variation. If the cost per unit of quantity changes, or if the nature of timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the contractor shall be in the form of new rates for the relevant items of work.

40.3 If the Contractor's quotation is unreasonable, the Engineer may order the Variation and make a change to the Contract Price which shall be based on Engineer's own forecast of the effects of the variation on the Contractor's costs.

40.4 The Contractor shall not be entitled to additional payment for costs which could have been avoided by giving early warning.

41. Cash Flow Forecasts

41.1 When the Programme is updated, the contractor is to provide the engineer with an updated cash flow forecast.

42. Payment Certificates

42.1 The Contractor shall submit to the Engineer monthly statements of the estimated value of the work completed less the cumulative amount certified previously.

42.2 The Engineer shall check the Contractor's monthly statement within 14 days and certify the amount to be paid to the Contractor.

42.3 The value of work executed shall be determined by the Engineer.

- 42.4 The value of work executed shall comprise the value of the quantities of the items in the Bill of Quantities completed
- 42.5 The value of work executed shall include the valuation of Variations.
- 42.6 The Engineer may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

43. Payments

- 43.1 Payments shall be adjusted for deductions for advance payments, retention, other recoveries in terms of contract and taxes at source, as applicable under the law. The Employer shall pay the Contractor the amounts certified by the Engineer as soon as possible. No interest/ claim will be entertained by the Dept. for delayed payment.
- 43.2 Items of the Works for which no rate or price has been entered in will not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

44. Deleted.

45. Tax

- 45.1 The rates quoted by the Contractor shall be deemed to be inclusive of the sales and other Taxes (except those items which are mentioned in clause no. 11 of sec. 5 of Bid document) that the Contractor will have to pay for the performance of this Contract. The Employee will perform such duties in regard to the deduction of such taxes at source as per applicable law.
- 45.2 In items in which there is provision of Tax exemption by State govt./GOI ,the Employer will pay the contractor total amount including the tax (except those items which are mentioned in clause no. 11 of sec. 5 of Bid document). The contractor shall have to deposit the amount of Tax exemption availed in Govt. Treasury and the contractor will be solely responsible for any lapses in Tax deposit.
- 45.3 Service tax has not been considered in this bill of quantity, the same will be reimbursed to the contractor as per prevailing Govt. circular on production of proof of payment by the contractor.
- 45.4 The rate is inclusive of 1% labour cess, 2% Work Contract Tax, 0.50 % Krishi Tax, 0.50% Swatch Bharat Mission Tax and accordingly the same will be deducted from each bill.

46. Currencies

- 46.1 All payments shall be made in Indian Rupees.

47. Deleted

48. Retention

- 48.1 The Employer shall retain from each payment due to the Contractor the proportion stated in the Contract Data until Completion of the whole of the Works.
- 48.2 On Completion of the whole of the Works half the total amount retained is repaid to the contractor and half when the Defects Liability Period has passed and the Engineer has

certified that all Defects notified by the Engineer to the Contractor before the end of this period have been corrected.

- 48.3 On request of agency the retention money may be return to him on submission of B.G.of equivalent amount with adequate validity but only after the retention money becomes 50% of the total retention money of the project.

49. Liquidated Damages

- 49.1 The Contractor shall pay liquidated damages to the Employer at the rate per day stated in the Contract data for each day that the Completion Date is later than the Intended Completion Date (for the whole of the works or the milestones as stated in the contract data). The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages does not affect the Contractor's liabilities.

- 49.2 If the Intended Completion date is extended after liquidated damages have been paid, the Engineer shall correct any over payment of liquidated damages by the Contractor by adjusting the next payment certificate. The Contractor shall be paid interest on the over payment calculated from the date of payment to the date of repayment at the rates specified in Sub Clause 43.1.

- 49.3 If the Contractor fails to comply with the time for completion as stipulated in the tender, then the contractor shall pay to the Employer the relevant sum stated in the Contract Data as Liquidated damages for such default and not as penalty for everyday or part of day which shall elapse between relevant time for completion and the date stated in the taking over certificate of the whole of the works on the relevant section, subject to the limit stated in the contract data. The Employer may, without prejudice to any other method of recovery deduct the amount of such damages from any monies due or to become due to the contractor as per relevant recovery laws.. The payment or deduction of such damages shall not relieve the contractor from his obligation to complete the works on form any other of his obligations and liabilities under the contract.

- 49.4 If, before the Time for Completion of the whole of the Works or, if applicable, any Section, a Taking – Over Certificate has been issued for any part of the Works or of a Section, the liquidated damages for delay in completion of the remainders of the Works or of that Section shall, for any period of delay after the date stated in such Taking-Over Certificate, and in the absence of alternative provisions in the Contract, be reduced in the proportion which the value of the part so certified bears to the value of the whole of the Works or Section, as applicable. The provisions of this Sub-Clause shall only apply to the rate of liquidated damages and shall not affect the limit thereof.

50. Bonus

- 50.1 If the contractor achieves completion of the whole of the works prior to the Intended Completion date prescribed in Contract Data the Employer shall pay to the contractor a sum stated in Contract Data as bonus for every completed month which shall elapse between the date of completion of all items of works as stipulated in the contract, including variations ordered by the Engineer and the time prescribed in Clause 17.

For the purpose of calculating bonus payments, the time given in the Bid for completion of the whole of the works is fixed and unless otherwise agreed, no adjustments of the time by reason of granting an extension of time pursuant to Clause 28 or any other clause of these conditions will be allowed. Any period falling short of a complete month

shall be ignored for the purpose of computing the period relevant for the payment of bonus.

51. Advance Payment

51.1 The Employer shall make advance payment to the Contractor of the amounts stated in the Contract Data by the date stated in the Contract Data, against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a bank acceptable to the Employer in amounts and currencies equal to the advance payment. The guarantee shall remain effective until the advance payment has been repaid, but the amount of guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest will not be charged on the advance payment.

51.2 The Contractor is to use the advance payment only to pay for Equipment, Plant and for Mobilization expenses required specifically for execution of the works. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents.

51.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, Variations, price adjustments, or Liquidated Damages.

51.4 Deleted

52. Securities

52.1 The Performance Security (including additional security for unbalanced bids) shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount and form and by a bank or surety acceptable to the Employer, and denominated in Indian Rupees. The Performance Security shall be valid until a date 28 days from the date of expiry of Defects Liability Period and the additional security for unbalanced bids shall be valid until a date 28 days from the date of issue of the certificate of completion.

52.2 The person/persons whose tender(s) may be accepted (hereinafter called the contractor) shall permit Government at the time of making any payment to him for work done under the contract to deduct a sum of 9% (Nine percent) from the gross amount of each running bill till full amount of security deposit 10% (ten percent) of agreement value or value of work (whichever is higher) is reached. If value of work exceeds the agreement value, security deposit (10%) will be recovered for the exceeded work

53. Deleted

54. Cost of Repairs

54.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

E. FINISHING THE CONTRACT

55. Completion

- 55.1 The Contractor shall request the Engineer to issue a Certificate of Completion of the Works and the Engineer will do so upon deciding that the Work is completed.

56. Taking Over

- 56.1 The Employer shall take over the Site and the Works within seven days of the Engineer issuing a certificate of Completion.

57. Final Account

- 57.1 The Contractor shall supply to the Engineer a detailed account of the total amount that the Contractor considers payable under the contract before the end of the Defects Liability Period. The Engineer shall issue a Defect Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor's account if it is correct and complete. If it is not, the Engineer shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Engineer shall decide on the amount payable to the Contractor and issue a payment certificate, within 56 days of receiving the Contractor's revised account.

58. Operation and Maintenance Manuals

- 58.1 If "as built" Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by dates stated in the Contract Data.
- 58.2 If the Contractor does not supply the Drawings and/or manuals by the dates stated in the Contract Data, or they do not receive the Engineer's approval, the Engineer shall withhold the amount stated in the Contract Data from payments due to the Contractor.

59. Termination

- 59.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.
- 59.2 Fundamental breaches of Contract include, but shall not be limited to the following:
- (a) The Contractor stops work for 28 days when no stoppage of work is shown on the current Programme and the stoppage has not been authorized by the Engineer;
 - (b) The Engineer may instruct the Contractor to delay the progress of the Works and the instruction is not withdrawn within 28 days;
 - (c) The Employer or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;;
 - (d) A payment certified by the Engineer is not paid by the Employer to the Contractor within 56 days of the date of the Engineer's certificate.
 - (e) The Engineer gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer.

- (f) The Contractor does not maintain a security which is required;
- (g) The Contractor has delayed the completion of works by the number of days for which the maximum amount of liquidated damages can be paid as defined in the Contract data; and
- (h) If the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.

For the purpose of this paragraph: "corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution. "Fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Borrower, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Borrower of the benefits of free and open competition."

- 59.3 When either party to the Contract gives notice of a breach of contract to the Engineer for a cause other than those listed under Sub Clause 59.2. above, the Engineer shall decide whether the breach is fundamental or not.
- 59.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.
- 59.5 If the Contract is terminated the Contractor shall stop work immediately, make the Site safe and secure and leave the Site as soon as reasonably possible.

60. Payment upon Termination

- 60.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer shall issue a certificate for the value of the work done less advance payments received up to the date of the issue of the certificate, less other recoveries due in terms of the contract, less taxes due to be deducted at source as per applicable law and less the percentage to apply to the work not completed as indicated in the Contract Data. Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor shall be a debt payable to the Employer.
- 60.2 If the Contract is terminated at the Employer's convenience or because of a fundamental Breach of Contract by the Employer, the Engineer shall issue a certificate for the value of the work done, the cost of balance by the contractor and available at site, the reasonable cost of removal of Equipment, a repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works and less advance payments received due in terms of the contract and less taxes due to be deducted at source as per applicable law.

61. Property

- 61.1 All materials on the Site, Plant, Equipment, Temporary Works and Works are deemed to be the property of the Employer, if the Contract is terminated because of a Contractor's default.

62. Release from Performance

- 62.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Employer or the Contractor the Engineer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which commitment was made.

SECTION – 4
CONTRACT DATA

CONTRACT DATA
Clause Reference With respect to section 3

Items marked "N/A" do not apply in this contract.

1. The Employer is [Cl.1.1.]
Name: **JUIDCo Ltd Ranchi.**
Address: JUIDCo Ltd, 3rd Floor, Pragati Sadan, Kachahari Chawk Ranchi-834001
Name of Employer's Representative: - General Manager (W & P) JUIDCO Ltd Ranchi
2. The Engineer is: - To be Informed Later .
3. The dispute review expert appointed by as per [Cl. 1. 1].
Name -----NA-----
Address -----
4. The Defects Liability Period (DLP) is 90 days from the date of Construction completion. These 3 months includes one month of Trail run [Cl. 1. 1&35]
5. The Start Date shall be 07 days for the date of issue of the Notice to proceed with the work. [Cl.1.1.]
6. The Intended Completion Date for the whole of the Works is 12 months comprises 9 months of construction + 3 months of DLP including 1 month of Trail run [Cl.1.1,17&28]
months after start of work with the following milestones: [C1.2.2&49.1]
Physical works to be completed. Period from the start date
Milestone dates: [C1.2.2&49.1]
As per Clause No 42 of Contract Data
7. The Site is located at Chas town area as shown in the location Map [Cl. 1.1]
8. The name and identification number of the Contract Septage Management of Chas Town, Jharkhand.
[Cl. 1.1]
9. The works consist of **Septage Management of Chas Town, Jharkhand - including:**

- a) **Procurement of equipments and provision of services for collection and transportation of septage from households;**
- b) **Supply, construction, installation, testing and commissioning of septage treatment plant at Chas Town; and**
- c) **Operation and maintenance of the above system for 10 years including public outreach activities and collection of user charges from consumers.**

under Urban Development Department Jharkhand.

[Cl. 1.1]

The works shall, inter alia, include the following, as specified or as directed:

10. Scope of work:

Septage Management of Chas Town, Jharkhand - including:

- a) **Procurement of equipments and provision of services for collection and transportation of Septage from Households;**
- b) **Supply, Construction, installation, testing and commissioning of Septage Treatment Plant at Chas; and**
- c) **Operation and maintenance of the above system for 10 years including public outreach activities and collection of user charges from consumers.**

And as per detailed Technical Specifications presented in Section 6 of this bid document

Other Items:

Any other items as required to fulfill all contractual obligations as per the Bid documents.

The following documents also form part of the Contract:

[Cl. 2.3 & (9)]

- a) Standard drawings released for tender purpose
- b) -
- c) -

.....

11. The law which applies to the Contract is the law of Union of India [Cl. 3.1]
12. The language of the Contract documents is English [Cl. 3.1]

-
13. Limit of subcontracting 10 % of the Initial Contract Price only for transportation of sewage from house hold to treatment plant. [Cl. 7.1]
14. The Schedule of Other Contractors ----- [Cl. 8]
Clause Reference: With respect to Section3
15. The Schedule of Key Personnel As per Annex.-II to Section I [Cl.9]
16. The minimum insurance cover for physical property, injury and death [Cl.13]
is Rs.2.5 lakhs per occurrence with the number of occurrences limited to four. After each occurrence, contractor will pay additional premium necessary to make insurance valid for four occurrences always.
17. Site investigation report. [Cl.14]
18. The Site Possession Dates shall be [Cl.21]
19. **Deleted**
20. **Deleted**
21. The period for submission of the programme for approval of Engineer shall be 21 days from the issue of Letter of Acceptance. [Cl.27.1]
222. The period between programme updates shall be 90 days. [Cl.27.3]
- 23. The amount to be withheld for late submission of an updated programme shall be Rs. 1.00 lakh per limited to maximum 10% of the contract value.**
24. **Deleted**
25. The currency of the Contract is Indian Rupees. [Cl. 46]
clause Reference with respect to section 3
26. **Deleted** [Cl. 47]
27. The proportion of payments retained (retention money) shall be 9 % from each bills subject to a maximum of 10% of final contract price including Performance Security money. [Cl. 48]
28. Amount of liquidated damages for delay in completion of works: [C1.49]
For whole of work: (1/2000)th of the Initial Contract Price, rounded off to the nearest Thousand, per day.
-

For part completion: (1/200)th of Initial Contract Price, rounded off to the nearest Thousand per day.

29. Maximum limit of liquidated damages for delay in completion of work. [Cl. 49]
10 per cent of the Initial Contract Price rounded off to the nearest thousand.
30. Amount of Bonus for early completion
1 per cent of the Initial Contract Price (excluding O&M cost) (part of a month to be excluded), rounded off to the nearest thousand per month. [Cl. 50]
31. Maximum limit of bonus for early completion
6 per cent of the Contract Price rounded off to the nearest thousand. (excluding O&M cost) [Cl. 50]
32. The amounts of the advance payment are: [C1.51&52]

Nature of Advance

- | | | |
|---|---|---|
| I | Mobilization 10% of the Contract price Amount (Rs.) | Conditions to be fulfilled

On submission of unconditional Bank Guarantee, (to be drawn before the end of 20% of Contract period).

The contractor may furnish four bank guarantees of 2.5% each, valid for full period.
Refer Clause 42 (a) and (b) |
|---|---|---|

II Deleted.

33. Repayment of advance payment for mobilization and equipment: [Cl. 51.3]

The advance loan shall be repaid with percentage deductions from the interim payments certified by the Engineer under the Contract. Deductions shall commence in the next Interim Payment Certificate following that in which the total of all such payments to the Contractor has reached not less than 20 per cent of the Contract Price or 6 (Six) months from the date of payment of first installment of advance, whichever period concludes earlier, and shall be made at the rate of 20 per cent of the amounts of all Interim Payment Certificates until such time as the loan has been repaid, always provided that the loan shall be completely repaid prior to the expiry of the original time for completion pursuant to Clauses 17 and 28.

35. The Securities shall be for the following minimum amounts equivalent as a percentage of the Contract Price: [Cl. 52]

Performance security (Capital Works): This shall be for an amount equivalent to 3% of the Capital cost plus Rs..... (to be decided after evaluation of the bid) as additional security in terms of ITB Clause 29.5.

Performance security (O&M Works): This shall be for an amount equivalent to 3% of O&M cost of two years and shall be submitted with revised amount after every two years.

The standard form of Performance Security acceptable to the Employer shall be an unconditional Bank Guarantee of the type as presented in Section 8 of the Bidding Documents. [Cl 50][C1.50]

36. The Schedule of Operation and Maintenance Manuals _____ [Cl.58]

As specified in Technical specification

37. The date by which "as-built" drawings (in scale as directed) in 2 sets are required is within 28 days of issue of certificate of completion of whole or section of the work, as the case may be. [Cl. 58]

38. The amount to be withheld for failing to supply "as built" drawings by the date required is Rs 2.00 Lakhs. [Cl. 58]

39. The following events shall also be fundamental breach of contract: [Cl.59.2]

"The Contractor has contravened Sub-clause 7.1 and Clause 9 of GCC."

40. The percentage to apply to the value of the work not completed representing the Employer's additional cost for completing the Works shall be 20 per cent. [Cl. 60]

41. In the Price Schedules, Bidders shall give the required details and a breakdown of their prices as follows:

(i) Price for Design-Build Services shall be quoted as follows:

- (a) Cost of all equipment and vehicles for suction of septage from households to the designated processing and disposal site.
- (b) Cost of setting up SeTP, including site development cost, civil cost, plant & machinery, materials etc. for the proper execution of the Design-Build Services in accordance with the Contract.

Design-Build Price shall remain firm and fixed and will not be subject to price adjustment unless specified otherwise in the **Contract Data**.

(ii) Price for Operations and Maintenance Services shall be quoted as under:

- (a) **Cost of Treated Septage per KLD basis including cost of collection of septage to transportation to designated treatment plant to disposal point as per contract or direction of EIC/Employer** including all labour, related operator's Equipment (Operations), consumables and all matters and things of whatever nature, including the preparation and implementation of plans, programs and reports, and carrying out operations and maintenance services,, training, customer service, as necessary for the proper execution of related Operations Services in accordance with the Contract. The treatment cost shall cover all periodic capital expenses on Facility resulting from need based augmentation or replacement of assets. The periodic capital expenses shall also cover the including cost of collection to disposal of sullage to designated landfill site and treated septage to disposal point as per contract or direction of EIC/Employer/Department of UD & HD.

42. Terms of Payment

1.1 General

The Employer shall pay the Operator in the manner and at the times set out in this Terms and Procedures of Payment.

1.2 Payment during the Design-Build Period

- (a) Mobilisation Advance:

Advance payment as an interest free loan for mobilisation and cash flow support for an amount equal to 10 % of the Design-Build Price stipulated in the contract shall be paid to the Operator against Bank Guarantee for Advance Payment for the same amount in two installments as under subject to the provisions of this Contract.

- (i) 5% within 30 days of effective date of contract; and
- (ii) 5% on mobilization at the site including setting up of the Operator's office, deployment of manpower and machinery & equipment for construction.

- (b) Repayment of Mobilisation advance

The Mobilization Advance paid to the Operator by the Employer shall be recovered commencing from the date on which the payment to the Operator has reached 20% of the value of Design, Build and Commissioning Services and shall be recovered at the rate of 25% of Mobilization Advance from each bill submitted by the Operator for the payment. The entire amount of mobilization advance shall be recovered latest by the time payments up to 90% of the value of Design Build & Commissioning services have been paid to the operator.

- (c) Payment for Design-Build Price

In respect of the amount for Design-Build Services payable by Employer listed in Price schedule of the Operator s Bid (the Design-Build Price) the Owner

shall make the payments against the Operator s monthly bills prepared for the work done in the preceding month in accordance with the agreed billing. The PMC will certify the Bill within 15 days of its receipt to confirm completion of portions of the Design-Build Services for which payment has been claimed in the Bill. Liquidated damages for delay in completing the specified milestones/activities, shall be deducted from the bill and reflected in the amount certified for payment. Employer will make payment of the amount certified in the Bill by the PMC no later than 30 days after receipt of the certified Bill.

The payment shall be made as per the following payment breakup schedule:

S.No	Description of Item	% Payment	Timeline from Start of Contract
1	Completion of Survey and Basic Engineering Package (BEP) and preparation of Good for construction drawings	3%	2 Months
2	On completion of Site Clearance Boundary Wall, Fencing and Gate	3%	3 Months
3	On completion of SeTP - Civil Works	25%	7 Months
4	On completion of SeTP - Mechanical Works	32%	9 Months
5	On completion of SeTP - Electrical and instrumentation Works	10%	9 Months
6	On commissioning of SeTP	5%	
7	On completion of Trial Run of SeTP	5%	10 Months
8	On completion of DLP of SeTP	5%	12 Months
9	Procurement of Equipments and Machineries for Collection System	12%	8 Months
	Total	100%	12

(d) The amounts to be paid to the Operator during the Design-Build Period shall include only costs and expenses of the Operator in building the Facility and providing the Design-Build Services, including all costs and expenses relating to the Plant and Equipment payable by Employer as per Price Schedule.

1.3 Payment during the Operation Period

In respect of the Operations Services performed by the Operator after the Operations Starting Date, the Employer shall pay the Operator on monthly basis (Monthly Operations Payment). For this purpose, monthly bills for the Operations services performed by the Operator shall be submitted to the PMC at the end of each month and the bills will include the fee calculated in the following manner.

- a) Treatment fees payment will be calculated based on the quantity of septage treated at SeTP facility per month.
- b) Payment shall be made after review of Key Performance Indicators (KPIs) set out for this contract as per Clause no. 3 in Special Conditions of Contract.

SECTION 5
SPECIAL CONDITIONS OF CONTRACT

SECTION 5

SPECIAL CONDITION OF CONTRACT

1. OPENING OF ESCROW ACCOUNT

1.1 Definition

“**Escrow Account**” means an account opened with a nationalized bank, prior to start of work, in which all inflows and outflows of cash on account of capital and revenue receipts and expenditure shall be credited and debited, as the case may be, in accordance with the provisions of this Agreement.

“**Project Completion Period**” shall mean the period commencing from the day immediately following the Active Operations Period and ending on the 10th anniversary of the said day.

1.2 PAYMENTS OF CAPITAL GRANT, O&M CHARGES

1.2.1 Payment of capital grant for construction and procurement phase

The capital cost of the project shall be the estimated project cost as per the DPR prepared by consultant and approved by the UDD. The capital cost shall be provided through the UDD grant.

The Grant shall be credited to the Escrow Account in the form of payment made for actual work done as per the payment terms set out in Clause 42 of Contract Data.

1.2.2 Measurement of Works

Measurement of work shall be done as per the actual progress of work and standards of work done by contractor and approved by PMC and Employer. Each milestone shall represent percentage of work completed till that milestone.

1.2.3 Payments

Contractor shall prepare monthly running for the work actually done during previous month on the basis of BOQ prepared by Contractor and approved by PMC and Employer. The bill shall be submitted by contractor on or before 7th day of each month. The Contractor shall submit three numbers of hard copies and one soft copy of floppy/ CD for all bills. After certification of bills by PMC and Employer, payment shall be made to contractor after applicable deductions. All other statutory deductions shall be made on the basis of prevailing taxation rules of GOI and GOJ. The payment due to the contractor shall be made within Thirty days of bill submission.

All running payments shall be regarded as payments by way of advance against the final grant/payment only and not as payments for work actually done and completed and / or accepted by Employer and shall not preclude the recovery for 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 the due performance of the contract, or any part thereof, in this respect, or the accruing of any claim, nor shall it conclude,

determine or affect in any way the powers of the Employer under these conditions or any of them as to the final settlement and adjustments of the accounts or otherwise, or in any other way vary/ affect the contract. The final bill for grant shall be submitted by the contractor within three months of the completion of work, otherwise GNP's certificate of the measurement and of the total amount payable for the work accordingly shall be final and binding on contractor Each Running Bills should be accompanied by two sets of at-least 20 (twenty) photographs as per direction of Project in charge taken from various points depicting status of work as on Report/ Bill date along with Monthly Progress Report for the concerned month in the pro-forma to be given/ approved by Engineer-in-Charge. Intermittent progress Photographs as and when required shall also be provided by the Contractor at his own cost as per direction of Engineer-in-Charge. No payment of running account bill shall be released unless it is accompanied by progress photographs and Monthly Progress Report as above.

All payments shall be released by Employer by Payee's Account Cheque or through transfer in Payees account. In case of Payments is made by Demand Draft at the request of the Contractor, Bank Commission charges shall be debited to the account of contractor.

1.3 Mechanism of Payment

During Construction phase, payment to the Contractor shall be made as per details in Clause 42(c) of Contract Data, whereas in O&M phase, it shall be as per KLD basis linked with key performance Indicators.

(a) Employer shall, within 30 days from the date of receipt of the invoice supported by necessary documents, Pay to the Contractor, only in Escrow account.

(b) Any delay in making any payment in accordance with the invoice shall, without prejudice to any other consequences under this Agreement, entail payment of interest on the amount in default at prevailing annual prime lending rate of State Bank of India calculated for the duration of delay. The period of delay shall be counted from 60 days after; the day of submission of the Invoice.

(d) All payments to the Contractor shall be made in Escrow account by way of Cheque/electronic transfer.

2. USER CHARGES

It will be contractor's responsibility to collect user charges from customer/ household. Contractor to deploy dedicated team to collect the user charges, pursue with household owner in case of non-payment; and deposit revenue accrue to Escrow Account.

The Contractor shall collect the user charges as per **Appendix I to SCC**. The mentioned user charges are provided for year 2018. User charges may be escalated @ 10% per year on prior approval from Employer.

3. PERFORMANCE BASED PAYMENTS

The following Key Performance Indicators (KPIs) are framed for this tender:

- 1. Coverage of HH and Frequency of septage collection**
- 2. Quantity of total septage to be treated at SeTP**
- 3. Efficiency in consumer complaint redressal**
- 4. Achieving quality of effluent at the outlet of SeTP as stipulated in tender**
- 5. Collection efficiency of User Charges**

There shall be 50% fixed pay and 50% performance linked pay - with 10% linked to each of the 5 KPIs. However, the contractor shall be eligible for the 50% fixed pay only if he achieves at least 20% performance linked pay. Up to 10% Performance Pay, the Fixed Pay shall be 40% and upto 5% it shall be 30%. There shall be no Fixed Pay if Performance Pay is below 5%. These KPIs will be monitored by the Employer before releasing any payment against O&M bills submitted by the Contractor.

Performance link payment against the KPI no 1, 3 and 5 (i.e. Coverage of HH and Frequency of septage collection, Efficiency in consumer complaint redressal and Collection efficiency of User Charges respectively) shall be made to Contractor based on pro-rata basis; whereas payment against the KPI no 2 and 4 shall be paid only on 100% achievement.

In case contractor fails to achieve targets (mentioned in Table 2) for any of the KPI 1, 3 and 5 consecutively for 3 months, then Pro-rata basis for payment will not be applicable. This operational behaviour of Contractor shall be considered as Non Compliance and No Payment shall be paid to contractor from 3rd Month onwards until contractor performs to achieve the target.

The targets for these KPIs alongwith their monitoring system has been as presented in the table below:

Table-2 : Key Performance Indicators for the Project

S.No.	Indicator	Annual Cumulative Targets					Monitoring System
		FY 2018		FY 2019	FY 2020	FY 2021-2027	
		1 st half	2 nd half				
1	Coverage of HH and Frequency of septage collection	30%	50%	80%	100%	100% with frequency of once in two years	Number of households covered shall be based on validation of receipts produced by the operator duly signed by the Employer. Frequency shall also be verified through supporting receipts produced by the operator.
2.	Quantity of total septage to be treated at SeTP	27 KLD	45 KLD	71 KLD	89 KLD	89 KLD	Inflow : Measurement of each lot of septage at weighbridge located at entry to SeTP. Outflow: Measurement of dried sludge And flow measurement of treated effluent for disposal / reuse
3	Efficiency in consumer complaint redressal	70%	90%	100%	100%	100%	Checking of Complaint redressal receipts against the complaints received.
4	Achieving quality of effluent and sludge at the outlet	100%	100%	100%	100%	100%	SeTP Log books

S.No.	Indicator	Annual Cumulative Targets					Monitoring System
		FY 2018		FY 2019	FY 2020	FY 2021-2027	
		1 st half	2 nd half				
	of SeTP as stipulated in tender						
5	Collection efficiency of User Charges	15%	40%	90%	100%	100%	Comparison of logbook of household covered for cleaning and logbook of revenue collection.

A sample calculation depicting application of these KPI for releasing payments to contractor during O&M phase is enclosed as Appendix II to SCC. These calculations will assist in understanding KPI's applicability Contractor / Engineer.

4. INCENTIVES

Employer shall reward contractor with incentives as per the following for their out of box thinking / marketing skill:

4.1 On Sale of Composted Sludge

Contractor shall be rewarded for revenue generation from the sale of Composted Sludge with 50% of the revenue generation as reward through Escrow Account only.

5. OTHER CONDITIONS

a) In case of inspection by Project Monitoring Consultant on particular day after the work is completed, if work is not found satisfactory on measurement through marks/points, the amount in accordance to the loss of points for that day, shall be deducted from the monthly running bills.

b) In case of Employer's representative not available for the joint inspection with the Independent Consultant, the evaluation carried out by the Project Monitoring Consultant shall be taken for processing the payment.

6. ROLE OF PMC

For monitoring the progress and over all works, Employer has appointed M/s Tata Consulting Engineers Limited, Noida, as Project Monitoring Consultant (PMC) for the monitoring overall engineering, procurements and construction and initial operation period. Detailed roles and responsibilities of the PMC are provided in Technical Specifications of Tender Documents.

7. CONDUCTING PUBLIC OUTREACH ACTIVATES

Role of I.E.C Activities in the Project

Information, Health Education and Communication I.E.C activities shall play crucial role in the successful implementation of the proposed project. Community participation in implementation of the project is proposed to ensure right from the planning stage through competent & experienced teams. The main objective of I.E.C activities is the support of the operation and maintenance of the septage management project ensuring the sustainability of the project, collect revenue from the users and to maximize its benefits for the target population.

Scope of Work

The broader objective of community participation is to assure sustainability of the project by involving the community in town level planning, implementation and management of sanitation services. The communities will be trained, empowered and motivated to take up these tasks. In the process of community participation the involvement of women and weaker section will be assured in the decision making.

Septage Management

The activities under this component will primarily be focussed for building environment for project acceptance. A town level committee will be formed in every project town. If similar committee already exists in the town though any other sanitation programme being carried out in the town, then that committee can be used. This committee will take-up all the tasks related the project.

Through this committee, the Contractor will collect monthly water charges. The public will be explained about the septage management system being adopted in the town and the direct and indirect benefits of the same for the entire town. The members of committee will be trained and facilitated to take up all these tasks. Following will be the major steps under this

i. Environment Building for project acceptance:

- Minimum 3 nos. of meetings with people are required for each sector of residents and women participation with at least 30% representation from total households of town in each meeting. Meetings of 2 sectors can be held on the same day but in different shifts. These meetings should be continued till the town become positive for accepting concept of the project.
- Additional 2-meetings/ get together with the students in school should also be kept. This component also includes designing projects and message specific posters (at least 2 different types) in consultation with the department.
- Pasting of such posters at different places in the town is required @ one per 100 souls rounded off to next integer. This also includes poster pasting in schools and other public building.
- Contractor has to make provision for mass communication with the public by any one of the following three modes i.e. picture show, puppet show or culture show. Such show shall be kept minimum 1 in each ward and shall be project specific/ task specific. All the above activity shall be intimated to the department in advance.
- Town general meeting and committee formation as per latest circulars of department.
- Committee orientation and job distribution
- Habitation wise list of households with name of household, total no. of male/female persons & children's, ward/habitation wise abstract.
- Deciding payment model for monthly user charges as per departmental/ govt. guidelines.
- Community level training programmes on operation, maintenance fault reporting, record keeping etc. One person per 250 population of town with minimum of 2 people in each ward shall be trained.
- Follow-up of regular deposition of monthly user charges.

ii. Women Participation:

Women play an important role in maintaining the health of the family. Hence it is very important to make them aware of the benefits of this scheme. They need to be involved in every step of implementation. In the society they have lesser say in decision making. Therefore, the community participation initiatives will focus on bringing women in the groups and empower them so they can play a pivotal role in town level water supply related decisions. The major steps under women participation components are as follows:

- Environment building among women (identification of issues of women's concern, sensitizing women about project, identification of women about project, identification of women leader, contacting women in small groups)
- Large group meeting and selection of women representative for the committee
- Women Group and Self Help Group formation as per need
- Capacity building measures

iii. Health Education:

The ultimate aim of the project is to improve in the standards of health of the target communities. The health education efforts will focus on educating the people about related health and hygiene practices especially about the water borne & Sewage borne diseases. For each activity draft of various formats, training materials etc. are to be prepared according to latest circulars of the department, in consultations with the department authorities, with the aim to achieve the objects of the project.

iv. Provision of Vehicles & Communication

The contractor shall have to provide one closed body vehicle (Mahindra BOLERO Deluxe or equivalent, closed body) in good running condition with registration not older than 2012, for Engineer In Charge on 10th day of issue of work order for use of supervision of works during contract execution period (including extended period, if any), under the scope of works of this contract which shall include all running expenditure towards, driver, fuel lubricants, repairs and maintenance of vehicle spares, tax of all types including service tax, octroi etc. Average run per month for each of such engaged vehicle shall be limited to 2500 km. All expenses incurred for providing these vehicles as mentioned above shall be borne by the bidder. If contractor will not provide the vehicles, the deduction at the rate of 3000/- per day/vehicle will be deducted from the contractors running bills. The contractor shall provide 2 smart mobile handsets along with SIM & 1 internet data cards. All expenses incurred for providing these facilities as mentioned above shall be borne by the bidder.

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v. Link with Swachh Bharat Mission:

The campaign should be linked to the Swachh Bharat Mission and the basic outline of that programme shall be followed as extracted below:

The most important task of IEC/ BCC initiatives is to create a need / demand for toilets and solid waste management facilities by informing the people about the negative impact of open defecation and unsafe disposal of solid waste, and the impact it can have on the health of individuals, especially children. The second task is to create awareness on the benefits of using toilets and safe disposal of solid wastes, and how they can lessen the burden of diseases, uphold dignity of the people of the household, especially that of women and create a positive and healthy environment in the cities, towns and villages.. The third task is to inform the people about the range of technology options for toilets and solid waste management systems, their costs,, and appropriateness of designs and inform the people about various subsidies/ incentives that are being provided by the government to the citizens to build toilets and other sanitation facilities.

The Ministry has always placed a lot of emphasis on IEC and BCC initiatives. A national communication strategy framework (The Sanitation and Hygiene Advocacy and Communication Strategy Framework 2012-17) has been developed by Government of India for rural India. The strategy focuses on three main approaches (1) Creating awareness on critical issues related to safe sanitation behavior, (2) Advocacy initiatives at various level (3) Social and Behavioral Change Communication interventions. The communications strategy also focuses on key areas of intervention with frame works instructing the states on how to develop national level, state level and district level IEC interventions. The states are to evolve their own strategy using folk media, mass media and also outdoor media like wall painting, hoardings etc.

The contractor should work on following methodology:

- Carry out study and thorough analysis of the present status of awareness about this project and Swachh Bharat Mission objectives. This will be termed as situational analysis.
- The contractor will do a holistic CNA (Communication Needs Assessment). The CNA report will identify the media vehicles, most suitable to reach the target audience based on their media habits from the perspective of media strategy.
- Find out the gaps and suggest most effective media-mix for the next phase of intensive media campaign.

8. LABOUR

The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport.

The Contractor shall, if required by the Engineer, deliver to the Engineer a return in detail, in such form and at such intervals as the Engineer may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such other information as the Engineer may require.

9. COMPLIANCE WITH LABOUR REGULATIONS

During continuance of the contract, the Contractor and his sub-contractors shall abide at all times by all existing labour enactments and rules made there under, regulations,

notifications and bye laws of the State or Central Government or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. Salient features of some of the major laws that are applicable to construction industry are given below. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/byelaws/ Acts/ Rules/ regulations including amendments, if any, on the part of the Contractor, the Engineer/Employer shall have the right to deduct any money due to the Contractor including his amount of performance security. The Employer/Engineer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK

- a) Workmen Compensation Act 1923 :- The Act provides for compensation in case of injury by accident arising out of and during the course of employment.
- b) Payment of Gratuity Act 1972 :- Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more on death, the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.
- (c) Employees P.F. and Miscellaneous Provision Act 1952: The Act Provides for monthly contributions by the Employer plus workers @ 10% or 8.33%. The benefits payable under the Act are:
 - (i) Pension or family pension on retirement or death, as the case may be.
 - (ii) Deposit linked insurance on the death in harness of the worker, (iii) (iii) Payment of P.F. accumulation on retirement/death etc.
- d) Maternity Benefit Act 1951:- The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.
- e) Contract Labour (Regulation & Abolition) Act 1970:- The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Employer, if they employ 20 or more contract labour.

-
- f) Minimum Wages Act 1948:- The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act, if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments.
 - g) Payment of Wages Act 1936:- It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.
 - h) Equal Remuneration Act 1979 :- The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.
 - i) Payment of Bonus Act 1965: - The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.3500/-per month or less. The bonus to be paid to employees getting Rs.2500/- per month or above upto Rs.3500/- per month shall be worked out by taking wages as Rs.2500/ -per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.
 - j) Industrial Disputes Act 1947:- The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.
 - k) Industrial Employment (Standing Orders) Act 1946:- It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.
 - l) Trade Unions Act 1926: - The Act lays down the procedure for registration of trade unions of workmen and Employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.
 - m) Child Labour (Prohibition & Regulation) Act 1986 :- The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry.
 - n) Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979:- The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home up to the establishment and back, etc.
 - o) The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996 :- All the establishments who carry on any building or other construction work and employs 10 or more workers

are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

- p) Factories Act 1948 :- The Act lays down the procedure for approval of plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

10. Arbitration

Any dispute between Government and agency regarding works or any matter initially resolved by the adjudicator, if within 30 days adjudicator did not resolved the issue the matter will be finally goes to arbitration. Arbitration will be done according to rule "arbitration and cancellation act 1996".

Appendix I to SCC : User Charges for Septage collection		
Reference Clause 2 of SCC		
Sl.No.	Type of User	User ChargesRs./Month
	<i>Residential Area</i>	
1	Slums	10
2	LIG	50
3	MIG	65
4	HIG	80
	<i>Hotel</i>	
5	up to 10 Room	275
6	11-20 Rooms	550
7	21-30 Rooms	800
8	31-50 Rooms	1350
9	Above 50 Rooms	2700
10	Dharmshala/Community Halls	275
11	Restaurant	550
12	Bakery	275
13	Sweetshops	275
14	Shopping Complex-Non AC	1350
15	Shopping Complex- AC	2700
16	Cinema Hall	1350
	<i>Factory and Workshop</i>	
17	Small Scale	275
18	Medium Scale	550
19	Large Scale	1350
20	Shops-Wholesale	
	<i>Office/Commercial Area</i>	
21	Up to 2 Rooms or 10 Sqm	100
22	3-5 Rooms or 25 Sqm	195
23	6-10 Rooms or 50 Sqm	250
24	11-20 Rooms or 100 Sqm	550
25	above 20 Rooms or 100 Sqm	1100
	<i>Hospitals /Dispensary/Private clinics</i>	
26	without Bed	275
27	Up to 20 Beds	550
28	21-50 Beds	1350
29	above 50 Beds	2700
	<i>School/ Colleges/ Coaching Centers</i>	
30	Government Institutes	40
31	Private Institutes	80
32	With Hostel Facilities-Up to 50 Rooms	550
33	With Hostel Facilities-Above 50 Rooms	1350
	<i>Banquets/Comminute Halls</i>	
34	Up to 3000 Sqm. Area	800
35	above 3000 Sqm. Area	1500

Note: Above User Charges are estimated for Year 2018. An Additional Escalation of 10% per year may be added for revised user charges in coming years on approval of Engineering in Charges.

Appendix II to SCC
[Reference Clause 3 of SCC]

SECTION 6
TECHNICAL SPECIFICATIONS

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3. General Specifications for Materials
4. Specifications for Civil Works
5. Specifications for Mechanical Works
6. Specifications for Electrical Works
7. Specifications for Instrumentation Works
8. Process Requirements
9. Testing, Erection and Commissioning
10. Trial Run of the Plant
11. Operation and Maintenance Requirements

Appendix 6-1: Guidelines and Format for Technical Proposal

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PART 1

PROJECT REQUIREMENTS

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1 Background of the Project

Chas is the town located in the central part of Jharkhand and is located in the Bokaro district. Chas is the Sub-Urban area of the Bokaro city. It is one of the most industrialised zones in Jharkhand. The economy of the city is primarily based on Iron and Steel and Coal. There is very minimal agricultural activity as the area is highly industrialised. The city has presence of Steel Authority of India Ltd., Oil and Natural Gas Corporation, Electrosteel Steels Limited amongst others.

It is located at 23° 63' N latitude and 86° 17' E longitude. It has an average elevation of 210 metres (688 feet). It is situated on the junction of National Highway 23 and National Highway 32. The project area covers the entire municipal area of Chas town, which is spread in an area of approx. 18.46 sq. Km as per topographical survey carried out for the town and the same has been adopted for design. Thus, the same area has been considered distributed within 30 wards for the design.

There is no existing sewerage system in the town. Most of the households are practicing onsite disposal through septic tanks into soak-pits or open, surface drains. These drains are ultimately discharging into open lands, river or other water body. The overall scenario of sewerage system in Chas town is very poor, which is one of the major causes of river and ground water pollution. Since there is no underground sewerage system in the town, no STP exists in the town at present.

Septic tank effluent and septage, with appreciable levels of organics, nitrogen and pathogens, disposed without proper treatment are a cause of concern on account of the organic carbon (as measured as BOD), nitrogen, phosphorus and pathogens in the effluent.

2 Proposed Septage Management System

Jharkhand Urban Infrastructure Development Company (JUIDCo), an undertaking of the Govt. of Jharkhand (GoJ), has identified 13 towns under two packages to develop basic urban infrastructure in the state. The components identified are sewerage and storm water drainage. Tata Consulting Engineers Limited (TCE) has been appointed as Design & Project Management Consultant. This bid document is prepared for execution of **Septage Management System for Chas town of Package-1.**

The proposed project will promote a sustainable environment and provide basic urban infrastructure and sanitation facilities to all citizens and visitors of Chas town.

The proposed Septage system has been designed to cater the requirements till year 2032. A total of 89 kld septage has been estimated for this town for the year 2032. A series of dedicated Vacuum Trucks (4 cum capacity, typical) are proposed for Septage collection from each household – 16 nos. for year 2017 to 25 nos. for year 2032. A household size of 5.5 persons has been considered. Septic Tank cleaning frequency has been considered as 2 years. The entire town has been divided into 15 Service areas formed by clubbing nearby wards. Each

service area will be catered by dedicated vacuum truck. 2 nos. trucks will be available to attend emergency calls.

An Independent Septage Treatment Plant (SeTP) of 89 kld capacity is proposed.

3 Description of Works

The Septage Collection System and Septage Treatment Plant (SeTP) shall comprise the following components:

- Components and unit processes as described in **Part 8 (Process Requirements)** of this section of bid document.
- All functional buildings, structures, equipment, and any and all other items, accessories, and ancillaries required for proper functioning and operation of the above components and unit processes.
- Civil and Building Works for
 - Structures for afore mentioned processes
 - Pipeline Systems and Channels
 - Roadways, Curbs, Pavements, Parking Spaces, and associated drainage
 - Pumping Mains
- Complete Electrical Equipment and Systems
- Complete Mechanical Equipment and Systems
- Complete Instrumentation, Control, and Automation Equipment and Systems
- Civil, Mechanical, Electrical, and Instrumentation, Control, and Automation for successful Erection, Installation, Testing, and Commissioning Services

4 Scope of Work

The scope of this bid document is Septage Management of Chas Town, Jharkhand - including:

- a) Procurement of equipments and provision of services for collection and transportation of septage from households;
- b) Supply, construction, installation, testing and commissioning of septage treatment plant at Chas Town; and
- c) Operation and maintenance of the above system for 10 years including public outreach activities and collection of user charges from consumers.

The detailed scope of work is as follows:

Civil Works:

1. Survey
 - a. Geotechnical investigations
 - b. Household survey
2. Construction of 52 KLD capacity Septage Treatment Plant including:
 - a. Inlet / Receiving Chamber
 - b. Screen Chamber
 - c. Grit Chamber
 - d. Equalization Tank
 - e. Sludge Sump and Pump House
 - f. Centrate Collection Tank
 - g. Civil work for Centrifuge Machine
 - h. Civil Work for Package MBBR Units
 - i. Shed for Package Plant and Centrifuge Machine
 - j. Storage Shed for dried sludge
 - k. Administrative Building (double storeyed)
 - l. Staff Quarters and Security Chambers
 - m. Panel/ DG room
 - n. Boundary Walls and Gates
 - o. Access Road upto SeTP and internal roads
 - p. Disposal pipeline and associated ancillaries
 - q. Landscaping including green belt development within the SeTP premises
 - r. Drainage System
 - s. Dismantling and repair work (involved during cleaning of septic tanks)

Mechanical Works:

1. Trailer mounted sewage suction machine (Vacuum trucks)
2. Backhoe Loader
3. Weighbridge (20 Tonne capacity)
4. Flow measurement devices:
 - a. Ultrasonic type Flowmeter at inlet of Equalization Tank
 - b. Electromagnetic type flowmeter at inlet of Package Treatment Plant
 - c. Electromagnetic type flowmeter at inlet of treated water tank
5. Mechanical Screens with Conveyor Belt System
6. Grit Removal Mechanism
7. Mixing arrangement for Equalization Tank (Submersible mixers)
8. Centrifuge feed pumps (Screw Pumps)
9. Centrifuge (Solid Bowl type)
10. Centrate Transfer Pumps (Submersible Pumps)
11. Package MBBR plant for Centrate treatment
12. Lime Dosing System
13. Polyelectrolyte Dosing System
14. Effluent Disposal Pipe and associated valves
15. In addition to above, all necessary pipes and associated valves / gates required for the proper functioning of SeTP are to be covered.

Electrical & Instrumentation Works:

1. Supply, installation, testing and commissioning of complete electrical system as required for providing power to all the equipments and accessories of SeTP, Buildings, Facilities and Roads.
2. Installation of flowmeters as specified in the bid document.
3. Installation of other necessary equipments like pressure switches, level transmitters, etc. as per good engineering practice.
4. The contractor has to prepare all the drawings which includes the following working drawings
 - i. Cable routing layout
 - ii. Earthing layout
 - iii. Lighting layout
 - iv. Conduiting layout
 - v. Survey drawing of transmission line
 - vi. Transmission line layout drawing
 - vii. Switchgear room layout
 - viii. Cable tray layout
5. Contractor shall prepare the cable schedule and submit to the PMC for the approval.
6. The BOQ and SLD prepared and attached is for tender purpose only.

The Guideline / Format for Technical Proposal has been provided as Appendix 6-1.

5 Funding Agency

The project is being funded by AMRUT (Atal Mission for Rejuvenation and Urban Transformation), MoUD, Gol. 100% of capital cost will be obtained through grant from AMRUT. This will be provided through the Escrow Account. The O&M cost will be borne by the Govt. of Jharkhand and the user charges to be collected from the users.

6 Site Description

Plant shall be designed and constructed taking into account the following:

- **Physical Setting**

Chas is located at 23.63°N 84.17° E. Chas town is situated on the bank of River Garga. Chas town is the twin city of Bokaro. Chas is situated around NH-23 & NH-32 and separated from Bokaro Steel City.

- **Topography**

From the topographical survey map, Digital Elevation Model (DEM) of the town has been developed with the help of Civil 3D software to have overall idea of the topography of the town (Figure 1). From the DEM, overall terrain of Chas town is slopping towards the north. River Garga is located at the periphery to the west of the town and flows from south to north direction. A major drain exists in the middle of the town and flows from

south to north to eventually drain into River Garga. The ground elevation varies from 192 m to 232 m.

- **Climate**

The year may be divided into three seasons; the winter from Nov-Feb, the summer from Mar-May, and the rainy season from Jun-Oct. The cold season is delightful while it is unpleasantly hot in the summer season with hot westerly winds prevailing. Because of the barrier of hills in the southeast, the atmosphere is generally dry. The Rainfall is the highest in July and August. Monsoon generally breaks in the second week of June. Average annual rainfall of Chas is 1198 mm. December-January is the coldest months while April-May is the hottest.

- **Soil Strata and Subsoil Water**

The sub-soil strata at proposed site are generally homogeneous and comprises of mainly two layers (based on field tests & laboratory test result data). The subsoil water was not encountered in the trial pits during the excavation activity. Description of layer is described in **Table 3** below.

Table 1 Layer Details of Sub-soil Strata

Layer Details			
Stratum No.	Description	Depth below GL (m)	
		Start	End
I	Filled Up Soil	0.0	Up to 0.00 to 0.50
li	Fine to Coarse Sand/ Sandy Silt	Varies from 0.50 – 4.50	Up to 1.50 to 4.50
lii	Weathered Rock	Varies from 4.50 to 6.00	Up to Depth of exploration

(Source: Geotechnical Investigations)

- **Socioeconomic Condition**

As of 2011 India census, Chas had a population of 141,640 with 25,540 households. Male and female populations are 74,727 and 66,913 respectively.

- **Project Site**

The identified land is the government land parcel of 3.08 Acres, located in the village of Phudinidih, Mauja no. 27. As per the proposed layout of the SeTP, the land requirement for the plant is approx 2.25 acres. This includes land requirement for SeTP units and for the infrastructure facilities (i.e., parking lot for vacuum trucks, administrative building and staff quarters).

Plant shall be designed, constructed, and operated to suit actual site conditions including those mentioned above.

7 Survey and Geotechnical Data

The Employer has the following data available and used these in formulation of the bid elements. They are listed below and shall be used only as guideline.

The details of topographical survey for the town are presented in Volume II. The detailed survey map is provided in Volume IV. (Refer Drawing nos. **TCE.7690A-110-TG-6151**, and **TCE.7690A-110-TG-6152**).

The data on topographical & geotechnical investigations is enclosed in Volume II. Detailed borehole locations are presented in Volume IV (Refer Drawing **TCE.7690A-176-LM-6153**).

Any use of this report or information contained therein shall be solely at the Contractor's own risk. The bidder shall make his own interpretation of this data. The Employer accepts no responsibility whatsoever for, nor guarantee, the accuracy, applicability, or completeness of the Report or information contained therein.

Bidder may carry out the topographical survey, geotechnical investigation and all other details necessary for proper formulation of his price proposal before submission of bid.

After award of contract, Contractor shall carry out independently fresh survey, geotechnical investigation and all other details necessary for proper planning and detailed design. Geotechnical studies shall be conducted by the contractor to primarily ascertain the SBC value- an important input to the structural design of the hydraulic structures of SeTP.

Topography survey of the area shall be conducted by the contractor. Base Map to be prepared - containing the features like road alignment, road levels, important landmarks, drain and canal alignments, locations of electric and telephone posts etc.

The Contractor will be required to provide full details of the survey and geotechnical investigations for proposed site for approval of the Employer.

8 Household Survey

Septic tank condition assessment survey:

The condition assessment survey shall be carried out by the contractor. This household survey shall be conducted to obtain the existing septic tank details for the planning of septage management and treatment scheme. Such sample study was conducted by the consultant and the Report pertaining to the Condition Assessment Survey has been provided in Volume II, Annexure 9.3 of the DPR (DPR shall be shared with the successful bidder).

9 Access for Other Contractors

The Contractor shall allow reasonable access to other Contractors engaged on the Site or on areas adjoining the Site to carry out their works.

In the event of a dispute over access or priority between Contractors, the Employer's Representative shall be informed in writing. The Employer's Representative shall inform all parties concerned in writing of his decision.

Where any part of the Works is associated with or in physical contact with plant supplied under a separate contract, the Contractor shall satisfy himself that the work carried out by the other contractor is consistent with the correct operation of the Plant. In the event of the Contractor considering any work being carried out or any work already completed to be detrimental to the ultimate operation of the Plant, he shall report the matter at once to the Employer's Representative.

If the work of the Contractor is delayed because of any acts or omissions of any other Contractor, the Contractor shall have no claim against the Employer on that account other than for an extension of time.

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PART 2

GENERAL REQUIREMENTS

1. Introduction

This Part sets out the technical requirements that are general to the Contract.

2. Technical Standards and Regulations

Except where otherwise specified in the bid document plant, materials and workmanship shall comply with the requirements of the relevant Indian Standards (hereinafter referred to as IS) issued by the Bureau of Indian Standards (BIS). Other equivalent National or International Standard Specifications such as those issued by the International Organisation for Standardisation (ISO) or the International Electro technical Commission (IEC) may be substituted by the Contractor (so as long as they are more stringent than the equivalent IS) at the sole discretion of the Employer's Representative or as may have been agreed in the Contract. All standards used shall be the current and latest version.

All works shall comply with all relevant statutory regulations and standards current at date of bids, unless otherwise indicated within the Employer's Requirements. Electrical installations shall, where relevant, be in accordance with the Indian Standards Code of Practice for Electrical Wiring Installations IS 732.

All materials, plant and equipment shall be new and all materials and workmanship not fully specified herein or covered by an approved standard shall be of such kind as is used in first class work and suitable to the climate in the project area.

Where reference is made in the Specification to a British Standard Specification (hereinafter abbreviated to 'B.S.') issued by the British Standards Institution of 2, Park street, London W.I., or to an Indian Standard Specification (I.S.) issued by the Bureau of Indian Standards, (earlier known as Indian Standards Institution), Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002, or American Society for Testing and Materials (ASTM) issued by ASTM 1916 Race Street, Philadelphia, P.A., 19103, U.S.A. or American National Standards Institute (ANSI) issued by ANSI 1430, Broadway, New York, N.Y., 10018, U.S.A. or to any other equivalent Standard it shall be to the latest revision of that Standard at the Tender opening date.

All details, materials and equipment supplied and workmanship performed shall comply with these Standards. If the Bidder offers equipment to other Standards, the equipment/material should be equal or superior to those specified and shall be subject to approval by the Employer's Representative and full details of the difference shall be supplied by the Contractor.

In the event of conflict between this Specification and the Codes for equipment, the most stringent provision shall govern, except as otherwise approved by the Employer. Certain specifications issued by national or other widely recognised bodies are referred to in this Specification. Such specifications shall be defined and referred to hereinafter as Standard Specifications. In referring to the Standard Specifications the following abbreviations are used:

IS	:	Indian Standard
ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society of Testing and Materials
AWS	:	American Welding Society
AWWA	:	American Water Works Association
ISO	:	International Organisation for Standardisation
DIN	:	Deutsches Institute fur Normung
BS	:	British Standard
IEC	:	International Electrotechnical Commission
IEE	:	Institution of Electrical Engineers
IEEE	:	Institute of Electrical and Electronic Engineers
NEMA	:	National Electrical Manufacturers Association
AGMA	:	American Gear Manufacturer's Association

3. Precedence of Employer's Requirements

The requirements specified in the Project and Process Requirements parts, shall be in addition to those specified in the General Requirements parts. In case of conflict between the parts, the requirements of the Project and Process Requirements parts shall take precedence.

4. Units of Measurement

All designs, drawings, specifications and manuals shall use SI units and all measurements, dimensions and performance data shall be quoted in those units.

5. Programme

The Contractor shall submit within in the stipulated time detailed contract programme for approval, which shall include details of all temporary and permanent works, construction procedures and methodologies.

In addition to the requirements set down in the Conditions of Contract the programme shall include the following details:

- (a) Contractor's organisational family tree for the Contract including details of all site supervisors and their responsibilities;
- (b) A statement giving the numbers and categories of supervisory and technical staff and skilled and unskilled labour to be employed on the Works;
- (c) A list and type details of major constructional plant (including vehicles) which the Contractor proposes to employ on the Works, including programmed dates for order and delivery;
- (d) Details of the Contractor's methods of working for all operations;
- (e) A statement giving the proposals for location or locations and sizes of offices, workshops and stores at the Site;
- (f) A complete resource allocation showing the number of units and allotted times for each unit of constructional plant, materials and labour allocated to each part of the Works;

The programme shall be co-ordinated to take into account the requirements of climatic, groundwater and other conditions to provide for the completion of the Works in accordance with the Contract.

The programme shall be prepared using MS Project software and other latest software shall be submitted in both electronic softcopy and paper hardcopy form.

6. Contract Management

The Contractor shall be responsible for administration of the Contract from award of Contract through design, manufacture, manufacturer's works testing, and delivery of Plant to Site,

installation, testing and performance testing to final take over. For this purpose he shall nominate a Contractor's Representative who shall be fully responsible for and undertake this administration.

Specific responsibilities of the Contractor's Representative shall be:

- (a) The sole representation on behalf of the Contractor in all discussion, correspondence and matters relating to the Works.
- (b) The co-ordination and monitoring of Contract progress, which shall include the preparation of the Contract programme, monitoring of progress and submission of monthly progress reports. At the discretion of the Employer's Representative, regular meetings shall be called at which the Contractor's Representative shall give a full account of the Contract progress and programme.
- (c) The co-ordination and checking of designs, drawings and submissions. The Contractor's Representative shall be responsible for co-ordinating the design, technical information and data between sub-contractors. All calculations, drawings and information submitted to the Employer's Representative shall be checked by the Contractor's Representative and certified as having been checked before submission.
- (d) Contract communication between the Employer/Employer's Representative and the Contractor. The Contractor's Representative shall attend all meetings involving the Contractor and the Employer's Representative.
- (e) The co-ordination and programming of manufacturer's works tests and the submission of test certificates.
- (f) The co-ordination and programming of Plant delivery.
- (g) The co-ordination and programming of the installation of Plant on the Site, site tests and take over trials. The Contractor's Representative shall be responsible for the various sub-contractors. At the discretion of the Employer's Representative regular site meetings will be held during which the Contractor's Representative shall give full account of site progress and programme.
- (h) The Contractor's Representative shall also be responsible for producing in advance of the work being undertaken, detailed method statements of any work, which involves or affects the performance of existing equipment, processes, or disruption to existing water supplies.
- (i) The co-ordination and preparation and submission of As-Built Drawings and Operation and Maintenance Manuals.

- (j) Soft copies of all submissions should be in editable form.
- (k) The preparation and co-ordination of training of Employer's Personnel.
- (l) The submission of applications for payment.

7. Meetings

From time to time the Employer's Representative will call meetings in his office or at the Contractor's office, or at the Site, as he deems necessary, to discuss progress and any technical points requiring settlement.

The Contractor's Representative or responsible representative shall attend such meetings.

The Contractor shall prepare and submit to the Employer's Representative a daily activity report summarising the main activities undertaken each day.

8. Setting Out of the Works

The Contractor shall set out the Works, and carry out the Contractor's quality control procedures verifying the accuracy and precision of the setting out for each item of the works. The Contractor shall notify the Employer's Representative sufficiently in advance of the setting out to enable the Employer's Representative to observe the accuracy and precision of the laying out. The observations of the Employer's Representative shall not relieve the Contractor of the responsibility under the Contract for the accuracy and precision of the setting out.

9. Employer's Representative's Requirements

The Contractor shall provide the following for use by Employer's Representative at proposed plant sites covered under the contract. These items are to be maintained by the Contractor in proper, safe, and clean working condition throughout the construction period and shall be returned to the Employer after completion of works.

No separate payment shall be made for the items covered here.

10. SeTP Site Office

A separate office shall be provided by the Contractor at SeTP site. The Contractor shall provide, erect, furnish, clean, maintain and subsequently transfer the office and associated furniture/items to the Employer after the completion of works. The carpet area of the office shall not be less than 50 Sq. Meter.

The walls shall be of 230mm thick brick masonry, plastered and with oil bound distemper on the inner face and snowcem on the outer face. RCC roofing at 3 metre from floor, painted with oil bound distemper shall be provided. The doors shall be of first quality wood and steel windows of approved quality shall be provided. The flooring for the office building shall be minimum 2.5mm thick Vinyl over PCC base. Before commencing the construction of the office, the Contractor shall submit to the Employer's Representative for his approval a drawing of the proposed building with all architectural and finishing details fully shown. The location of the office shall be as directed by the Employer's Representative.

The Office shall be maintained throughout the construction period with office help staff, power, water, sewerage, and housekeeping. Power and water supply shall be arranged by the Contractor either with the available resources or from independent sources (e.g. diesel generator sets, borewells, etc. at his own cost.

The Contractor shall furnish the rooms as described below and the equipment, furniture, furnishings, and fittings supplied shall be new items of approved make.

The equipment, furniture, and furnishings shall include for STP

- (a) One conference table 10'-0" x 5'-0" with 12 chairs (approved make)
- (b) 12 chairs (approved make) excluding chairs for Computer and Conference Rooms
- (c) 1 Nos. of Steel cupboards (Storewel type or similar approved)
- (d) 1 No. Drawing Cabinet
- (e) Vertical blinds / Curtains for all windows
- (f) Water supply / Plumbing / Electrical complete
- (g) Computer Table and Chair – 1 No.
- (h) Personal Computer - 1 No., plus UPS, Laserjet Printer (suitable for A4/A3 size paper) or equivalent
 - Additional software – MS Office and AutoCAD version 2011, Microsoft Word latest version, Microsoft Excel latest version, Adobe Portable Document Format (PDF) version 7.x or latest version
 - All the necessary consumables including paper, CDs, printer cartridges etc.
- (i) Fire Extinguisher – CO2 type (3 Kg) – 3 No.

10.1 Lighting Distribution Board

1. The Distribution Board shall be of high quality CRCA sheet steel enclosed, suitable for surface mounting on the wall. Premier quality powder coating shall be applied and the final shade shall be Light Grey Semi Glossy Shade 631 of IS 5.
2. The Distribution Board shall be provided with double door arrangement consisting of an intermediate plate with necessary windows and a door so that when the door is opened, live parts are not exposed.
3. The Distribution Board shall be provided with removable top and bottom gland plates with adequate number of knockouts to enable top and bottom entry of conduits and cables.
4. The Distribution Board shall be of phase segregated type.
5. The incomer shall be TPN, MCCB of required rating. The sub incomers for each phase shall be DP, MCB's of required rating. The outgoings shall be SP MCB's of required ratings.

10.2 Luminaries:

1. The luminaries for all office premises shall have the following features :
 - The Housing made of epoxy powder coated extruded aluminium / CRCA sheet suitable for suspended /surface mounting/recess mounting
 - Decorative low glare mirror optics with anodised aluminium louvers.
 - Designed for 2x 36 W TL-D lamps with electronic ballast.
 - Number of luminaries for each room shall be selected to achieve illumination level of 300 lux.
 - In addition to the above luminaries, down light with the following features shall be provided at the four corners of the conference room.
 - (i) Housing made of Powder Coated CRCA, Sheet steel, suitable for recess mounting with wide cast aluminium ring .
 - (ii) Anodised aluminium reflector for low glare and diffused lighting.
 - (iii) Suitable for horizontally mounted Single 18W CFL with electronic ballast.

2. The luminaries for other rooms & toilets shall have the following features :

- Housing made of Powder Coated CRCA Sheet steel, suitable for surface mounting on ceiling /wall.
- Cover made of Opal acrylic.
- Designed for 1x 36 W, TL'D' lamps with electronic ballast.

10.3 Ceiling Fans

The Ceiling Fan shall be of 48" size, 3 blades type. The fan shall be with aerodynamically balanced aluminium blades. The fan shall be provided with double ball bearings precisely aligned for noiseless performance. The fan shall be powder coated and complete with all mounting accessories. The fan shall be suitable for operation with electronic fan regulator. One Ceiling fan shall be provided for each 10 m² or part thereof of the area concerned.

10.4 Switchboards

The Switchboard shall have unbreakable concealed box and mounting plate flushed with wall. The mounting plate shall be of twin plate arrangement, inner plate to hold the modules and the outer cover plate. The switch board shall have required Nos of switches for lighting fixtures & Ceiling fans . The switches shall be of modular type with minimum rating of 6 amperes. Each lighting fixture & Ceiling fan shall be provided with individual switch. The switchboard shall be provided with one no 6 Amperes 5 pin universal socket with switch. Number of modules in the switchboard shall be to suit the actual requirement. Atleast 2 Nos, 6A switches shall be provided in each switchboard as spares. The cover plate and switches shall be of white /cream in colour. Minimum One no Switchboard shall be provided in each of the premises.

10.5 Switch Sockets

The switch sockets shall have unbreakable concealed boxes and mounting plates flushed with the wall. The mounting plates shall be of twin plate arrangement , inner plate to hold the modules and the outer cover plate . Each switch socket shall be provided with 15 Amps , 240 V , Switch and 6 Pin socket .The number of switch sockets shall be 2 Nos in each of the premises and one no in Pantry.

10.6 Power Plug & Sockets

The power sockets shall have unbreakable concealed boxes and mounting plates flushed with the wall. The mounting plates shall be of twin plate arrangement, inner plate to hold the modules and the outer cover plate . Each power socket shall be provided with 16 Amps , 240 V , SPN MCB and 16 Amps , 240 V , 3 Pin socket and 16A 3 Pin Plug. The number of Power Plug & sockets shall be provided as per requirement in various premises & pantry.

10.7 Peripheral Lighting:

Bracket/Conduit mounted Peripheral Lighting shall be provided on all the corners of the building.

The Lighting fixture shall have the following features

- Weather Proof Housing made of Powder Coated CRCA Sheet steel.
- Cover made of Opal acrylic.
- Designed for 1x 36 W, TL'D' lamps with electronic ballast.

11. Assistance to the Employer's Representative

The Contractor shall provide all necessary assistance to the Employer's Representative and his staff in carrying out their duties of checking, inspecting, and measuring the Works. The Contractor shall provide, at no additional cost, chainmen, staffmen, office attendants, and labourers as may be needed from time to time by the Employer's Representative.

The Contractor shall provide for the Employer's Representative and his staff, consultants and their staff and visitors such protective clothing, safety helmets and rubber boots of suitable sizes, hand lamps and the like as may be reasonably required by them. These articles shall remain the property of the Contractor. No extra payment shall be made on this account.

12. Erection of Plant

Erection of Plant shall be phased in such a manner as not to obstruct the work being done by other contractors.

Before commencing any erection work, the Contractor shall check the dimensions of structures where the various items of Plant are to be installed and shall bring any deviations from the required positions, lines or dimensions to the notice of the Employer's Representative.

Plant shall be erected in a neat and workmanlike manner on the foundations and at the locations shown on the Approved Drawings. Unless otherwise directed by the Employer's Representative, the Contractor shall adhere strictly to the aforesaid drawings.

The Contractor shall be responsible for setting up and erecting the Plant to the line and level required and shall ensure that all Plant is securely held and remains in correct alignment before, during and after grouting-in. This responsibility shall not be passed to any other contractor.

Any damage caused by the Contractor during the course of erection to new or existing plant or building or any part thereto, the Contractor shall at his own cost, make good, repair or replace the damage, promptly and effectively as approved by the Employer's Representative.

13. Site Labour and Supervision

The Contractor shall provide all the skilled and unskilled labour required, and all necessary tools and equipment, to erect, test and commission the Works within the period agreed in the programme.

The Contractor shall not remove any supervisory staff or skilled labour from the Site without the Employer's Representatives prior approval.

14. Sub-letting

The Contractor shall not sub-let the whole of the Works. Where any design or manufacture is sub-let, the Contractor shall not be relieved of his obligation under the Contract. The Contractor shall be responsible for the acts, defaults and neglect acts in manufacture or design of any sub-contractor, as if they were his own.

Where the Employer's Representative has consented to supply of Plant or execution of work by manufacturers or sub-contractors proposed by the Contractor, such manufacturers or sub-contractors shall not be changed without the prior approval in writing of the Employer's Representative.

A copy of every sub-order shall be sent to the Employer's Representative at the time the order is placed each clearly marked with the title of the Contract and the Contract number.

15. Temporary Works

Not less than 14 days before commencing any portion of the Works, the Contractor shall submit to the Employer's Representative for his approval comprehensive drawings and calculations for all Temporary Works which the Contractor proposes for the construction of that part of the Works.

Notwithstanding approval by the Employer's Representative of any design for the Temporary Works, the Contractor shall be entirely responsible for their safety, efficiency, security and maintenance and for all obligations and risks in regard to such Temporary Works specified or implied in the Contract.

16. Languages

All drawings, instructions, signs, notices, name-plates, etc. for use in the design, construction, operation and maintenance of the Works shall be in English.

All site sign boards and warning signs shall be in Hindi and English Languages.

17. Drawings and Information to be provided

17.1 General

The drawings that will be prepared and issued for this Contract shall be classified as follows and where relevant shall be to a scale which is suitable for the representation of those details illustrated.

The term Drawing shall be deemed to include all drawings, schedules, lists, software documentation, descriptive text and calculations necessary for the design, construction, operation and maintenance of the Works and referred to in this clause.

Drawings and all other submittals required by this contract shall be submitted in editable electronic softcopy format on CD(s) or DVD(s) as well as in hardcopy paper format.

The softcopy format for various items shall be as follows:

- Drawings: AutoCAD Latest version
- Text Documents: Microsoft Word version 2007
- All programmes and schedules related to the project: Microsoft Project version 2007
- Spreadsheets, calculations, tables, technical schedules, prices schedules, and other numerical data: Microsoft Excel version 2007
- Databases: Microsoft Access version 2007
- All other required information not included in the above: Adobe Portable Document Format (PDF) version 7.x

The hardcopy format/sizes for various items shall be as follows:

- Drawings: Standard A1 size paper. The scale for each drawing shall be selected such that the information is presented without any clutter or ambiguity and is clearly and easily legible without the use of magnifying aids other than a reader's normal eye-glasses.
- All other information: Standard A4 or A3 paper size, except for any pre-printed standard information such as brochures or catalogue information, which may be submitted in the original size and format.

Drawing Format and Numbering

All drawings shall be prepared using an identical title block format. This shall be approved by the Employer's Representative and shall identify the project, drawing title, the Employer, the Contractor, Sub-contractor, if applicable, and the Employer's Representative.

A formalised drawing numbering system shall be adopted with digits of each number, referencing location, revision, drawing type and size. The numbering format and allocation of drawing number blocks shall be approved by the Employer's Representative.

The Contractor shall provide a sequential numbering system for all Construction Documents. The drawing number shall not be repeated or duplicated.

All drawings shall be submitted to a formalised checking procedure prior to submission. Drawings not so checked will not be approved.

Pre-contract Drawings

The Pre-contract Drawings are those issued to Bidders either with the Bidding Documents for the purpose of illustrating and clarifying the Works described in the Employer's Requirements or later during the bidding period as part of an Addendum to the Contract Documents.

Such drawings shall be deemed to have been issued for the guidance of Bidders.

Bid Drawings and Details

The Bid Drawings are those furnished by a Bidder with his Bid for the purpose of illustrating and clarifying his proposals.

The following drawings, details and specific information pertaining to the entire sewage treatment process / plant / SPS shall be furnished by the Bidder for STP / SPS in the technical envelope in addition to other information mentioned elsewhere in the tender. The

lists provided below shall not be considered comprehensive. The bidder shall be responsible for including any and all drawings and information for any and all works that may be necessary for full and complete definition or clarification of the design, regardless of whether or not such drawings, information, or works are explicitly included in the lists below or elsewhere in these bid documents.

General and Process

- (i) Narrative Description of the Works
- (ii) Plant Operation and Control Philosophy
- (iii) Sizing and Design Calculations covering all Major Unit Processes and components of the Works
- (iv) List of all structures (basins, tanks, channels, buildings, etc.) including dimensions and freeboards
- (v) Major Equipment List
- (vi) All Equipment Catalogues and selection chart (with all relevant manufacturers' documentation).
- (vii) Major Piping Schedule to include service (process stream), installation type (e.g., buried, exposed, submerged, etc.), size, material, coating, lining, joint type(s), gauge/thickness, pressure rating, testing protocol, design standards
- (viii) Major Valve Schedule to include service (process stream), installation type (e.g., buried, exposed, submerged, etc.), size, type, material, joint type(s), pressure rating, differential pressure rating, testing protocol, design standards, operator/actuator type, and whether Open/Close or Modulating
- (ix) Major Gate Schedule to include service (process stream), installation type (e.g., buried, exposed, submerged, etc.) size, type, differential head, seating or unseating, testing protocol, design standards, operator/actuator type, and whether Open/Close or Modulating
- (x) Plant Layout.
- (xi) Hydraulic Profile.
- (xii) Process Flow Diagram.
- (xiii) Process and Instrumentation Diagrams (P&IDs)

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- (xiv) Electrical Load List & Power Consumption Chart.
 - (xv) List of Chemical Consumption on Daily/ Monthly Basis.

Mechanical

Data sheets for various mechanical equipments shall be submitted by the bidder.

Electrical & Instrumentation

Data sheets for various electrical & instrumentation equipments shall be submitted by the bidder.

SeTP:

- (i) Electrical Load List.
- (ii) Electrical Single Line Diagram of SeTP.
- (iii) Sizing Calculations for Transformers and DG Sets.
- (iv) Specific Energy Consumption
- (v) Technical Schedules for Electrical Works duly filled in.
- (vi) Instrumentation
- (vii) Construction schedule

Details of Drawings and Calculations to be submitted by the Contractor for Approval

Drawings / Calculations for approval shall be submitted by the selected Contractor after award of the contract in two Phases.

The first phase shall be the Preliminary Drawings / Designs. Drawings / Designs submitted during this phase shall be of sufficient detail for the Employer and Employer's Representative to understand in outline the Contractor's proposals for the design and construction of the Works. The lists provided below shall not be considered comprehensive. The Contractor shall be responsible for including any and all drawings and information for any and all works that may be necessary for full and complete definition or clarification of the design, regardless of whether or not such drawings, information, or works are explicitly included in the lists below or elsewhere in these bid documents.

The Preliminary Drawings / Designs for SeTP shall inter alia comprise:

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- Detailed Description of the proposed Septage Treatment Plant and Treatment Process offered (including Raw and Treated Sewage Quality).
 - Detailed Plant Operation and Control Philosophy;
 - Detailed Process Design Calculations / Mass Balance Calculations covering all Units/ Equipment.
 - Detailed List of Units including Unit Dimensions/ Free Boards.
 - Detailed Equipment List
 - Major Equipment /Instrument Specifications (with supporting Brochures).
 - Major Piping Schedule to include size, material, coating, lining, gauges/thickness, and pressure rating
 - Major Valve Schedule to include size, type, material, pressure rating, operator/actuator type, and whether Open/Close or Modulating
 - Gate Schedule to include size, type, differential head, seating or unseating, operator/actuator type, and whether Open/Close or Modulating
 - Detailed Plant Layout (including Pipe Sizes/ Pipe Routing/ Channel Size/ Channel Routing/ Site Roads/ Site Drainage)
 - Detailed Hydraulic Profile including Hydraulic Calculations;
 - Detailed Process Flow Diagram (inclusive of Mass Balance)
 - Process and Instrumentation Diagram (P&ID).
 - Detailed Electrical Load List for SeTP prepared based on approved Equipment list from process and Mechanical
 - Transformer sizing calculation for SeTP based on approved Electrical load list
 - D.G sizing calculation for SeTP based on approved Electrical load list
 - Detailed Chemical Consumption Calculations (Daily/ Monthly Basis).
 - Full Hazardous Area Classification Analysis and Report per IS 5572 for SeTP in the contract.

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- Hazardous Area Classification Drawings per IS 5572 for SeTP in the contract.

The second phase shall be the Detailed Engineering Design phase and shall comprise the submission of the Detailed Mechanical/ Electrical/ Instrumentation/ Structural/ Civil Construction Drawings and Calculations. These shall be submitted after the approval of the Preliminary Drawings. The lists provided below shall not be considered comprehensive. The Contractor shall be responsible for including any and all drawings and information for any and all works that may be necessary for full and complete definition or clarification of the design, regardless of whether or not such drawings, information, or works are explicitly included in the lists below or elsewhere in these bid documents.

The Construction Documents shall be used for the construction of the Works and shall inter alia comprise (but not limited to this):

Civil

Site layout for SeTP providing information on levels and detailing the location of:

- General arrangements and main sections of all plant areas;
- Plans, elevations and main sections of all structures and buildings;
- Buildings
- Storage tanks;
- Process plants;
- Transformer enclosures
- Roadways;
- Drainage (plant drainage, sanitation and storm water drainage);
- Buried pipelines;
- Cable routes for direct in ground and ducted systems;

Detail drawings of:

- Cable and pipework chambers;
- Buried pipework;

- Pipework connections;
- Contract interface;
- Reinforcement drawings;
- Bar bending schedules.

Calculations for:

- Detailed Structural Design calculation of all the units/ Structures;

Hydraulic

- Detailed hydraulic profile;
- Detailed hydraulic calculations

Process

Drawings:

- process flow diagram;
- comprehensive P&ID s including details of:
 - pipeline sizes and materials;
 - valve size and type;
 - Equipment detail
 - instrumentation;
 - identification of controlling PLC.

Calculations for:

- Detailed Process Design Calculations / Mass Balance Calculations covering all Units/ Equipment.
- Detailed List of Units including Unit Dimensions/ Free Boards.

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- Detailed Equipment List
 - Equipment /Instrument Specifications (with supporting Brochures).
 - Piping Schedule to include size, material, coating, lining, gauges/thickness, and pressure rating
 - Valve Schedule to include size, type, material, pressure rating, operator/actuator type, and whether Open/Close or Modulating
 - Gate Schedule to include size, type, differential head, seating or unseating, operator/actuator type, and whether Open/Close or Modulating
 - Detailed Process Flow Diagram (inclusive of Mass Balance)
 - Detailed Electrical Power Consumption Calculations for STP, SPS.
 - Detailed Chemical Consumption Calculations (Daily/ Monthly Basis).

Mechanical

Drawings:

Outline dimensional drawing & Cross section Drawing (with Bill of Quantity and Material of construction) for the following items for SeTP, but not limited to:

1.	Fine screens for SeTP
2.	Belt Conveyor for screenings
3.	Sluice valve – motorised
4.	Sluice valve – manually operated
5.	Non-Return valves
6.	Knife Edge Gate Valves
7.	Dismantling joints
8.	H.O.T Cranes

9.	Sluice gate – Manual & Motorised
10.	Dewatering Pumpset
11.	Grit removal equipment
12.	Mixing equipment for Equalization Tank
13.	Process Air Blowers
14.	Plant Water Pumps
15.	Sludge Dewatering Centrifuges
16.	Chemical Dosing Pumps and Agitators
<p>Graphs for all major pumps and blowers (including but not limited to Raw Sewage Pumps, Return Activated Sludge Pumps, Thickener feed Pumps, Centrifuge Feed Pumps, Process Air Blowers):</p> <ul style="list-style-type: none"> • Pump Performance Curves : Q vs H, speed, P, Efficiency, and NPSH • Iso-efficiency curves of the pump model proposed 	
	Motor Curve
(i)	Starting Current vs time
(ii)	Characteristics

Mechanical Equipment System Building

Drawings:

- single line schematics for waste water system and drainage systems;
- general arrangement drawings showing the location of each mechanical building service plant item;
- general arrangement of ventilation systems;
- fixing details.

Schedule:

- plant data sheets with Equipment GA dimensional drawing, Foundation detail, Calculation and Manufacturer's Quality Assurance Plan;
- pipeline schedules;
- Valve schedules.

Calculations for:

- System & Equipment sizing.

The Employer's Representative reserves the right to ask for additional Equipment/system information apart from the above to ascertain good system design and proper selection of Equipment.

Electrical

Drawings

- (1) Single Line Diagram of Complete Electrical System for SeTP based on the equipments finalized by Mechanical and Process.
- (2) Electrical Substation Layout of SeTP showing Panel locations, Transformer locations, DG Set Locations and Trench Layout.
- (3) 11kV Switchgears for SeTP
 - (a) Dimensional Drawing showing overall dimensions, plan, elevation and cable entry details.
 - (b) Complete assembly drawings of the Switchgear showing plan, elevation and typical sectional views, details of busbars and location of cable end boxes and control cable terminal blocks for external wiring connections, etc.
 - (c) Foundation plan showing the location of channel sills, anchor bolts and anchors, floor plans and openings.
 - (d) Schematic power and control wiring diagrams along with control & interlock details, complete bill of materials indicating make, type, rating, setting etc of Circuit breakers, relays, contactors, current

transformers, potential transformers, instruments, meters, annunciations etc .

(4) Diesel Generator Set for SeTP

- (a) GA Drawing showing overall dimensions ,plan, elevation, sectional views, mounting arrangement, layout, make ,type ,rating etc of diesel engine, Alternator, Control panel, battery, battery charger etc.
- (b) Single Line & Schematic diagrams showing details of Power & Control, Change over, AMF details, Synchronising details, interlocks, protections annunciations, battery , battery charger etc with make, type, rating, setting etc of various equipment, components etc.
- (c) Foundation plan showing the location of channel sills, foundation, anchor bolts and anchors, floor plans and openings.
- (d) Exhaust system with piping layout
- (e) Day oil tank sizing with mounting arrangement details
- (f) Fuel bulk storage tank sizing with mounting arrangement details
- (g) Fuel supply system with pipe arrangement.

(5) 11kV / 433 kV Transformers for SeTP

- (a) General arrangement drawing of the transformer, showing plan, front elevation and side elevation complete with all accessories and fittings, detailed dimensions, net weights, quantity of oil, clearances between HV terminals, between LV terminals, between HV and LV terminals, between HV & LV terminals and ground etc.
- (b) Rating, diagram and terminal marking, complete with polarity and vector group.
- (c) Control wiring diagram for marshalling box.
- (d) Foundation drawing with position of foundation bolts and depth.

(6) L.T Panels, Distribution Boards, Power Control Centres, Power Motor Control Centres, Motor Control Centres, Control Panels etc. for SeTP.

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- (a) Dimensional Drawing showing overall dimensions , plan, elevation and cable entry details.
 - (b) Complete assembly drawings of the switchboard/distribution board / MCC showing plan, elevation and typical sectional views,details of busbars and location of power & control cable terminal blocks for external wiring connections, etc.
 - (c) Foundation plan showing the location of channel sills, anchor bolts and anchors, floor plans and openings.
 - (d) Schematic power and control wiring diagrams along with control & interlock details, complete bill of materials indicating make, type, rating, setting etc of Circuit breakers, relays, contactors, current transformers, potential transformers, instruments, meters, annunciators etc .
 - (e) Feeder Operation and Interlock logic.
- (7) L.T Capacitor bank with Automatic Power Factor Correction Relay for SeTP
- (a) Fully dimensioned general arrangement drawings of capacitor and capacitor control panel with elevation, side view, sectional view and foundation details.
 - (b) Justification for number of steps for switching.
 - (c) Complete schematic and wiring diagrams for capacitor control panel.
- (8) Variable Frequency Drives for SeTP
- (a) Dimensional details with mounting arrangement.
 - (b) Schematic power and control wiring diagrams along with control & interlock details, complete bill of materials indicating make, type, rating, setting etc of Circuit breakers, relays, contactors, current transformers, potential transformers, instruments, meters, annunciators etc .
 - (c) Specific details of converter, inverter and harmonic control units.
- (9) UPS & Battery and Battery Charger for SeTP
- (a) Dimensioned general arrangement drawings

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- (b) Fully dimensioned general arrangement drawings with elevation, side view, sectional view and foundation details
 - (c) Complete schematic and wiring diagrams
- (10) Cabling System
- (a) Make and type of HT& LT Power and Control Cables.
 - (b) Details of Installation of Cables in Trenches, on cable trays, directly buried Etc at all locations inside the plant.
 - (c) Cable routing plan and section inside the plant.
 - (d) 11kV Cable termination and mounting Kit Layout drawing.
- (11) Lighting system
- (a) Make, type, rating etc of various fixtures, receptacles, switches etc in various premises.
 - (b) Make, type, rating etc of various fixtures, lighting poles etc for street lighting and flood lighting.
 - (c) Detailed Room wise Lighting Layout with Type of fixture details and Circuit diagram showing phase wise load distribution and interconnection between switches, fixtures, Lighting panel, receptacles etc.
 - (d) Internal road Lighting and Area lighting layout with location of poles, details of fixtures and mounting.
 - (e) Street Light pole details with Foundation details.
- (12) Earthing System
- (a) Details such as material, sizes, etc. of the earth conductor and electrode pits.
 - (b) Earthing layout drawing showing routing of main grid inside the plant with details of interconnection of equipment earthing to the grid and earth pits.
- (13) Electrical Equipment and Panel Layout for SeTP
-

Schedules

- (1) Cable schedules & bill of quantities
- (2) Electrical Load and Power consumption schedule
- (3) Junction box schedule
- (4) Protection relay setting schedule.

Calculations

- (1) Specific Energy Consumption Calculations.
- (2) Bus bar sizing calculation for 11 KV Switchgears, 415 V Switchgears etc.
- (3) Co-ordinated protection study.
- (4) Fault level and Voltage Dip Calculations.
- (5) Sizing of Capacitor banks.
- (7) HT and LT Cable sizing.
- (8) Earthing sizing calculation
- (9) Room wise Lighting Calculation as per Lux level given in the specification.
- (10) Building Lightning Protection and Earthing Sizing Calculation.

Control and Instrumentation

Drawings:

- power supply distribution single line and schematics diagrams (see note 1) for each control panel;
- internal and external (see note 2) general arrangement for each control panel (dimensional);
- Control panel wiring diagram, , relay logic diagram along with terminal block details;

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- System configuration and layout diagram along with bill of material, program listings, block logic diagram and control logic write up for PLC;
 - UPS and battery sizing calculations;
 - control and instrumentation loop drawings (see note 3);
 - instrument installation detail drawing (hook up, see note 4);
 - cable block diagrams;
 - cable routing/installation drawings;
 - foundation and fixing details and trenches drawings;
 - mimic general arrangement (full colour copies shall be provided).

Schedules:

- cable schedule;
- cable interconnection schedule;
- control and instrumentation load schedule for each control panel;
- I/O schedule;
- junction box schedule;
- instrument schedule with tag nos;
- instrumentation, process control set point schedule;
- instrument data sheets;

Documentation:

- functional design specification (FDS)(see note 5);
- factory acceptance test document (FAT);
- site acceptance test document (SAT).

Notes:

1. Schematic drawings shall include a comprehensive schedule of the components used in each switchboard, MCC and control panel including details of the type, manufacturer and rating of each component.
2. The external arrangement of each switchboard, MCC and control panel shall show the arrangement of all components including details of panel section, switch and instrument labels.
3. Control and instrumentation loop drawings shall show on a single drawing the complete circuit associated with an instrument or device including details and location of power supplies, cabling and terminations.
4. Hook up drawings shall detail how an instrument or device is installed.
5. See details later for requirements of the FDS.

Electrical control schematics, loop diagrams and schedules shall where practical be A3 size drawings; all other drawings shall be A1 size.

18. As-Built Drawings

These drawings shall be compiled by the Contractor and shall constitute a permanent record of the Works as executed. These shall include all such drawings, schedules, documentation and calculations as necessary for a complete understanding of the Works design, operation and maintenance.

The As-Built Drawings shall consist of the fully up-dated versions of the approved Construction Documents incorporating any additional information which will assist the Employer in operating, maintaining and if necessary modifying or extending the Works at a later date. These drawings should extend and supplement the information given in the Operating and Maintenance Manuals.

A3 and smaller sized As-Built Drawings shall be provided on durable paper for reproduction by photocopier. As-Built Drawings larger than A3 sized shall be provided as a paper copy and also produced in the form of black lines on a durable translucent film from which further paper prints can be taken by others as required. In addition drawings shall be provided as an AutoCAD software copy in editable form in Compact Disc (CD) in two sets.

Other related information shall be provided in hardcopy as well as editable softcopy format (Microsoft Word, Excel, Access, or Project).

19. Operating and Maintenance Manuals

General

The Contractor shall compile operating, maintenance and overhauling instructions for the whole of the Plant.

The instructions shall consist of one volume of:

- (a) General descriptive text (including drawings for illustration) of the Works described section by section.
- (b) Complete operational instructions for the sewage treatment plant. This shall be termed the Operators Manual. It shall be aimed at the operational staff and shall be written in clear unambiguous text complete with drawings which necessary for clarification of any issues. The manual shall comprehensively detail what to do on a day to day basis and also what to do in the event of faults develop. It shall in addition provide a complete list of the process maintenance tasks the operator should carry out including the intervals between these tasks.
- (c) Essential instructions for mechanical and electrical maintenance of the Plant. These instructions shall be short and concise and set out in a consolidated schedule the inspection, lubrication, cleaning and any other type of servicing operations required. The Contractor shall prepare typical maintenance log sheets that the Employer can subsequently use for daily, weekly, monthly or other periodic maintenance and shall form record sheets of plant maintenance operations.
- (d) Instructions for use of skilled maintenance personnel in fault location, carrying out routine replacements, withdrawing, dismantling, overhauling, re-assembling and testing the various items of Plant.
- (e) Manufacturer's Technical Documentation subdivided into categories for:
 - civil;
 - process;
 - electrical;
 - electrical building services;
 - mechanical building services;
 - Instrumentation and control.

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- (f) Civil As-Built Drawings.
 - (g) Comprising the FDS and PLC code.
 - (h) Electrical As-Built Drawings: The electrical drawings shall be complete sets including all information necessary for maintenance and spares replacement.
 - (i) Control and instrumentation As-Built Drawings: The drawings shall be complete sets including all information necessary for maintenance and spares replacement.
 - (j) Mechanical As-Built Drawings: The mechanical drawings shall be complete sets including all information necessary for maintenance and spares replacement.
 - (k) Electrical and mechanical building services As-Built Drawings: The drawings shall be complete sets including all information necessary for maintenance and spares replacement.
 - (l) FAT records for the Plants and Works.
 - (m) SAT records for the Plants and Works.

Each volume shall be subdivided (relating to areas of plant) into sub sections or sub-volumes in order to ease the location of plant details. Each volume or sub volume shall be provided with a comprehensive index for the volume or sub-volume concerned and the O & M manual as a whole.

Each volume shall be enclosed within A4 and A3 ring binders having tough grease resistant covers suitable for use on site and designed to permit the easy removal and insertion of the contents. The front cover and spine of each volume shall show details of the project, Employer, Employer's Representative and a volume title.

Text shall generally be enclosed in A4 ring binders, A3 drawings shall be enclosed within A3 ring binders except where they accompanies A4 text in which case they shall be folded. A1 drawings shall generally be folded and enclose in A4 box files. Where A1 drawings accompany text they shall be folded and enclosed in an A4 plastic wallet, one wallet per drawing.

20. Submission of Documents and Drawings

The Contractor shall supply to the Employer's Representative 5 (five) copies each of the drawings and design calculations for the process and sizing of all components of the System including architectural, structural, mechanical, electrical and instrumentation equipment, supported by flow diagrams and general arrangement drawings for review and approval.

The Employer's Representative may require the Contractor to submit for approval additional drawings if they are necessary to enable him to satisfy himself that the items are well designed, that they comply with the Employer's Requirements and that they are suitable for their intended purpose. These drawings shall form the agreed basis for the execution of the Works.

The Employer shall review and arrange to send observations within 14 (Fourteen) calendar days of submission of the design and drawings for modifications to the Contractor. The Contractor shall incorporate all necessary comments of the Employer's Representative in the above design and drawings, if any, and shall re-submit further 5 (five) copies each of the revised designs and drawings within 10 (ten) calendar days for the final approval of the Employer's Representative. The Contractor shall thereafter submit 8 (eight) copies each of the approved designs and 8 (eight) copies each of the approved drawings together with one copy each of the reproducible tracings. The Employer's Representative will return 2 (two) approved copies to the Contractor and retain 6 (six) for the Employer's Representative's office and field use.

If an approved drawing is revised, revised copies shall be submitted for approval as above and no such revised drawing shall be used for the purposes of the Contract until it has been approved in place of the earlier issue of the drawing.

If the submissions require more than one round of revision on account of incomplete compliance from Contractor, the delay will be on account of the Contractor. If new observations are given by the Employer's Representative, the Contractor will be entitled to take an additional 10 (ten) calendar days period for compliance.

The Employer's Representative will signify his approval or disapproval of the Preliminary Phase Drawings / Construction Documents within 14 (Fourteen) calendar days of each submission.

The structural designs shall be submitted along with STAAD files (input and output) also in soft copy.

The Construction Documents are certified Drawings submitted by the Contractor to the Employer or Employer's Representative during the course of the Contract for approval. Construction Documents shall be submitted in accordance with the timetable set down in the Work Programme.

Approval of drawings by the Employer's Representative shall not be held to relieve the Contractor of his responsibilities under the Contract.

The construction drawings shall be submitted as specified in clause no 3.15.1.

The Employer's Representative will not permit construction to start on a part or section of the Works unless Construction Documents for that part or section have been approved.

Draft copies of the O & M Manuals shall be submitted to the Employer's Representative for his approval at least 56 (fifty six) calendar days prior to the commencement of Tests on Completion.

The Employer's Representative will signify his approval or disapproval of the O & M Manuals within 28 (twenty eight) calendar days of submission.

Draft As-Built Drawings shall be submitted 56 calendar days prior to the commencement of Tests on Completion.

The Employer's Representative will signify his approval or disapproval of the As-Built Drawings within 28 (twenty eight) calendar days of submission.

The Final As-Built Drawings shall be submitted prior to the issue of any Taking Over Certificate.

To remove doubt the submission dates referred to above shall be the dates on which the drawings and documents are received by the Employer's Representative.

The contractor shall not use construction drawings, documents at site unless approved by the Employer.

21. Notice of Operations

The Contractor shall give full and complete written notice of all important operations to the Employer's Representative sufficiently in advance to enable the Employer's Representative to make such arrangements as the Employer's Representative may consider necessary for inspection and for any other purpose. The Contractor shall not start any important operation without the written approval of the Employer's Representative.

22. Protection of Existing Installations

The Contractor shall apply to the Employer's Representative in writing at least 28 days before starting any work that involves interference with existing structures, equipment, etc. The Contractor shall not execute such work until he has received permission to proceed, in writing from the Employer's Representative.

The Contractor shall ensure that no earth, debris or rock is deposited on public or private roads or rights of way as a result of the Works and all vehicles leaving the Site shall be cleaned accordingly.

23. Protection of Existing Public and Private Services

The Contractor shall notify all public authorities, utility companies and private owners of proposed works that will affect them not less than two weeks before commencing the works.

The Contractor shall adequately protect, uphold, maintain and prevent damage to all services and shall not interfere with their operation without the prior consent of the public authorities, utility companies, private owners, or the Employer's Representative as appropriate.

If any damage to services results from the execution of the Works, the Contractor shall immediately:

- (a) Notify the Employer's Representative and appropriate public authority, utility company or private owner.
- (b) Make arrangements for the damage to be made good without delay to the satisfaction of the public authorities, utility company or private owner as appropriate. The Contractor shall be liable for all costs for making good such damage.

The Employer's Representative may issue instructions or make other such arrangements as he deems necessary, to repair rapidly any essential services damaged during the execution of the Contract. Such arrangements shall not affect any liability to pay for making good the damage.

24. Reinstatement and Compensation for Damage to Persons or Property

The Contractor shall reinstate all properties whether public or private which are damaged in consequence of the construction and operation & maintenance of the Works to a condition as specified and at least equal to that obtaining before his first entry on them.

If in the opinion of the Employer's Representative the Contractor shall have failed to take reasonable and prompt action to discharge his obligations in the matter of reinstatement, the Employer's Representative will inform the Contractor in writing of his opinion, in which circumstances the Employer reserves the right to employ others to do the necessary work of reinstatement and to deduct the cost thereof as certified by the Employer's Representative from any money due or which shall become due from the Employer to the Contractor.

The Contractor shall refer to the Employer without delay all claims, which may be considered to fall within the exceptions listed in the Conditions of Contract.

25. Packing and Protection

Before any Plant is despatched from a manufacturer's factory it shall be adequately protected and packed to ensure that it will arrive on the Site in an undamaged condition. The methods employed for protection and packing must be suitable for withstanding the conditions which may be experienced during shipment, delivery to the Site and prolonged periods of storage in the open, whether the items are shipped in packing cases, crates or only partially protected according to their nature.

Bright parts and bearing surfaces shall be protected from corrosion by applying a rust preventive lacquer, high melting point grease or similar temporary protection. A sufficient quantity of solvent shall be supplied with the plant to enable this coating to be removed on the Site.

All machined flanges and other mating surfaces shall be protected by means of wood templates. The bolts for securing these templates shall not be reused in the final installation.

No one crate or package shall contain items of Plant intended for incorporation in more than one part of the Works.

All items of Plant shall be clearly marked for identification against the packing list, which shall be placed in a waterproof envelope inside every packing case or crate.

Every packing case and crate shall be indelibly marked to show its weight, serial number, top and bottom, shipping marks and handling instructions or sling marks.

Electrical Plant shall be enclosed in sealed airtight packages with dehydrating material, before being placed in packing cases on shock-absorbent material and secured by means of battens.

26. Quality Assurance

Policy

The Contractor shall apply the formal requirements of Quality Assurance to the design, supply, construction and operation & maintenance of the Works. This shall be achieved through the implementation of a Quality System compliant with the requirements of BS 5750 or an equivalent International Standard.

Positive commitment to Quality Assurance shall be expressed in a formal policy statement given in the Contractor's Quality Manual.

Objectives

It shall be the stated aim of the Contractor to achieve and demonstrate the achievement of quality as expressed by 'due care and diligence' of the design, supply, construction and operation & maintenance of the Works as defined by the Employer's Requirements.

The criteria to define 'due care and diligence' shall be explained in the Contractor's Quality Plan and shall embody all of the design, supply, construction and maintenance requirements of the Works.

Quality System

The Quality System shall be fully integrated for all of the Works.

This system will be defined by the organisational structure, responsibilities, activities, resources, and events that together demonstrate the capability of the Contractor to meet the stated quality requirements.

The Contractor shall ensure that all sub-contractors and sub-consultants establish quality systems and shall supply to the Employer such evidence as is necessary to demonstrate the effective implementation of a quality system in each sub-contractor or sub-consultant organisation.

The Quality System of the Contractor and of his sub-contractor and sub-consultants will be subject to periodic audits undertaken by the Employer's Representative. The Employer's Representative will give two weeks' notice of such audits that will involve a full assessment of the performance and efficiency of the Quality System and will include review of the feedback and records derived from the Contractor's monitoring and internal reviews.

On a day-to-day basis the Contractor shall afford reasonable availability of staff and documentation for the Employer's Representative to assess the implementation of the Quality System. The Contractor shall ensure that all relevant personnel and documentation are available for such audits.

Quality Plan

The implementation of the Quality System shall be through the establishment of a comprehensive Quality Plan issued to and approved by the Employer's Representative.

The documented procedures shall include but not be limited to:

- Management Procedures;
- Design;
- Supply/Procurement;
- Construction;
- Putting to work/Commissioning/Reliability Trial/Performance Test;
- Operator Training and Maintenance;
- Interface Control;

- Quality Performance, Monitoring and Review.

There shall be procedures to control transmission of information across all interfaces both internally (that is, within the Contractor's Quality System) and externally. Those of the latter shall include all Statutory Bodies, Authorities and the Employer's Representative.

Formal assessment of any non-compliance with the Quality Plan shall be achieved through periodic reviews undertaken by a team appointed by the Contractor. All deficiencies shall be recorded and appropriate corrective measures shall be assessed, within an appropriate timescale, through subsequent formal reviews undertaken by the Contractor.

Quality Feedback

The system shall include for the reporting back, recording and incorporation into the system of deficiencies and remedial measures to correct them noted during the control of the project.

27. Environmental Protection

The Contractor shall minimize, as far as is practically possible, the effects of all his and his Subcontractors' activities upon the environment and shall implement and monitor measures to prevent:

- (a) Contamination of surfaces, ground, groundwater, surface water and rivers,
- (b) Emissions to air, including smells, gases, smoke, and dust.
- (c) Unsanitary or unsafe storage or discharge to drain, sewer and surface waters,
- (d) Unsanitary or unsafe storage or discharge of solid wastes,
- (e) Noise,
- (f) Visual intrusion, and
- (g) Excessive energy and water consumption.

These requirements shall be met through the constant and careful attention of the Contractor's management of all Site and off-site activities, and by instruction to all staff and labour in these matters.

The Contractor shall appoint an Environmental Control Manager (Resume shall be approved by Employer) for the Works, who shall be responsible for preparing an Environmental

Management Plan and ensuring its implementation by the Contractor after obtaining approval of the Employer's Representative.

Implementation shall include for monitoring and reporting on the results of the above measures. Monitoring reports shall be in writing and submitted on a monthly basis as part of the monthly report referred to above. The report shall include a listing and summary of daily monitoring results on all aspects listed above.

All potentially affected areas of the Site, other areas used for or affected by the works and all adjacent or affected waterways shall be monitored and, where instructed by the Employer's Representative, tested.

The Environmental Management Plan (EMP) shall identify the potential environmental impacts from the various construction and operations and maintenance activities to be undertaken in the Contract and set out in detail the approach he will adopt in mitigating these environmental impacts to ensure that the residual impacts are minor and confined to a short period.

The EMP shall consider but not be limited to the following:

- The methods of materials delivery, storage, usage and disposal; equipment usage; and site activities to ensure they have minimal impact on the environment,
- Only environmentally safe products and practices shall be adopted in performing his works, and
- The Contractor shall comply with all of the statutes regarding environmental effects.

The EMP shall provide separate descriptions of its proposals for minimizing any adverse environmental impacts/effects during the construction phase and the subsequent operations and maintenance phase.

The EMP shall be provided in draft form within 28 days from the Notice to Commence, and shall be updated from time to time by the Contractor as agreed or required by the Employer's Representative to ensure the objectives of environmental protection are fully met.

28. Safety

The Contractor shall prepare a Safety Plan and submit the same to the Employer's Representative for approval within 28 days of receiving the Notice to Commence.

The Safety Plan shall be followed at all times by the Contractor and shall contain adequate control measures, in accordance with the relevant protection of property and local laws and regulations as well as internationally accepted good practice, for the prevention of accidents, fires and public nuisance.

The Safety Plan shall be implemented properly and diligently throughout the execution of the Works and during the operations and maintenance period.

The Contractor's Safety Plan shall make safety provision for, among other things:

- Deep excavations and collapsing sides in trench excavations,
- Scaffolds and overhead working,
- Working in confined spaces,
- Working in water,
- Contractor's Equipment, especially cranes,
- Hand held power tools,
- Electrical equipment,
- Hazardous chemicals, gases and fuels,
- The use of protective clothing, and
- The provision of first aid facilities.

The Safety Plan shall be developed to ensure zero fatal accidents and zero hazardous incidents/occurrences in all construction works. The Safety Plan shall include descriptions of the company's standard policies and procedures regarding its site organization and procedures, methods and frequency of conducting safety audits at the Site(s), record keeping and reporting, providing safety training for its personnel (including subcontractors), issue and mandatory use of safety equipment, and details of the qualifications and experience of the Bidder's proposed safety officers to be deployed at the Site(s). The Contractor shall provide separate descriptions in its Safety Plan covering the construction phase and the subsequent operations and maintenance phase.

The Contractor shall appoint a Full Time English and Hindi speaking Safety Manager for the Works having experience in this field, who shall be responsible for implementing the Safety Plan. He shall be supported by at least two safety officers who are qualified and familiar with Hindi and English languages for such safety works.

The Contractor shall ensure that his staff and labour and his Subcontractors are all fully trained in and aware of good and safe working practices.

The Contractor shall ensure that all precautions are taken to safeguard the general public and construction/operating staff from any danger.

All temporary and partially completed works shall be protected by way of barriers, lights, notices and the like.

All excavations and the like are to be protected by barriers at all times and adequately illuminated at night.

Warning and diversion signs concerning roadwork shall be suitably placed to give motorists ample warning. During the movement of heavy vehicles across roads or onto roads, men, bearing red flags, shall be in attendance to warn other road users and to generally control traffic in a safe manner.

The Safety Plan shall also consider requirements for warning and protection for other risks including overhead and underground cables, pipes or obstructions, or voids, openings, pits and trenches. The Contractor shall ensure that all appropriate measures are implemented.

The Safety Plan shall include a policy statement signed by the CEO or equivalent authority of the Organization declaring that safety and loss prevention shall be given the highest practicable priority in all aspects of the Contract. The Safety Plan shall be updated as necessary to cover the activities to be undertaken for operations and maintenance.

29. PROJECT MONITORING CONSULTANT

29.1 Appointment

JUIDCo has appointed Tata Consulting Engineers, Noida as project monitoring consultant (PMC).

The scope of work of PMC is bid process management, project monitoring during construction phase and DLP phase of the project.

29.2 Payments to Project Monitoring Consultant

All fees, costs, charges and expenses payable to the Project Monitoring Consultant shall be paid by JUIDCo in accordance with the terms of its appointment within 15 days of receiving an invoice from PMC.

29.3 PROJECT MONITORING CONSULTANT - SCOPE OF WORK

- i. The Project Monitoring Consultant is expected to play a positive and independent role in discharging its functions, thereby facilitating the smooth implementation and operation of the Project. Broadly, the role of the Project Monitoring Consultant shall encompass:
- ii. Verification and random checks of collection & Transportation work.
- iii. Verification and random checks of weighment and Testing of the septage at the SeTP.
- iv. Independently review, monitor and where required by the Agreement, to approve the design, construction, operation and maintenance of the Project Facilities to ensure compliance by the bidder with the Operations Plan, Design Requirements, Construction Requirements and O&M Requirements,
- v. Report to the Parties on the various physical, technical and financial aspects of the Project based on inspections, site visits and Tests,
- vi. Assist the Parties in arriving at an amicable settlement of disputes, should the need arise, and
- vii. Review matters related to safety and environment management measures adopted by the bidder for the Project.

29.4 Scope of Services of the Project Monitoring Consultant

The services to be provided by the Project Monitoring Consultant shall be in accordance with the applicable provisions of agreement made between JUIDCo and Tata Consulting Engineers, Noida and also as per the general obligations of this Agreement are specified in this section.

29.5 Obligations during Implementation Period

The Project Monitoring Consultant would monitor, in accordance with Good Industry Practice, the progress in implementation of the Collection, Transportation, and the Septage Treatment Plant and ensure compliance with the Construction & Procurement Requirements. For this purpose the Project Monitoring Consultant shall undertake, inter alia, the following activities and where appropriate make suitable suggestions:

- a) Provide administration of the contract in full and in complete accordance with applicable laws;

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- b) Act on the Employer's behalf as the Employer's representative regarding all contact with the Contractor unless expressly indicated otherwise;
 - c) Designate tests on materials and/or equipment;
 - d) Review and check the quality of vehicles and material procured;
 - e) Review and approve test results and materials and/or equipment used in the Construction Works;
 - f) Interpret the requirements of the contract and make decisions regarding performance of the Contractor. The PMC shall inform and advise the Employer, in a timely manner all matters relating to the execution, progress, and completeness of the Construction Works;
 - g) Reject work which fails to comply with the specifications and requirements of the Agreement. Whenever considered necessary or advisable to ensure correction of defective work, the PMC may require inspection or testing of such work, whether or not such work be then fabricated, installed, or completed;
 - h) Review, approve or disapprove drawings, samples, and other submissions of the Contractor to determine compliance and conformance with the requirements of the Agreement;
 - i) Provide the services of a full time resident project representative during the period commencing from 7 (seven) days from the date of appointment of the PE until the expiry of the PMC's appointment;
 - j) Provide the services of experts to check the quality of materials and the workmanship during the procurement phase of C&T work, including the following:
 - (i) Waste transportation vehicles;
 - k) Provide the services of experts to check the quality of materials and the workmanship during the procurement/installation/construction phase of waste processing facility, including the following:
 - (i) weigh bridge at the Project Facility entry gate;
 - (ii) drainage system;
 - (iii) water supply system;
 - (iv) quality control laboratory and associated equipments;

(v) Electrical systems.

- l) Provide the services of experts to check the quality of materials and the workmanship during the installation/construction of the treatment units, including the following:
 - i. drainage system;
 - ii. testing laboratory and associated equipments

- m) Address issues relating to specific site conditions, design modifications, or Contractor disputes.

The PMC shall prepare and submit to Employer, Monthly Progress Reports including the following:

- 1. Daily progress of works;
- 2. Slippages, if any, in the construction vis-à-vis planned construction schedule and the reasons thereof;
- 3. Construction schedule for the succeeding week;
 - i. Report on Tests
 - ii. Report on notices issued
- 4. Issues, if any, with regard to the works along with the details of the action taken for the resolution of the same;
- 5. Photographic record of progress of works over the previous week.

The PMC shall provide all other services as normally provided by an engineer in charge.

29.6 During Trial Run and DLP Operation Period

- 1. During this period the Project Monitoring Consultant would monitor, in accordance with Good Industry Practice, the operations and maintenance activities undertaken by the Contractor so as to ensure compliance with the O&M Requirements. The specific activities to be undertaken would include the following:
 - a) Provide administration of the contract in full and in complete accordance with applicable laws;

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- b) Act on the Employer's behalf as the Employer's representative regarding all contact with the Contractor unless expressly indicated otherwise;
 - c) Designate tests on materials and/or equipment;
 - d) Review and approve test results and materials and/or equipment used;
 - e) Interpret the requirements of the contract and make decisions regarding performance of the Contractor. The PMC shall inform and advise the Employer, in a timely manner all matters relating to the execution, progress, and completeness of works;
 - f) Reject work which fails to comply with the specifications and requirements of the Agreement. Whenever considered necessary or advisable to ensure correction of defective work, the PMC may require inspection or testing of such work, whether or not such work be then fabricated, installed, or completed;
 - g) Review, approve or disapprove drawings, samples, and other submissions of the Contractor to determine compliance and conformance with the requirements of the Agreement;
 - h) Provide the services of a full time resident project representative during the period commencing from 7 seven days from the date of appointment of the PE until the expiry of the PMC's appointment;
 - i) In addition to the daily responsibilities, conduct a general inspection of the Project Facilities at least once a month and as and when exigencies require to ascertain conformity with Construction Requirements and O&M Requirements;
 - j) Provide the services of experts to check the quality of materials and the workmanship during the construction of the treatment plant units
 - k) Inspect the quality of compost being sold or otherwise disposed outside the Site
 - l) deleted
 - m) Address issues relating to specific site conditions, design modifications, or Contractor disputes.
 - n) Review the O&M Plans submitted by the Contractor from time to time and assist the Contractor in finalising the same. The Project Monitoring Consultant shall also consult Employer prior to finalisation of the O&M Plans;
 - o) Periodically review the O&M Manual for adequacy;

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- p) Monitor Operation and Maintenance activities (including maintenance of Project Facilities and equipment, standards of service, safety and environmental issues) and the overall quality of O&M activities so as to ensure compliance by the Contractor with the O&M Requirements, O&M Plan and O&M Manual;
 - q) Review and ascertain the cost variation arising as a result of Change in Law and determine the Additional Cost;
 - r) Undertake a quarterly review of the various records and registers to be maintained by the Contractor and suggest suitable remedial measures/ procedures, where necessary.
2. The PMC shall attend regular meetings (“Project Review Meetings” or “PRMs”) with the Employer and the Contractor, to be held at least once in every month during the Active Operations Period to report on progress and quality of work performed by the Contractor and to discuss problems or other pertinent matters relating to the work. The IC shall take notes at the meetings and provide a copy of the PRM minutes to each person who attended the meeting.
3. The PMC shall prepare and submit to Employer, Monthly Project Reports including the following:
- a) Report on Tests
 - b) Report on notices issued
 - c) Issues, if any, with regard to the works along with the details of the action taken for the resolution of the same;
 - d) Photographic record of progress of works over the previous week.

29.7 Deleted

29.8 Deleted

PART 3

GENERAL SPECIFICATIONS

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GENERAL SPECIFICATIONS (Material)

Materials and methods of construction for all civil works shall be as per relevant Indian standard specification, part of which are incorporated in the standard specification of DWSD and P.W.D. Jharkhand and all will be followed during the execution of the work. The work shall be executed as per the guidelines and provisions of B.I.S. All materials shall conform to Indian standard code of practice National Building Code and CPHEEO manual to maintain quality of work.

1. General

All materials shall be best of their kind and shall conform to the relevant latest Indian standard.

All materials shall be of approved quality as per samples and from origins approved by the Engineer in Charge. A set of specimen samples of all approved materials shall be kept in sealed container or otherwise at site, cost of which is to be borne by the contractor.

2. Bricks

Only 1st class kiln burnt bricks shall be used unless otherwise specified. They shall be of a uniform deep cherry color; thoroughly burnt, regular in shape with sharp and square areas and they must emit a clear ringing sound on being struck. They must be free from cracks, chips, flaws, stones or lumps of any kind and they shall not absorb water more than one seventh of their own weight after soaking them in water for 15 minutes. The bricks shall show no sign of efflorescence either dry or subsequent to soaking in water.

3. Sand

The source from which sand is to be obtained shall be subject to the approval of Engineer-in-charge. The sand shall be clean, sharp and gritty to touch and be freed from soil and other impurities by washing. The sand shall be washed to such a degree that when a handful is mixed with clean water in a glass and allowed to stand for an hour the precipitate of mud over the sand shall not exceed 5%. The sand should conform to IS 382-1982 for fine and coarse aggregates from natural sources.

4. Coarse Sand

It is to be screened through a sieve of 64 meshes to the square inch so as to exclude large particles from the work. The fineness modulus shall not be less than 1.0

5. Fine sand

It is to be screened through a sieve of 64 meshes to the square inch so as to exclude large particles from the work. The fineness modulus shall not be less than 2.5

6. Stone chips

It shall be obtained from crushing trap quartzite or hard stones and from quarries approved by Engineer-in-charge. It shall be of approved quality and proper grade. It shall pass through $\frac{3}{4}$ "mesh and retained on $\frac{1}{4}$ "mesh. It shall be free from dirt, leaves, clay and any organic matter. The material conforming generally to IS 383-1983 for coarse and fine aggregate from natural sources or IS 515-1959 for natural and manufactured aggregates for use in mass concrete with latest revisions.

7. Cement

Ordinary or lowest heat Portland cement conforming I.S.S. 269 –1989 of A.C.C. / LAFARGE shall be used after due approval of the Engineer-in-charge. All cement shall be fresh when delivered. Cements of different types are not to be mixed with one another. Consignments shall be used in the order of delivery. Admixture if any shall be used only after approvals of Engineer in charge.

8. Reinforcement

Steel reinforcement shall be of mild steel of tested quality conforming to I.S.S. – 432 - 1966/ H.Y.S.D. bars conforming to ISS-1786/1779-of SAIL / TATA make.

All the reinforcement shall be clean and free from rust, mild scales, dust, paint, oil, grease, adhering soil or any other material or coating that may impair the bond between the concrete and the reinforcement, or cause corrosion of the reinforcement or disintegration of concrete. Neither the size nor length of bar or wire shall be less than the size or length described in the bar schedule or elsewhere and the length shall not be more than 50 mm in excess of the length as described.

Welded joints in reinforcement may be used but in cases of important connection, tests shall be made to prove that the joints are of the full strength of bars connected, welding of reinforcement shall be done in accordance with the recommendations of the relevant Indian standards for welding mild steel bars used in the reinforced concrete construction.

Bending and overlapping, placing in position, fabrication, binding, reinforcement with wire of approved gauge shall be done as per I.S. 432 – 1960 (revised) and I.S. 1786 – 1966 and I.S. 2502 (revised). Handling and storage of materials for concrete or RCC should be followed as per I.S. 4082 –1977.

9. Water

The water to be used in making and curing of concrete, mortar etc. shall be free from objectionable quantities of silts, organic matter, injurious amount of oils, acids, salts and other impurities etc. as per IS-456-1978. The Engineer-in-charge or his authorized representatives will determine whether or not such quantities of impurities are objectionable. Such comparison will usually be made by comparison of compressive strength, water requirement, time of setting and other properties of concrete made with

distilled or every clean water and concrete made with the water proposed for use, Permissible limit for solids when tested in accordance with I.S. 3025-1964. Shall be as tabulated below

1. Organic	Permissible limit for solids Maximum permissible limit. 200 mg/litre.
2. Inorganic	3000 mg/litre.
3. Sulphate (As SO ₄)	500 mg/litre.
4. Chloride (As Cl)	2000 mg/litre for P.C.C and 1000 mg/litre for R.C.C. work
5. Suspended matter	2000 mg/litre.

If any water to be used in concrete, suspected by the Engineer-in-charge/or his authorized representative of exceeding the permissible limits of solids, samples of water will be obtained and get it tested by Engineer-in-charge in accordance with IS- 3025-1964 at the cost of contractor

10. Cement Mortar

The mortar shall consist of cement and sand mixed in proportion defined in relevant schedule item for various item of work. Only measured quantity shall be used. The sand shall be shovelled in a wooden measure of a clean masonry platform, after removing the measure box and spreading out sand if necessary, the cement (in required proportion) shall be emptied on the top of sand. The sand and cement shall be then turned over with shovels once dry and made into the form of a hollow cone; into this water can be poured and the whole shall then be turned over completely twice. The color and consistency shall at this stage be quite uniform, if not, further turning shall be done. Water shall be added by measured quantities. Only such quantities of mortar shall be mixed at one time as can be used at once before it can set. No mortar, which has once caked or begun to set, shall be used, nor shall such mortar be remixed; but it shall be removed from the site of the work immediately.

11. Cement concrete

The concrete shall consist of an aggregate of the proportion by volume/ weight as defined in relevant schedule item or work. Only measured quantity shall be used. The aggregate shall consist of stone ballast of quality approved by Engineer-in-charge and shall consist of graded size 20 mm and down wards as per PWD specification or the size mentioned in the item description. The quality of cement concrete should conform to the specification mentioned in BOQ and standard and specification as laid down in different IS codes for concrete to be used for different component and for different design concrete.

12. Laying:

The cement, sand and stone chips shall be mixed properly in mechanical mixer in such a manner as to avoid loss of water. The concrete shall be mixed for minimum period of 2 minutes or until it is of even colour and uniform consistency throughout. As soon as the

concrete is mixed it should be removed to the work in iron vessels as rapidly as practicable. The concrete laid will be vibrated for compaction by the vibrators. Slum test will be carried at site during execution of work. Cube (crushing) test of concrete will have to be carried out at the frequency as mentioned in relevant IS code of practice and record of such test will be preserved for future reference.

13. Curing:

The concrete laid shall not be disturbed and shall be kept thoroughly damped by means of wet matting and sand until it shall have become thoroughly set and hard enough to prevent its drying and cracking.

14. Forms:

Contractor shall furnish on the site of work sufficient number of centering, moulds or templates for its expeditious execution. The forms shall be made in such a way and of such materials as will ensure a smooth surface on the finished concrete. Forms and centering shall be left in place until the concrete has set sufficiently to permit the removal without danger to the structure and as per direction of E/I.

15. Brick masonry work

Materials:

The brick works shall consist of bricks and mortar in accordance with general specification and plans.

Soaking bricks:

All bricks shall be soaked in clean water in tank for a period of at least twelve hour immediately before use. The contractor shall provide at his expense tanks of sufficient capacity to admit of the simultaneous immersion of bricks for the work its normal rate of progress.

Laying:

All the best shaped uniformly coloured bricks shall be picked out and used for face work without any extra payment to the contractor. All bricks work shall be constructed in English bond and shall follow the type bond junctions etc. All courses unless other wise specified or ordered by the Engineer in charge shall be truly horizontal and the walls shall be taken up truly plumb. Mortar joints shall never exceed 10 mm in thickness and this thickness shall be uniform throughout. Vertical joints in alternate courses shall not come directly over one another. The joints shall be raked out not less than 12mm deep when the mortar is green so as to provide proper key for the plaster or pointing to be done. Each face brick shall be set with both bed and vertical joints quite full of mortar. No damaged or broken brick shall be used in any part of the work except such as may be cut to size for closing the course. Closers shall be clean out to size as indicated in English bond and shall be situated near the end of walls. The masonry shall be carried up regularly and no step shall be allowed more than 60cm. Where the masonry of one part has to be delayed, the work must be raked back at an angle not exceeding 45 °

Angles and Junctions. At all angles forming the junction of walls, the brick shall at each alternate course be carried into their respective walls so as to thoroughly unite the work with English bond. Care shall be taken that when a brick is left out to allow support for the scaffold pole on the wall face, such brick shall always be a header and that not more than one header for each pole shall be left out.

16. Scaffolding:

Proper scaffolding shall be provided whenever necessary having two sets of vertical supports and shall be subject to the approval of the Engineer in charge; who may order the contractor to alter or strengthen the scaffolding if he considers it necessary, without thus becoming responsible either for the safety of the work or workmen or for any additional payment. Holes shall be made good by bricks to match the face work when scaffolding is removed.

17. Curing:

All bricks work shall be keep well watered for 14 days after laying.

18. Reinforced Cement Concrete:

All R.C.C. work shall be of the grade M -15, M20, M 25 or as per IS 456: 2000 and as given in specifications. The materials will be measured when dry. The stone chips should be thoroughly washed in clean water and stacked. Vibrator will be used for all R.C.C and P.C.C work. The aggregate shall consist of stone ballast of quality approved by Engineer-in-charge and shall consist of graded size 20 mm and downwards as per PWD specification or the size mentioned in the item description. Cube (crushing) test of concrete will have to be carried out at the frequency as mentioned in relevant IS code of practice and record of such test will be preserved for future reference.

19. Laying:

Cement, sand and stone chips shall be mixed properly in a mechanical mixer in such a manner as to avoid loss of water. The concrete shall be mixed for minimum period of 2 minutes or until it is of even color and uniform consistency throughout. As soon as the concrete is mixed it should be removed to the work in iron vessels as rapidly as practicable. The concrete laid will be vibrated for compaction by vibrators. Slum test will be carried at site during execution of work.

20. Curing:

The concrete laid should not be disturbed and shall be kept damped by means of wet matting and sand until it shall have become thoroughly set and hard enough to prevent its drying and cracking.

21. Forms:

Contractor shall furnish on the site of work sufficient number of centering, forms, moulds or templates for its expeditious execution, the forms shall be made in such way and of such material as will ensure a very smooth surface on the finished concrete. Forms and

centering shall be left in place until the concrete has set sufficiently to permit the removal without danger to the structure.

22. Reinforcement:

Steel bars for reinforcing concrete shall be of such shape to afford an approved mechanical bond with concrete to ensure intimate control between steel and concrete. Steel reinforcement shall be either mild steel of tested quality confirming to IS-432-1996 or cold worked steel high strength deformed bars as per IS-1786-1979 in strength grade Fe-415 or hot rolled high yield strength steel deformed bars with minimum yield strength of 425 N/mm² as per IS – 1939 –1966 (Amended 1968) Reinforcement bars will be rejected if the actual weight vary more than 5% from the standard weight. All bars must conform to the requirement of Indian standard specification. They shall be protected at all time before placed in the concrete from mechanical injury and the weather and when placed in the work, they shall be free from dirt, scales, loose or scaly rust, paint and oil. Bars which are to be embodied in concrete but remain exposed for sometime after being placed in the work shall, if directed be immediately coated with a thin grout of equal part of cement and sand. Bars shall be bend to the shape shown on the drawings and in conforming to approved templates. When bars are cut and bent on the work site the contractor shall employ competent men and provide the necessary appliances for the purpose. All steel shall be rigidly held in place with 18 gauge annealed steel wire, cement mortar (1:2) cubes. M.S. chairs and spacer shall be used in order to ensure accurate positioning of reinforcement. All joints in steel reinforcement shall be overlapped. The length of overlap for tension and compression shall be as per the requirement of Indian standard specification. In water retaining structures a clear cover of 25 mm over steel should be provided.

23. Construction Joints

Construction joints shall be provided, where directed approved by the Engineer-in-charge. Such joints shall be kept in minimum and shall be right angles to the direction of main reinforcement. In case of column and walls the joint shall be horizontal and 8 to 15 cm below the bottom of the beam or slab running into the column or wall head or below the anchor reinforcement of beam and slab coming into the column and wall and the portion of the column or wall between the stopping level and the top of slab shall be concerted with the beam or slab.

24. Vertical Joints

At the end of any days work or run of concrete, the concrete should be finished off against temporary shutter stop, which should be vertical and securely fixed. This stop should be removed as early as weather permits.

25. Horizontal Joints:

Horizontal joints should be washed down two hours after a casting in the manner described above for vertical joints. If the concrete has been allowed to hard excessively, the surface shall be chipped over its whole surface to depth of at least 10 mm and there after thoroughly washed. Before fresh concrete is added on the other side of a

construction joints, the surface of the old concrete will be thoroughly wetted then covered with a thin layer of cement mortar (1:2). All the construction joints in all concrete structure having contact with water or soil shall be provided with approved PVC water stops on both side with hot asphalt or approved metallic strips.

26. Expansion joints:

Expansion joints shall be provided wherever directed by the engineer in charge, or where necessary as per standard specification and practice. The filler to be used shall be of approved material.

27. Cube test:

Cube test for RCC work shall be done as per the frequency based on volume of concrete casted in the work as specified in IS Code and CPWD specification in laboratories to be specified by the department and its compressive strength should be within the allowable limit. The cost of testing has to be born by the contractor. Test certificates of concrete cubes have to be attached along with each bill without which no payment will be made.

28. Cement Plaster:

12 mm thick cement plaster in (1:4) proportion shall be applied on outside surface of all concrete works from 30cm below ground level up to top. The surface in contact with water will have 12 mm thick cement plaster of not less than (1:3) proportion with 3% water proofing compound. The concrete surface shall be properly hacked, washed, cleaned and applied with thick cement slurry before applying. All brick work unless otherwise specified will be plastered externally and internally with 12mm cement plaster (1:6) proportion. The plaster shall be protected from sun, rain and frost at the contractor's expense by such means as the Engineer in charge may approve. To protect the plaster from the sun, ordinarily the whole surface shall be covered with wet sacks. The contractor shall keep the plaster continuously waited for a period of seven days after application.

29. Flooring

Except where in otherwise specified flooring will have minimum 15cm thick sand filling, one brick flat soling and 100mm thick PCC(1:2:4) in ground floor and 25mm thick patent stone flooring shall be provided over this base. In case flooring in raw water pump house 25mm patent stone flooring shall be provided directly over R.C.C. slab in strip placed in suitable manner to avoid construction cracks.

30. Door and Window:

All the doors and windows shall be of good quality well seasoned and well-dressed Sal wood with oxidized iron fittings. All windows shall be provided with M.S. grill of approved design. Rolling shutter of approved make with pusher and pull operated properly fabricated with M.S. lathers including all accessories and necessary fitting of approved quality as per PWD specification will be provided in the pump house. All the doors and windows shall be painted with two coats of enamel paints over a coat of primer. The

materials, the size, the shape and the fitting of doors and windows shall be approved by Engineer in Charge before put in position.

31. Roof and Roof treatment:

R.C.C. M. 15 grade roof slab of adequate thickness shall be provided unless specified. The roof shall be treated with 25 mm PCC.

32. Snowcem Wash/Plastic emulsion paint:

All the building shall have two coat of snowcem wash of approved shade over a coat of cement primer on outer surface and two coat plastic emulsion paint over inner surface including preparing the plastered surface smooth with sand paper, scaffolding, centering etc. all complete as per building specification.

33. Painting:

All steel or wood shall have two coats of synthetic enamel paint over a coat of primer as specified by the manufacturer of the paint. The make, shade and color of the paints shall have to be approved by the Engineer-in-charge before use.

34. Pipe Laying Works:

GI pipes will be laid as per the provision of relevant BIS specifications.

35. Testing

The line of pipes after laying and jointing shall be tested to a pressure at least doubles that of working pressure. Labour for testing the pipes at his own expense.

36. Painting:

All exposed surface of pipes, specials valves, Steel doors and windows, etc, shall have two coats of synthetic enamel paint of approved shade over a coat of red oxide primer etc all complete as per approval and direction of the Engineer-in-charge

37. Trial Run:

The trial run shall consist of a period of one months after completion of job.. The contractor shall provide the skilled plant- operator/pump operators, supervisors along with other service staffs for this duration of trial run after completion of the total work on Turnkey job basis. The contractor staffs shall train the staffs/persons nominated by the Engineer in charge during this period. The contractor shall run the plant during this period and shall maintain a logbook to ascertain the quality and quantity, and chemicals consumed etc. Any shortcomings in quality and quantity of septage shall be corrected by the contractor adopting proper correction measures and as per direction of Engineer in charge. No extra payment will be made for trial and run.

PART 3

GENERAL SPECIFICATIONS

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1. General

All materials shall be best of their kind and shall conform to the relevant latest Indian standard.

All materials shall be of approved quality as per samples and from origins approved by the Engineer in Charge. A set of specimen samples of all approved materials shall be kept in sealed container or otherwise at site, cost of which is to be borne by the contractor.

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Only 1st class kiln burnt bricks shall be used unless otherwise specified. They shall be of a uniform deep cherry color; thoroughly burnt, regular in shape with sharp and square areas and they must emit a clear ringing sound on being struck. They must be free from cracks, chips, flaws, stones or lumps of any kind and they shall not absorb water more than one seventh of their own weight after soaking them in water for 15 minutes. The bricks shall show no sign of efflorescence either dry or subsequent to soaking in water.

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The source from which sand is to be obtained shall be subject to the approval of Engineer-in-charge. The sand shall be clean, sharp and gritty to touch and be freed from soil and other impurities by washing. The sand shall be washed to such a degree that when a handful is mixed with clean water in a glass and allowed to stand for an hour the precipitate of mud over the sand shall not exceed 5%. The sand should conform to IS 382-1982 for fine and coarse aggregates from natural sources.

4. Coarse Sand

It is to be screened through a sieve of 64 meshes to the square inch so as to exclude large particles from the work. The fineness modulus shall not be less than 1.0

5. Fine sand

It is to be screened through a sieve of 64 meshes to the square inch so as to exclude large particles from the work. The fineness modulus shall not be less than 2.5

6. Stone chips

It shall be obtained from crushing trap quartzite or hard stones and from quarries approved by Engineer-in-charge. It shall be of approved quality and proper grade. It shall pass through $\frac{3}{4}$ "mesh and retained on $\frac{1}{4}$ "mesh. It shall be free from dirt, leaves, clay and any organic matter. The material conforming generally to IS 383-1983 for coarse and fine aggregate from natural sources or IS 515-1959 for natural and manufactured aggregates for use in mass concrete with latest revisions.

7. Cement

Ordinary or lowest heat Portland cement conforming I.S.S. 269 –1989 of A.C.C. / LAFARGE shall be used after due approval of the Engineer-in-charge. All cement shall be fresh when delivered. Cements of different types are not to be mixed with one another. Consignments shall be used in the order of delivery. Admixture if any shall be used only after approvals of Engineer in charge.

8. Reinforcement

Steel reinforcement shall be of mild steel of tested quality conforming to I.S.S. – 432 - 1966/ H.Y.S.D. bars conforming to ISS-1786/1779-of SAIL / TATA make.

All the reinforcement shall be clean and free from rust, mild scales, dust, paint, oil, grease, adhering soil or any other material or coating that may impair the bond between the concrete and the reinforcement, or cause corrosion of the reinforcement or disintegration of concrete. Neither the size nor length of bar or wire shall be less than the size or length described in the bar schedule or elsewhere and the length shall not be more than 50 mm in excess of the length as described.

Welded joints in reinforcement may be used but in cases of important connection, tests shall be made to prove that the joints are of the full strength of bars connected, welding of reinforcement shall be done in accordance with the recommendations of the relevant Indian standards for welding mild steel bars used in the reinforced concrete construction.

Bending and overlapping, placing in position, fabrication, binding, reinforcement with wire of approved gauge shall be done as per I.S. 432 – 1960 (revised) and I.S. 1786 – 1966 and I.S. 2502 (revised). Handling and storage of materials for concrete or RCC should be followed as per I.S. 4082 –1977.

9. Water

The water to be used in making and curing of concrete, mortar etc. shall be free from objectionable quantities of silts, organic matter, injurious amount of oils, acids, salts and other impurities etc. as per IS-456-1978. The Engineer-in-charge or his authorized representatives will determine whether or not such quantities of impurities are objectionable. Such comparison will usually be made by comparison of compressive strength, water requirement, time of setting and other properties of concrete made with

distilled or every clean water and concrete made with the water proposed for use, Permissible limit for solids when tested in accordance with I.S. 3025-1964. Shall be as tabulated below

1. Organic	Permissible limit for solids Maximum permissible limit. 200 mg/litre.
2. Inorganic	3000 mg/litre.
3. Sulphate (As SO ₄)	500 mg/litre.
4. Chloride (As Cl)	2000 mg/litre for P.C.C and 1000 mg/litre for R.C.C. work
5. Suspended matter	2000 mg/litre.

If any water to be used in concrete, suspected by the Engineer-in-charge/or his authorized representative of exceeding the permissible limits of solids, samples of water will be obtained and get it tested by Engineer-in-charge in accordance with IS- 3025-1964 at the cost of contractor

10. Cement Mortar

The mortar shall consist of cement and sand mixed in proportion defined in relevant schedule item for various item of work. Only measured quantity shall be used. The sand shall be shovelled in a wooden measure of a clean masonry platform, after removing the measure box and spreading out sand if necessary, the cement (in required proportion) shall be emptied on the top of sand. The sand and cement shall be then turned over with shovels once dry and made into the form of a hollow cone; into this water can be poured and the whole shall then be turned over completely twice. The color and consistency shall at this stage be quite uniform, if not, further turning shall be done. Water shall be added by measured quantities. Only such quantities of mortar shall be mixed at one time as can be used at once before it can set. No mortar, which has once caked or begun to set, shall be used, nor shall such mortar be remixed; but it shall be removed from the site of the work immediately.

11. Cement concrete

The concrete shall consist of an aggregate of the proportion by volume/ weight as defined in relevant schedule item or work. Only measured quantity shall be used. The aggregate shall consist of stone ballast of quality approved by Engineer-in-charge and shall consist of graded size 20 mm and down wards as per PWD specification or the size mentioned in the item description. The quality of cement concrete should conform to the specification mentioned in BOQ and standard and specification as laid down in different IS codes for concrete to be used for different component and for different design concrete.

12. Laying:

The cement, sand and stone chips shall be mixed properly in mechanical mixer in such a manner as to avoid loss of water. The concrete shall be mixed for minimum period of 2 minutes or until it is of even colour and uniform consistency throughout. As soon as the

concrete is mixed it should be removed to the work in iron vessels as rapidly as practicable. The concrete laid will be vibrated for compaction by the vibrators. Slum test will be carried at site during execution of work. Cube (crushing) test of concrete will have to be carried out at the frequency as mentioned in relevant IS code of practice and record of such test will be preserved for future reference.

13. Curing:

The concrete laid shall not be disturbed and shall be kept thoroughly damped by means of wet matting and sand until it shall have become thoroughly set and hard enough to prevent its drying and cracking.

14. Forms:

Contractor shall furnish on the site of work sufficient number of centering, moulds or templates for its expeditious execution. The forms shall be made in such a way and of such materials as will ensure a smooth surface on the finished concrete. Forms and centering shall be left in place until the concrete has set sufficiently to permit the removal without danger to the structure and as per direction of E/I.

15. Brick masonry work

Materials:

The brick works shall consist of bricks and mortar in accordance with general specification and plans.

Soaking bricks:

All bricks shall be soaked in clean water in tank for a period of at least twelve hour immediately before use. The contractor shall provide at his expense tanks of sufficient capacity to admit of the simultaneous immersion of bricks for the work its normal rate of progress.

Laying:

All the best shaped uniformly coloured bricks shall be picked out and used for face work without any extra payment to the contractor. All bricks work shall be constructed in English bond and shall follow the type bond junctions etc. All courses unless other wise specified or ordered by the Engineer in charge shall be truly horizontal and the walls shall be taken up truly plumb. Mortar joints shall never exceed 10 mm in thickness and this thickness shall be uniform throughout. Vertical joints in alternate courses shall not come directly over one another. The joints shall be raked out not less than 12mm deep when the mortar is green so as to provide proper key for the plaster or pointing to be done. Each face brick shall be set with both bed and vertical joints quite full of mortar. No damaged or broken brick shall be used in any part of the work except such as may be cut to size for closing the course. Closers shall be clean out to size as indicated in English bond and shall be situated near the end of walls. The masonry shall be carried up regularly and no step shall be allowed more than 60cm. Where the masonry of one part has to be delayed, the work must be raked back at an angle not exceeding 45 °

Angles and Junctions. At all angles forming the junction of walls, the brick shall at each alternate course be carried into their respective walls so as to thoroughly unite the work with English bond. Care shall be taken that when a brick is left out to allow support for the scaffold pole on the wall face, such brick shall always be a header and that not more than one header for each pole shall be left out.

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Proper scaffolding shall be provided whenever necessary having two sets of vertical supports and shall be subject to the approval of the Engineer in charge; who may order the contractor to alter or strengthen the scaffolding if he considers it necessary, without thus becoming responsible either for the safety of the work or workmen or for any additional payment. Holes shall be made good by bricks to match the face work when scaffolding is removed.

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Cement, sand and stone chips shall be mixed properly in a mechanical mixer in such a manner as to avoid loss of water. The concrete shall be mixed for minimum period of 2 minutes or until it is of even color and uniform consistency throughout. As soon as the concrete is mixed it should be removed to the work in iron vessels as rapidly as practicable. The concrete laid will be vibrated for compaction by vibrators. Slum test will be carried at site during execution of work.

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21. Forms:

Contractor shall furnish on the site of work sufficient number of centering, forms, moulds or templates for its expeditious execution, the forms shall be made in such way and of such material as will ensure a very smooth surface on the finished concrete. Forms and

centering shall be left in place until the concrete has set sufficiently to permit the removal without danger to the structure.

22. Reinforcement:

Steel bars for reinforcing concrete shall be of such shape to afford an approved mechanical bond with concrete to ensure intimate control between steel and concrete. Steel reinforcement shall be either mild steel of tested quality confirming to IS-432-1996 or cold worked steel high strength deformed bars as per IS-1786-1979 in strength grade Fe-415 or hot rolled high yield strength steel deformed bars with minimum yield strength of 425 N/mm² as per IS – 1939 –1966 (Amended 1968) Reinforcement bars will be rejected if the actual weight vary more than 5% from the standard weight. All bars must conform to the requirement of Indian standard specification. They shall be protected at all time before placed in the concrete from mechanical injury and the weather and when placed in the work, they shall be free from dirt, scales, loose or scaly rust, paint and oil. Bars which are to be embodied in concrete but remain exposed for sometime after being placed in the work shall, if directed be immediately coated with a thin grout of equal part of cement and sand. Bars shall be bend to the shape shown on the drawings and in conforming to approved templates. When bars are cut and bent on the work site the contractor shall employ competent men and provide the necessary appliances for the purpose. All steel shall be rigidly held in place with 18 gauge annealed steel wire, cement mortar (1:2) cubes. M.S. chairs and spacer shall be used in order to ensure accurate positioning of reinforcement. All joints in steel reinforcement shall be overlapped. The length of overlap for tension and compression shall be as per the requirement of Indian standard specification. In water retaining structures a clear cover of 25 mm over steel should be provided.

23. Construction Joints

Construction joints shall be provided, where directed approved by the Engineer-in-charge. Such joints shall be kept in minimum and shall be right angles to the direction of main reinforcement. In case of column and walls the joint shall be horizontal and 8 to 15 cm below the bottom of the beam or slab running into the column or wall head or below the anchor reinforcement of beam and slab coming into the column and wall and the portion of the column or wall between the stopping level and the top of slab shall be concerted with the beam or slab.

24. Vertical Joints

At the end of any days work or run of concrete, the concrete should be finished off against temporary shutter stop, which should be vertical and securely fixed. This stop should be removed as early as weather permits.

25. Horizontal Joints:

Horizontal joints should be washed down two hours after a casting in the manner described above for vertical joints. If the concrete has been allowed to hard excessively, the surface shall be chipped over its whole surface to depth of at least 10 mm and there after thoroughly washed. Before fresh concrete is added on the other side of a

construction joints, the surface of the old concrete will be thoroughly wetted then covered with a thin layer of cement mortar (1:2). All the construction joints in all concrete structure having contact with water or soil shall be provided with approved PVC water stops on both side with hot asphalt or approved metallic strips.

26. Expansion joints:

Expansion joints shall be provided wherever directed by the engineer in charge, or where necessary as per standard specification and practice. The filler to be used shall be of approved material.

27. Cube test:

Cube test for RCC work shall be done as per the frequency based on volume of concrete casted in the work as specified in IS Code and CPWD specification in laboratories to be specified by the department and its compressive strength should be within the allowable limit. The cost of testing has to be born by the contractor. Test certificates of concrete cubes have to be attached along with each bill without which no payment will be made.

28. Cement Plaster:

12 mm thick cement plaster in (1:4) proportion shall be applied on outside surface of all concrete works from 30cm below ground level up to top. The surface in contact with water will have 12 mm thick cement plaster of not less than (1:3) proportion with 3% water proofing compound. The concrete surface shall be properly hacked, washed, cleaned and applied with thick cement slurry before applying. All brick work unless otherwise specified will be plastered externally and internally with 12mm cement plaster (1:6) proportion. The plaster shall be protected from sun, rain and frost at the contractor's expense by such means as the Engineer in charge may approve. To protect the plaster from the sun, ordinarily the whole surface shall be covered with wet sacks. The contractor shall keep the plaster continuously waited for a period of seven days after application.

29. Flooring

Except where in otherwise specified flooring will have minimum 15cm thick sand filling, one brick flat soling and 100mm thick PCC(1:2:4) in ground floor and 25mm thick patent stone flooring shall be provided over this base. In case flooring in raw water pump house 25mm patent stone flooring shall be provided directly over R.C.C. slab in strip placed in suitable manner to avoid construction cracks.

30. Door and Window:

All the doors and windows shall be of good quality well seasoned and well-dressed Sal wood with oxidized iron fittings. All windows shall be provided with M.S. grill of approved design. Rolling shutter of approved make with pusher and pull operated properly fabricated with M.S. lathers including all accessories and necessary fitting of approved quality as per PWD specification will be provided in the pump house. All the doors and windows shall be painted with two coats of enamel paints over a coat of primer. The

materials, the size, the shape and the fitting of doors and windows shall be approved by Engineer in Charge before put in position.

31. Roof and Roof treatment:

R.C.C. M. 15 grade roof slab of adequate thickness shall be provided unless specified. The roof shall be treated with 25 mm PCC.

32. Snowcem Wash/Plastic emulsion paint:

All the building shall have two coat of snowcem wash of approved shade over a coat of cement primer on outer surface and two coat plastic emulsion paint over inner surface including preparing the plastered surface smooth with sand paper, scaffolding, centering etc. all complete as per building specification.

33. Painting:

All steel or wood shall have two coats of synthetic enamel paint over a coat of primer as specified by the manufacturer of the paint. The make, shade and color of the paints shall have to be approved by the Engineer-in-charge before use.

34. Pipe Laying Works:

GI pipes will be laid as per the provision of relevant BIS specifications.

35. Testing

The line of pipes after laying and jointing shall be tested to a pressure at least doubles that of working pressure. Labour for testing the pipes at his own expense.

36. Painting:

All exposed surface of pipes, specials valves, Steel doors and windows, etc, shall have two coats of synthetic enamel paint of approved shade over a coat of red oxide primer etc all complete as per approval and direction of the Engineer-in-charge

37. Trial Run:

The trial run shall consist of a period of one months after completion of job.. The contractor shall provide the skilled plant- operator/pump operators, supervisors along with other service staffs for this duration of trial run after completion of the total work on Turnkey job basis. The contractor staffs shall train the staffs/persons nominated by the Engineer in charge during this period. The contractor shall run the plant during this period and shall maintain a logbook to ascertain the quality and quantity, and chemicals consumed etc. Any shortcomings in quality and quantity of septage shall be corrected by the contractor adopting proper correction measures and as per direction of Engineer in charge. No extra payment will be made for trial and run.

PART 4

TECHNICAL SPECIFICATIONS FOR CIVIL WORKS

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1. GENERAL SPECIFICATIONS

Section 1.01 Contractor's Responsibility

The information given hereunder and provided elsewhere is given in good faith but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim whatsoever will be entertained on the plea that information supplied by the Engineers is erroneous or insufficient.

Section 1.02 Construction Water

The Contractor shall make his own arrangement for the fresh water required for the manufacturing of the pipes, construction of civil works and testing of pipeline as well as for the potable water required for his factory & labour camps.

Section 1.03 Construction Power

The Contractor shall make his own arrangement for supply of electrical energy required at his sites and the works from the local electricity board/Employer. The Contractor is forewarned that there can be interruptions in power supply for reasons beyond the control of the local Electricity Department and therefore, the Contractor is advised to make his standby arrangement to provide and maintain all essential power supply for his work area at his expense. The Contractor shall not be entitled to any compensation for any loss or damage to his machinery or any equipment or any consequential loss in progress of work and idle labour.

Section 1.04 Survey

The Contractor shall, at his own expense provide and maintain survey stations which he may be required to carry out the works and shall remove the same on completion of the works. The Contractor shall, at his own expense, carry out all the necessary surveys, measurements and setting out of the works and shall for this purpose engage qualified and competent engineering surveyors whose names and qualifications shall be submitted to the Engineer for his approval.

The Contractor shall for the purpose of checking the survey and setting out, provide to the Engineer all the assistance, which he may require. The surveyor shall be selected having appropriate experience and as far as possible, the same surveyor shall be provided throughout the contract period. Before commencing any work at any locations, the Contractor shall give the Engineer not less than two days' notice of his intention to set out or give levels for any part of the work in order that arrangements may be made for inspection. The Contractor shall provide for the sole use of the Engineer and his staff, all necessary survey instruments and other equipment and all technicians, labour and attendants which the Engineer may require for checking the setting out and marking of the works. The Contractor shall maintain in good working order at all time during the period of contract the instruments

provided by him, for the proper setting out of the works. The Contractor shall make available at his own expense, any poles, staging templates.

Section 1.05 Temporary Fencing

The Contractor shall, at his own expense, erect and maintain in good condition temporary fences and gates along the boundaries of the areas assigned, if any, to him by the Employer for the purpose of the execution of the works. The Contractor shall, except when authorized by the Engineer, confine his men, materials and plant within the site of which he is given possession. The Contractor shall not use any part of the site for purposes not connected with the works unless prior written consent of the Engineer has been obtained. Access shall be made to such areas only by way of approved gateways.

Section 1.06 Return of Labour and Plant

The Contractor shall supply to the Engineer by 10 a.m. every working day a return of the men employed by him and his sub-contractors on the previous working day and all of the work on which they were engaged specifying also the number employed in each trade. He shall also supply monthly any other returns which may be required as to the number of men and constructional plant employed and the nature and type of the work done.

Section 1.07 Sanitary Facilities

The Contractor shall provide and maintain in a clean and sanitary condition adequate W.Cs and wash places which may be required on the various parts of the site for use of his employees, to the satisfaction of the Engineer. The Contractor shall make all arrangements for the disposal of sewage or drainage in accordance with the directions of the Engineer. 8. Restricted Entry to Site The Contractor shall get the prior permission of the Engineer before any person not directly connected with the works to visit the site.

Section 1.08 Existing Services

Drains, pipes, cables, overhead electric wires and similar services encountered in the course of the works shall be guarded from injury by the Contractor at his own cost, so that they may continue in full and uninterrupted use to the satisfaction of the Employer and the Contractor shall not store materials or otherwise occupy any part of the site in a manner likely to hinder the operation of such services. Should any damage be done by the Contractor on any mains, pipes, cables or lines (whether above or below ground), whether or not shown on the drawings, the Contractor must make good or bear the cost of making good the same without delay to the satisfaction of the Engineer and of the Employer.

Section 1.09 Local Roads and Haul Roads

The approach roads and other public roads in the state may be used by the Contractor to haul construction materials and equipment subject to restriction of load carrying capacity on the roads in particular over bridges and culverts. However, the Contractor will have to pay

customary vehicles license and permit fees for use of public roads. The Contractor shall plan transportation of construction materials to site in such a way that road accidents are avoided.

Section 1.10 Permission for Road Cuts

Wherever the Contractor considers that it is necessary to cut through an existing road or track he shall submit details to the Engineer for approval, a minimum of seven days before such work commence. In the event of cutting a road by the Contractor without permission from the Engineer the Contractor shall pay compensation as claimed by the owner of the road until it is restored at the cost of the erring Contractor.

Trench Digging: Digging of trench by the Contractor beyond the length than that is specified by the Engineer shall invite penalty till such time the damage is restored.

Section 1.11 Permission for Road Cuts

Wherever the Contractor considers that it is necessary to cut through an existing road or track he shall submit details to the Engineer for approval, a minimum of seven days before such work commence. In the event of cutting a road by the Contractor without permission from the Engineer the Contractor shall pay compensation as claimed by the owner of the road until it is restored at the cost of the erring Contractor. Trench Digging: Digging of trench by the Contractor beyond the length than that is specified by the Engineer shall invite penalty till such time the damage is restored.

Section 1.12 Temporary Diversion of Roads

During the execution of the works the Contractor shall make at his cost all necessary provision for the temporary diversion of roads, cart-tracks, footpaths, drains, water courses, channels etc., Should he fail to do so, the same shall be done by the Engineer and the cost thereof will be recovered from the Contractor.

Section 1.13 Notice to Telephone, Railways & Electricity Supply under Takings / Depts., etc.

The Employer shall deposit an amount to the respective local bodies/Highways department for restoration of road surface after completion of pipe laying work. The Employer shall obtain general permission to cut the road. Before commencing operation, the Contractor has to obtain specific permission from local bodies/Highways Department when he wants to cut any section of the road. Where operations involve cutting of roads, shifting utilities etc. during the process of work, the Contractor shall also give notice to the concerned authorities viz. the panchayats /the Municipalities, the Railway department, the Electricity Board, Telegraphs department, the Traffic department attached to the police and other departments or companies as may be affected by the work. The notice should identify the specific details so that the necessary diversion of traffic may be arranged and permissions obtained. The Contractor shall co-operate with the department concerned and provide for necessary barricading of roads, protection to existing underground cables etc. met with during the excavation of trenches. The Contractor shall provide at his own expenses watching and

lighting arrangements during day and night and erect required notice board such as "Caution Road closed for Traffic" etc. He should also provide and maintain at his own cost the necessary supports for underground cables etc. to afford best protection to them in consultation with the authorities incharge of the properties and to their best satisfaction. The Contractor has to make necessary arrangements to get supply of electricity from local electricity department for operating the machinery and equipment. The Employer will pay the necessary service connection and S.D. charges. The Contractor should obtain all approvals for the installation and commissioning of machinery and accessories offered by them from the respective inspecting authorities, fees if any, to be paid to the inspecting authorities will be reimbursed by the Employer.

Section 1.14 Barricading

The pit / trench shall be barricaded on all four sides. The Contractor who has dug up the trench shall be responsible for any mishap, which may occur. Non-barricading of trenches by the Contractor shall be liable for a penalty.

Section 1.15 Length of Trench Open at One Time

The Pipe line shall be excavated in such length as may be ordered by the Engineer depending on the nature of the ground, the depth from the surface and the risk of damage to the adjoining property. The pipes shall not be covered until they may have been tested to the satisfaction of the Engineer. But in bad ground in close proximity to buildings or in other places where the Engineer shall consider necessary he may limit the length of trench so that there shall not be more than three pipes lengths from the refilled trench to the unbroken ground ahead.

Section 1.16 Watching and Lighting

The Contractor shall at his expense provide at the site of work sufficient lighting and watching and fencing by night and by day and shall in every respect conform to the police regulations in these matters and he shall free and relieve the Employer, should he neglect to do so, the same shall be provided by the Engineer and the cost thereof will be recovered from the Contractor.

Section 1.17 Filling in Holes and Trenches Etc.

The Contractor immediately upon completion of the Works shall fill up holes and trenches which may have been made or dug, level the mounds, or heaps or earth that may have been raised or made, and clear away all rubbish which may have become superfluous or have been occasioned or made in the execution of the works, and the Contractor shall bear and pay all costs, charges etc. Failure to carry out the work within two days will attract a penalty.

Section 1.18 Power to Vary Work

The Engineer reserves the power to vary, extend or diminish the quantities of Work, to alter the line, level, or position of any work to increase, change or decrease the size, quantity, description, character or kind of any Work, to order the Contractor to execute the Works or

any part thereof, by day or night Work, or to add or to take from the Work included in the contract as he may think proper without violating the contract and the Contractor shall not have any claim upon the Employer for any such variation, extension, diminution, alteration, increase, change or decrease other than for the Work actually done, calculated according to the prices tendered and accepted in this contract.

Section 1.19 Extra for Varied Work

If the Engineer uses the power reserved to him under Clause 18 above an order in writing signed by the Engineer, shall be given to the Contractor to that effect and any Work executed under such order shall be paid for at the rates set forth in the Schedule of Rates prevailing at the time of execution where such rates in the opinion of the Engineer apply. This shall apply to unforeseen items of work which are not found in the Price Bld. If the rates are not available in the Schedule of Prices, a rate or price shall be agreed upon between the Engineer and the Contractor in writing and failing their agreement the Contractor shall forthwith execute such order and the Engineer shall determine the rates or prices at which the work shall be paid off.

Section 1.20 Free Flow of traffic

While executing the work, as soon as possible, the Contractor should allow as much traffic as possible on the roads / streets, by refilling the trenches cut across. 21. Tools and Plants All tools and plants required for the work including sheet piles and timber for shoring and strutting, pump sets etc. shall be supplied by the Contractor at his own cost. The rate for the relevant items of work are inclusive of all such tools and plants and apparatus required for the execution of the work.

Section 1.21 Excess Materials

The Contractor shall be responsible for the procurement of required quantity of materials like pipes, specials, machinery, electrical items etc. Any materials procured for the work, if found excess due to any reasons after completion of the works, shall be taken back by the Contractor and the Employer / Engineer shall not be responsible for such excess materials. Amount paid if any for such excess materials shall be deducted from any bills payable to the Contractor.

Section 1.22 Commissioning of Works

The Contractor shall be responsible for successful commissioning of the scheme and maintenance period of one year.

Section 1.23 General

Before submitting the bids, the bidder should carefully go through all the bid documents, drawings and also inspect the place of work so as to get full and firsthand knowledge of the site conditions based on which he has to quote his rate.

1.23.1 Accidents

It shall be the duty of the Contractor to arrange for the execution of the works in such a manner as to avoid the possibility of the accidents to persons or damage to the properties at any stage of the progress of work. Nevertheless, he shall be held wholly responsible for any injury or damage to persons and properties, which may occur irrespective of any precautions he may take during the execution of the works. The Contractor shall make good all claims and loss arising out of such accidents and indemnify the Employer from all such claims and expenses on account thereof.

1.23.2. Flood Damages etc

The Contractor has to take risk insurance at his cost against losses due to unprecedented floods and other acts of God. No claim shall be entertained on this account and paid for.

1.23.3. Water and Lighting

The Contractor shall pay all fees and provide water and light as required from Municipal mains or other sources and shall pay all charges therefor (including storage tanks, meters etc.) for the use of the works and workmen, unless otherwise arranged and decided on by writing with Engineer. The water used for the works shall be free from earthy vegetable or organic matter and from salts or other substances likely to interfere with the setting of mortar or otherwise prove harmful to the work and conform to relevant standards.

1.23.4. Rates

The Contractor shall particularly note that the accepted rates of the various items shall be inclusive of all incidental charges such as baling by manual labour, dewatering, shoring etc. if found necessary during the execution and no extra shall be due therefore on any account during the currency of the contract, unless stated otherwise. 24.5. Royalty Charges The Royalty will be charged for the materials obtained from P.W. Department, or other Government quarries. Assistance as necessary will be given to the Contractor by the Engineer. No plot rent shall be charged for materials stacked on Employer's lands during the course of construction provided all such materials are removed within one month after the work is completed. Royalty or charges due in the case of private quarries and private bodies shall be paid by the Contractor.

1.23.5. Payment to Labour

The Contractor should note that in the event of emergency, he shall pay all Labourers every day and if this is not done, the Employer shall make requisite payment and recover the cost from the Contractor. The Contractor shall not employ any laborer below the age of 15 years.

1.23.6. Night Works

If night work is required to fulfill the agreed rate of progress and to complete the work within the period stipulated, prior written approval is necessary and all arrangement shall be made by the Contractor including lighting without any claim for extra rate.

1.23.7. Errors, Omissions and Discrepancies

In the case of errors, omissions, and/or disagreement between the written and the scaled dimensions on the drawings or between the drawings and the specifications, the following order of precedence shall apply;

- i) In case of discrepancies in dimensions of any item of work as described between the descriptive specifications and detailed working drawings, the dimensions given in the detailed working drawings shall apply.
- ii) In case of discrepancies in description of scope of work between what is indicated in the item of work given in Price Bid and the corresponding detailed technical specifications, the latter shall apply
- iii) Figured dimensions shall supersede scaled dimensions. The drawings on a large scale shall take precedence over those on a smaller scale.
- iv) Drawing issued as construction drawings from time to time shall supersede the corresponding drawings previously issued.

1.23.8. Equivalence of Standards and Codes

Whenever reference is made in the contract to the respective standards and codes in accordance with which plant, equipment or materials are to be furnished and work is to be performed or tested the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly set forth in the contract.

Where such standards and codes are national in character, or relate to a particular country or region, other authoritative standards which ensure equal or higher quality than the standards and codes specified will be accepted subject to the prior review and written approval by the Engineer. Difference between the standards specified and the proposed authoritative standards must be fully described in writing by the Contractor and submitted to the Engineer well in advance for approval. If on the prior review, the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards set forth in the contract document.

1.23.9. Bidder to satisfy Himself

It will be the Contractor's responsibility to satisfy himself from the inspection of the site that sufficient quantities of construction materials required for the works exist in the designated borrow areas and quarry sites. Failure by the Contractor to have done all the things, which in accordance with this condition he is deemed to have done shall not relieve him of the responsibility for satisfactorily completing the work as required.

1.23.10. Employment of Scarcity Labour

If State Government declares a state of scarcity or famine to exist within 16 kMs of the project site, the Contractor shall be required to employ in his works for which he will need unskilled labour and to the extent his works can accommodate any person or persons certified to him

by the Engineer to be in need of relief and the Contractor shall pay to such persons wages not below the minimum wage which the Government may fix in this behalf from time to time.

1.23.11. Workman Compensation Act

All labourers and other employees of the Contractor should be covered by a suitable accident insurance policy to cover liabilities under the Workman's Compensation Act.

1.23.12. Electricity Tariff

The unit rates and prices quoted by the Bidder in the Price Bid shall include the cost of electric energy required for works at the rates fixed by Local Electricity Department or Employer.

Section 1.24 Design and Drawings Submissions

Complete detailed engineering design calculations (including hydraulic, physical, chemical and biological calculation) with general arrangement drawings, hydraulic flow diagram, piping and instrumentation diagram and explanatory sketches shall be submitted by the Contractor to the Engineer as a part of **Basic Engineering Package (BEP)** within stipulated time frame for approval from Employer.

Later, on approval of BEP, design calculations for structures, mechanical and electrical and instrumentation components along with the drawings, P&I diagrams is to be submitted to Employer. Separate design and drawings submitted independent of each other shall be deemed to be incomplete and will not be accepted by the Engineer.

Submissions of detailed design calculations and Good for Construction drawings shall include the following as a minimum:

A. Detailed Design Calculations

1. One (1) Copy of a Compact Disc (CD) containing electronic files relevant to the structure's modelling, analysis and design calculations (Microsoft Excel, Staad Pro, etc.). Files submitted shall be in editable format.
2. Print copy (6 Copies) of the contents as submitted in the Compact Disc.

B. Good for Construction Drawings

1. One (1) Copy of a Compact Disc (CD) containing AutoCAD files (Civil General Arrangement, Structural Dimensions and Reinforcement Details) pertaining to the structure. Files submitted shall be in editable format.

2. Print copy (6 Copies) of the contents as submitted in the Compact Disc. Prints to be submitted on A1 Size Sheet as a minimum or A0 Size Sheet when required by the Employer.
3. Bar-bending schedule indicating the number, shape and size of the rebars shall be submitted as part of the Reinforcement Details
4. Detailed drawing showing the location, number and depth of inserts shall be included for any structural steel inserts/Metal inserts in the structure such as rungs, bolted connections for ladders/railings, etc.
5. Location of Construction Joints and pour sequence shall be included on the drawing for base slabs, walls and top slabs.
6. Revised drawings shall be submitted by clouding at the location with the latest revision number and also show the history of revisions in a table format just above the title block.

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. The Contractor shall also take care to check the stability of partly completed structures.

Contractor shall also prepare "As-Built" Drawings of the works covering all the components and submit to Employer for records. Hard and Electronic version of the As Built Drawing drawings shall be submitted in order as for "Good for Construction Drawing".

Section 1.25 Design Standards

All the designs shall be based on the latest Bureau of Indian Standard (BIS) Specifications or Codes of Practice. The design standards adopted shall follow the best engineering practice. In case of any variation or contradiction between the provisions of the BIS Standards or Codes and the specifications given along with the tender document, the provision given in this Specification shall be followed.

All reinforced concrete structural design shall generally conform to the following publications of the Indian Standards Institution:

- (i) I.S. 456 : Code of Practice for plain and reinforced concrete
- (ii) I.S. 875 : Code of Practice for design loads for buildings and structures (Part I to V)
- (iii) I.S. 3370 : Code of Practice for concrete structures for the storage of liquids (Part I to IV)

- (iv) I.S. 1893 : Criteria for earthquake resistant design of structures (Part-1)
- (v) I.S. 2974 : Code of Practice for design and construction of machine foundations (Part 1 to 4)
- (vi) I.S. 4326 : Code of Practice for Earthquake Resistant Design and Construction of Buildings
- (vii) I.S. 13920 : Ductile Detailing of Reinforced Concrete Structures subjected to Seismic forces- Code of Practice
- (viii) IRC: 6 : Standard specification and Code of Practice for road bridges Loads and Stresses
- (ix) IRC: 21 : Standard specification and code of practice for road bridge, section III Cement Concrete
- (x) IRC 78 : Standard specification and code of practice for road and bridge, section VII Foundation & Sub-Structures

All structural steel design shall generally conform to the following publications of the Indian Standards Institution:

- (i) I.S. 800 : Code of Practice for general construction in steel
- (ii) I.S. 806 : Code of Practice for use of steel tubes in general building construction

1.25.1. Design Life

The design life of all structures and buildings shall be 60 years.

1.25.2 .Design Loadings

All buildings and structures shall be designed to resist the worst combination of the following loads/stresses under test and working conditions; these include dead load, live load, wind load, seismic load, stresses due to temperature changes, shrinkage and creep in materials, and dynamic loads:

1.25.3. 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 all fixtures and attached piping shall be included, but excluding contents, shall be considered.

The following minimum loads shall be considered in design of structures:

(i)	Weight of water	:	9.81 kN/m ³
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(ii)	Weight of soil (irrespective of strata available at site and type of soil used for filling etc). However, for checking stability against uplift, actual weight of soil as determined by field test shall be considered	:	20.00 kN/m ³
(iii)	Weight of concrete	:	24.00 kN/m ³
(iv)	Weight of reinforced concrete	:	25.00 kN/m ³
(v)	Weight of brickwork (exclusive of plaster)	:	22.00 N/m ² per mm thickness of brickwork
(vi)	Weight of plaster to masonry surface	:	18.00 N/m ² per mm thickness
(vii)	Weight of granolithic terrazzo finish or rendering screed, etc.	:	24.00 N/m ² per mm thickness
(viii)	Weight of MS chequered plates	:	78.5 N/m ² per mm thickness of plates

1.25.4. Live Load

Live Load (LL) shall include the superimposed loads due to the use/occupancy of the structure/building not including dead, wind or earthquake load. Live loads shall be in general as per I.S. 875 Part (II). However, the following minimum loads shall be considered in the design of structures:

- | | | | |
|-------|--|---|-------------------------|
| (i) | Live load on roofs | : | 1.50 kN/m ² |
| (ii) | Live load on floors supporting
Equipment such as pumps, valves etc. | : | 10.00 kN/m ² |
| (iii) | Live load on all other floors,
walkways, stairways and platforms | : | 5.00 kN/m ² |

In the absence of any suitable provisions for live loads in BIS Codes or as given above for any particular type of floor or structure, assumptions made must receive the approval of the Engineer prior to starting 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/construction shall be considered and shall be partial or full whichever causes the most critical condition.

1.25.5. Wind Load

Wind loads shall be as per I.S. 875 Part (III).

1.25.6. Earthquake Load

This shall be computed as per I.S. 1893.

1.25.7. Dynamic Load

Dynamic loads due to working of plant items such as pumps, blowers, compressors, switch gears, travelling cranes, etc. shall be considered in the design of structures.

1.25.8. Wheel Load

For any structure or pipeline below the roads, Class A loading of IRC 6 shall be taken.

1.25.9. Joints

Movement joints such as expansion joints, complete contraction joints, partial contraction joints and sliding joints shall be designed to suit the structure. However, contraction joints shall be provided at specified locations spaced not more than 7.5 m in both right angle directions for walls and rafts.

Expansion joints of suitable gap at suitable intervals not more than 30 m shall be provided in walls, floors and roof slabs of liquid retaining structures.

Construction joints shall be provided at right angles to the general direction of the member. The locations of construction joints shall be decided on convenience of construction. To avoid segregation of concrete in walls, horizontal construction joints are normally to be provided at every 2 m height. PVC water-stops of 150 mm width shall be used for walls and 230 mm width for base slabs.

Section 1.26 Design Conditions for Underground or Partly Underground Liquid Retaining Structures

All underground or partly underground liquid containing structures shall be designed for the following conditions:

- (i) Liquid depth up to full height of wall: no relief due to soil pressure from outside to be considered;
- (ii) Structure empty (i.e., empty of liquid, any material, etc.): full earth pressure, Outside water pressure if any and surcharge pressure wherever applicable , to be considered;
- (iii) Partition wall between dry sump and wet sump : to be designed for full liquid depth up to full height of wall;
- (iv) Partition wall between two compartments : to be designed as one compartment empty and other full;

- (v) Structures shall be designed for uplift in empty conditions with the water table as indicated in geotechnical report;
- (vi) Walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilization and dynamic water loads;
- (vii) 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 from below to base slab. A minimum factor of 1.2 shall be ensured against uplift or floatation.
- (viii) All the liquid retaining structures shall be designed for maximum design crack widths of 0.1mm for direct tension and flexure.

Section 1.27 Foundations

- (i) The minimum depth of foundations for all structures, equipments, buildings and frame foundations and load bearing walls shall be as per IS 1904 but in any case this shall not be less than 1.0 meter in the original soil.
- (ii) Safe bearing capacity of soil strata shall be taken as determined by the Contractor through his own independent investigations.
- (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 the Employer.
- (iv) Special attention is drawn to danger of uplift being caused by the ground water table. All underground structural slabs shall be designed for uplift forces due to ground water pressure.

Section 1.28 Design Requirements

The following are the design requirements for all reinforced or plain concrete structures:

- a) All blinding and levelling concrete shall be a minimum 150 mm thick in concrete grade M15.
- b) All liquid retaining reinforced concrete structures, concrete shall be of a minimum M30 grade with a maximum 40 mm aggregate size for footings and base slabs and with a maximum 20 mm aggregate size for all other structural member. All other structures, reinforced concrete shall be of a minimum M25 grade with a maximum 40 mm aggregate

size for footings and base slabs and with a maximum 20 mm aggregate size for all other structural member.

- c) The reinforced concrete for all structures shall have a minimum cement content of 375 kg/m³ with a maximum 20 mm size aggregate and 350 kg/m³ with a maximum 40 mm size aggregate. Reinforced concrete shall have maximum slump of 100mm with maximum water cement ratio of 0.48.
- d) As a design consideration to control crack, though general requirements of IS 3370 shall be followed, All liquid retaining structures shall be designed based on the serviceability crack width limit state (i.e. 0.1 mm crack width) and other limits including the ultimate limit states.
- e) The minimum cover to the main reinforcing bars for different members for non-liquid retaining structures shall be as follows unless stated otherwise:

Slab (Floor, Roof, Canopy, and Staircase)	30 mm
Beams (Sides, Bottom & Top)	40 mm
Columns	50 mm
Pedestals (in contact with earth)	50 mm
Basement wall, retaining walls	
i) Face in contact with earth	40 mm
ii) Interior face	30 mm
Foundations	50 mm

NOTE: The minimum clear cover to all reinforcement including stirrups and links shall be 50 mm for all liquid retaining structures.

- f) In general, reinforcement for buildings and septage treatment units shall be HYSD-CRS (Corrosion Resistant Steel) of Grade Fe 500. All physical and chemical properties of this Fe 500 grade steel shall conform to IS: 1786-2008. Welded wire fabric shall conform to IS: 1566 as shown or specified on the drawing. The CRS (corrosion resistant steel) index shall be at least 1.35 when tested for Salt Spray test as per "ASTM B 117 – 2009 test procedure for 120 hours when compared with the Fe 500 normal reinforcement bars and with same bar diameter. All test results (including physical and chemical properties and salt spray tests) have to be produced for the respective bar diameter for each consignment of steel delivered at site and at a frequency of every 20 Metric Tons.
- g) Reinforcement produced using iron ore as the raw material only will be accepted. Reinforcement produced from scrap metal will not be accepted.
- h) The amount of reinforcement in each of the two directions at right angles within each surface zone should not be less than 0.35% of the surface zone cross section (As per

cl. 2.6.2.3 of BS: 8007-1987). For slabs, minimum of 10 mm dia bars shall be used to avoid any deformation of lesser diameter bars under loads prior to construction.

- i) All buildings shall have a minimum 1 meter wide, 100 mm thick plinth protection paving in M15 grade concrete or stone slabs/tiles. All plinth protection shall be supported on well compacted strata.
- j) All pipes and ducts laid below the structural plinth and road works shall be surrounded with concrete of grade M15 having minimum 150 mm thick concrete or D/4 (D = outer dia. of pipe) thickness whichever is more.
- k) Use of pressure relief valves to reduce uplift pressure due to ground water table shall not be allowed.
- l) Detailing of the reinforcement shall be done as per latest IS-13920 considering Earthquake Seismic Zone-IV.
- m) Sliding layer or slip layer shall be provided between sub base and structural slab (Raft). Polythene sheets of 500 gauge shall be provided as sliding layer as per IS specification.
- n) Water tightness testing of water retaining structures shall be done in accordance with IS: 3370, Part I. It is described in **Clause 1.22**. The depth of water for testing shall be up to the soffit of the covering slab.

The following minimum thicknesses shall be used for different reinforced concrete members, irrespective of design thicknesses:

- | | | |
|--|---|--------|
| (i) Walls for liquid retaining structures | : | 250 mm |
| (ii) Roof slabs for liquid retaining structures | : | 200 mm |
| (Other than flat slabs) | | |
| (iii) Bottom slabs for liquid retaining structures | : | 250 mm |
| (iv) Floor slabs including roof slabs, walkways,
Canopy slabs | : | 125 mm |
| (v) Walls of cables / pipe trenches,
Underground pits etc. | : | 200 mm |
| (vi) Column footings | : | 300 mm |
| (vii) Parapets, chajja | : | 100 mm |
| (viii) Precast trench cover | : | 75 mm |

(ix) Column Dimensions : 300 mm

Section 1.29 General Arrangement of Septage Treatment Plant

The following general guidelines shall be followed in the preparation of general arrangement of Plant:

- Sufficient room shall be allowed between items of plant and adjacent Plant or fixed structures to permit safe and convenient access for operation and maintenance;
- An area adjacent to all mechanical Plant shall be provided as maintenance lay down area;
- fixed runways, lifting eyes or other means shall be provided to permit the removal of Plant that may be required to be removed during the course of its normal operational life for maintenance or any other purpose;
- areas where leakage is likely to occur whether in normal use or during maintenance shall be provided with covered drainage channels which shall direct spillage either to a suitable plant drain or to a sump from where it can be pumped to plant drain;

Section 1.30 Orientation

The works shall be laid out within the confines of the Site in order to interface to the existing infrastructure of roadways and inlet and outlet pipe work. Underground services requiring to be relocated in order to accommodate the proposed site layout shall, with the approval of the Engineer, be relocated by the Contractor.

2. MATERIALS IN GENERAL

The term "materials" shall mean all materials, goods and articles of every kind whether raw, processed or manufactured and equipment and plant 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.

As soon as practicable after receiving the order to commence the Works, the Contractor shall inform the Engineer of the names of the suppliers from whom he proposes to obtain any materials but he shall not place any order without the approval of the Engineer which may be withheld until samples have been submitted and satisfactorily tested. The Contractor shall thereafter keep the Engineer informed of orders for and delivery dates of all materials.

Materials shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination failing which such damaged materials will be rejected and shall not be used on any part of the Works under this contract.

Section 2.1 Samples and Tests of Materials

The Contractor shall submit samples of such materials as may be required by the Engineer and shall carry out the specified tests directed by the Engineer at the Site, at the supplier's premises or at a laboratory approved by the Engineer.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Engineer.

The Contractor shall give the Engineer seven days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the supplier's premises or at a laboratory approved by the Engineer. The Engineer shall attend the test at the appointed place within seven days of the said date on which the materials are expected to be ready for testing or inspection according to the Contractor, failing which the test may proceed in his absence unless instructed by the Engineer to carry out such a test on a mutually agreed date in his presence. The Contractor shall in any case submit to Engineer within seven days of every test such number of certified copies (not exceeding six) of the test results as the Engineer may require.

Approval by the Engineer as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Engineer's powers under the Contract.

The provisions of this clause shall also apply to materials supplied under any nominated sub-contract.

Section 2.2 Material

All materials required for the works shall be procured and supplied by the contractor himself. The materials shall be of good quality and conforming to relevant BIS mentioned in following sections. The materials which are classified for ISI marking should be supplied with ISI marking only.

2.2.1. Cement and Reinforcement:

- (a) The entire quantity of cement and steel required for the work will be procured by the contractor. The contractor is responsible for all transport and storage of the materials and shall bear all related cost. The Employer shall be entitled at any reasonable time to examine the cement and steel supplied by the contractor.

- (b) The cement procured by the contractor shall comply with the requirements of IS 269/ 1976 with the latest revision thereof for ordinary Portland cement and IS 8112/ 1989 with the latest revision thereof for 43 grade ordinary Portland cement. **The Sulphate Resisting Portland Cement procured by the contractor shall comply with the requirements of IS 12330 with the latest revision.** It shall be of the best normal setting quality unless special rapid hardening or quick setting quality if expressly instructed by the Engineer to be supplied. Each bag shall bear ISI Certification mark.
- (c) The steel bars shall comply with the requirements set forth in the IS 432 Part I, IS 1139, IS 1786 as the case may be with the latest revision thereof and the test as described for ultimate tensile strength, bond test and elongation tests. All reinforcing steel shall be clean and free from oil, grease, loose scales or rust or other coatings of any character which would reduce or destroy the bend. Each bundle containing the bars shall bear the ISI Certification mark.
- (d) The cement / steel shall be tested in nearby laboratories of Government / Polytechnic or Engineering College by the Employer. Two samples should be taken by the Engineer in charge in the presence of the contractor or his authorized representatives or the technical personnel employed by the contractor as in the agreement. The contractor shall without extra cost provide samples and cooperate in the testing of the cement/ steel. One sample shall be got tested and the other sample shall be retained by making clear identification in the sample by the Engineer in charge so as to identify at a later date. The cost of such test shall be borne by the contractor.
- (e) All cement shall be procured in bags and shall be stored in a dry place for which the contractor shall be responsible. Consignment of bagged cement shall be properly stacked in a manner which will permit easy access for inspection and definite identification. Cement shall be used in approximately in the chronological order in which it is received, but cement that has been stored for a period longer than 4 months from the date of initial sampling shall not be used unless it has been retested at the expenses of the contractor and passed by the Engineer in charge as good quality on the retest. Cement aged more than 180 days from the date of initial sampling shall be rejected.
- (f) Cement which has become caked or perished shall on no account be used on the works and shall be rejected. Although the Engineer may have passed any consignment, he shall however have the power at the subsequent time to reject such consignment if he finds that any deterioration in the quality thereon has taken place.
- (g) A record of the quantity of cement/ steel procured with the name of dealer, bill number and date shall be maintained by the contractor. This should be produced for examination by the Engineer in charge at any time. The age of the cement shall be reckoned from the date of manufacture and it shall be verified by the Engineer in charge.
- (h) The rejected consignment of cement and steel should be removed from the site within two days.

2.2.2. Bricks:

- (a) Manufacture: Common burnt clay building bricks shall conform to the requirements of IS 1077 and shall be of quality not less than class 50 with moisture absorption rate not exceeding 15% as defined in IS : 1077. The bricks shall be chamber burnt and shall not be damaged in any manner and sizes shall conform to the works sizes specified with tolerates as given in 6.2 of IS: 1077.
- (b) Samples: The Contractor shall deliver samples of each type of brick to the Engineer, and no orders shall be placed without the written approval of the Engineer. All the bricks used in the works shall be of the same standard as the approved samples. The samples shall be preserved on site, and subsequent deliveries shall be checked for uniformity of shape, colour and texture against the samples. If in the opinion of the Engineer any deliveries vary from the standard of the samples, such bricks shall be rejected and removed from the site.
- (c) Uniformity: The bricks selected for exposed pointed brickwork walls shall be of uniform colour, deep cherry red or copper colour and uniform texture. Only such bricks as are permitted by the Engineer shall be used.
- (d) Testing: Samples of the bricks shall be tested in accordance with IS: 3495 by the Contractor for compliance with the aforesaid, before any order is placed, and soon after receipt of a consignment. Tests shall be carried out as and when required by the Engineer on samples selected by the Engineer's representative.
- a. Laying: Brickwork shall be uniformly bedded bricks being laid upwards. Each brick shall be floated and rubbed in upon such sufficient quantity of mortar that the mortar is squeezed up into the joints, but if such joints are not filled with mortar by this process they shall be flushed up with the mortar from the next succeeding bed. The courses shall be laid truly and strictly to line and horizontal level.
- b. Bond: Brickwork courses shall be alternately laid in stretcher bond and header bond. Damaged bricks shall not be used. The greatest care shall be taken to prevent mortar dropping on to or in any other way disfiguring or discoloring the bricks, and all edges and sides shall be kept strictly plumb and square, in-line, and flush with the required finished face. As the work proceeds, it shall be continuously checked with a 2 m long straight edge and spirit level.
- c. Construction: Walls shall be carried up in a uniform manner and no one portion raised more than 1 m above another at any one time, the open end being racked out. Over-hang work shall in no case be permitted. Brickwork shall be cleaned down after each days work and newly laid brickwork shall be protected by suitable means.
- d. Dry Weather: In dry weather the suction rate of clay bricks shall be adjusted by wetting as necessary before use. Bricks shall be stored in a free draining area and protected from rain.
- (e) Lintels: Where brickwork rests upon lintels or supporting ribs of concrete, the bricks shall be cut as necessary and carefully bedded so that proper support to the outer leaf of brickwork is obtained.

- (f) Pointing: At the time of laying, all joint of exposed brickwork shall normally be raked out neatly and pointed to 15mm depth.
- (g) Approval: All workmanship shall be strictly in accordance with the foregoing. The Engineer or the Engineer's representative reserves the right to reject any of the work on grounds of shabby workmanship. Such rejected work shall be removed and rebuilt to the Engineer's satisfaction. Quantity of Mortar: Quantity of mortar to be used in one Cum. of masonry shall vary from 0.30 Cum. for thin masonry to 0.32 Cum. for massive masonry of conventional bricks (second class). Cement Mortar: The cement mortar to be used on the work should be generally conforming to specification contained in the PWD A/R. Only sufficient mortar shall be mixed as required for immediate use. Partly set mortar shall not be used.

2.2.3. Aggregates:

- (a) Sand for use in masonry and plaster works shall conform to relevant specification in I.S.2116/ 1985, I.S.1542/ 1977.
- (b) The coarse and fine aggregates for concrete shall conform to I.S.383/ 1970 and as specified in the relevant clauses of I.S.456/ 1978. Other aggregates free from deleterious materials shall be used at the concurrence and approval of the Engineer after sufficient tests have been carried out at the contractor's cost.
- (c) The maximum quantities of deleterious materials in the aggregates, as determined in accordance with I.S.2386 (Part II)/ 1963 shall not exceed the limits given in table I of I.S.383. Unless otherwise specified all coarse aggregate in RCC shall be graded aggregate of 20mm nominal size. All aggregates shall be stored in hard impervious surface to ensure exclusion of all foreign materials and as per IS 4082/ 1977.
- (d) Aggregate having a specific gravity below 2.6 (saturated surface dry basis) shall not be used without the special permission of the Engineer.

2.2.4. Water required for Construction:

The water used in the construction shall be of potable quality and shall be tested at the contractor's cost. The contractor has to make his own arrangements at his cost for water required for construction, testing, filling, etc., either from local bodies or from elsewhere, by paying the charges directly and arranging tanker etc., as per necessity. No claim for extra payment on account of non-availability of water nearby or extra lead for bringing water shall be entertained. All required piping arrangements and pumping if required for water shall be made by the contractor at his cost. Water for mortar, mixing and curing of concrete shall be free from harmful matter or other substances that may be deleterious to concrete or steel and taken from a source approved by the Engineer. Ground water for mixing and curing shall conform to the provisions in the class 4.3 of IS 456/ 2000.

2.2.5. Admixtures:

Only where a beneficial effect is produced shall any admixture be used and that too after test has been carried out to convince the Engineer that no harmful effect will be produced by the use of such admixture and after approval by the Engineer. The admixture shall conform to IS 9103/ 1972

2.2.6. Form Work and Centering

Steel/ wooden form centering shall be used. If wooden form work is used, it shall consist of planks not less than 40mm thick and strong props. This shall be provided complying with clause 10 of IS 456/ 2000. The timber for form works shall be best hard wood and got approved by the Engineer in charge. This shall be deemed to be included in the items of contract even otherwise specified.

2.2.7. Separator (Cover Block)

For bottom cover of beams, slabs etc., separators of pre cast cement mortar blocks of suitable size with wire embedment as directed shall be used and tied to the reinforcement. Between layers of reinforcements, separators consisting of pieces of bars of suitable diameter shall be used. The required cover shall be provided as per clause 24-4 of IS 456/ 2000.

Section 2.3 Standards

Materials and workmanship shall comply with the relevant Indian Standards (with amendments) current on the date of submission of the tender.

Where the relevant standard provides for the furnishing of a certificate to the Engineer, at his request, stating that the materials supplied comply in all respects with the standard, the Contractor shall obtain the certificate and forward it to the Engineer.

The specifications, standards and codes listed below are considered to be part of this specification. All standards, specifications, codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between the Specification and the Standards referred to herein, the Specification shall govern

2.3.1 Materials

- IS: 269 - Specification for 33 grade ordinary Portland cement
- IS: 383 - Specification for coarse and fine aggregates from natural sources for concrete
- IS: 428 - Specification for distemper, oil emulsion, colour as required
- IS: 432 - Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (Parts 1 & 2)
- IS: 455 - Specification for Portland slag cement

- IS: 458 - Specification for precast concrete pipes (with and without reinforcement)
- IS: 650 - Specification for standard sand for testing of cement
- IS: 651 - Specification for salt glazed stoneware pipes and fittings
- IS: 808 - Specification for dimensions for hot rolled steel beam, column channel and angle sections
- IS: 814 - Specification for covered electrodes for manual metal arc welding of Carbon and Carbon Manganese steel
- IS: 1003 - Specification for timber panelled and glazed shutters (Parts 1 & 2)
- IS: 1038 - Specification for steel doors, windows and ventilators
- IS: 1077 - Specification for common burnt clay building bricks
- IS: 1398 - Specification for packing paper, water proof, bitumen laminated
- IS: 1489 - Specification for Portland pozzolana cement (Parts 1 & 2)
- IS: 1566 - Specification for hard drawn steel wire fabric for concrete reinforcement
- IS: 1580 - Specification for bituminous compounds for water proofing and caulking purposes
- IS: 1786 - Specification for high strength deformed steel bars and wires for concrete reinforcement
- IS: 1852 - Specification for rolling and cutting tolerances for hot rolled steel products
- IS: 1948 - Specification for aluminium doors, windows and ventilators
- IS: 1977 - Specification for structural steel (ordinary quality)
- IS: 2062 - Specification for steel for general structural purposes
- IS: 2185 - Specification for concrete masonry units (Parts 1 & 2)
- IS: 2202 - Specification for wooden flush door shutters (Parts 1 & 2)
- IS: 2645 - Specification for integral cement water proofing compounds
- IS: 2750 - Specification for steel scaffoldings
- IS: 2835 - Specification for flat transparent sheet glass
- IS: 3384 - Specification for bitumen primer for use in waterproofing and damp proofing
- IS: 3502 - Specification for steel chequered plates
- IS: 4021 - Specification for timber door, window and ventilator frames
- IS: 4350 - Specification for concrete porous pipes for under drainage
- IS: 4351 - Specification for steel door frames
- IS: 4990 - Specification for plywood for concrete shuttering work
- IS: 8112 - Specification for 43 grade ordinary Portland cement
- IS: 9862 - Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and chlorine resisting
- IS: 10262 - Recommended guidelines for concrete mix design
- IS: 12269 - Specification for 53 grade ordinary Portland cement
- IS: 12330 - Specification for sulphate resisting Portland cement

IS: 12709 - Glass fibre reinforced plastics (GRP) pipes, joints and fittings for use for potable water supply

2.3.2 Tests

- IS: 516 - Method of test for strength of concrete
- IS: 1182 - Recommended practice for radiographic examination of fusion - welded butt joints in steel plates
- IS: 1199 - Methods of sampling and analysis of concrete
- IS: 2386 - Methods of test for aggregates for concrete (Parts 1 to 8)
- IS: 2720 - Methods of test for soils (Parts 1 to 39)
- IS: 3025 - Methods for sampling and test (physical and chemical) for water and wastewater (Parts 1 to 59)
- IS: 3495 - Method of test for burnt clay building bricks (Parts 1 to 4)
- IS: 3613 - Acceptance tests for wire flux combination for submerged arc welding
- IS: 4020 - Methods of tests for wooden flush doors shutters: Type tests
- IS: 4031 - Methods of physical tests for hydraulic cement (Parts 1 to 15)
- IS: 5807 - Method of test for clear finishes for wooden furniture (Parts 1 to 6)
- IS: 7318 - Approval tests for welders when welding procedure approval is not required (Parts 1 and 2)
- IS: 13311 - Methods of Non-destructive testing of Concrete- Part 1 & Part 2

2.3.3 Codes of Practice

- IS: 456 - Code of practice for plain and reinforced concrete
- IS: 783 - Code of practice for laying of concrete pipes
- IS: 800 - Code of practice for general construction in steel
- IS: 806 - Code of practice for use of steel tubes in general building construction
- IS: 816 - Code of practice for use of metal arc welding for general construction in mild steel
- IS: 817 - Code of practice for training and testing of metal arc welders
- IS: 875 - Code of practice for design loads (other than earthquake) for building structures (Parts 1 to 5)
- IS: 1081 - Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators
- IS: 1172 - Code of practice for basic requirements for water supply, drainage and sanitation
- IS: 1477 - Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)
- IS: 1597 - Code of practice for construction of stone masonry (Parts 1 & 2)
- IS: 1742 - Code of practice for building drainage
- IS: 1893 - Criteria for earthquake resistant design of structures
- IS: 1904 - Code of Practice for Design and Construction of Foundation in Soils: General Requirements.

- IS: 2065 - Code of practice for water supply in buildings
- IS: 2212 - Code of practice for brickwork
- IS: 2338 - Code of practice for finishing of wood and wood based materials (Parts 1 & 2)
- IS: 2394 - Code of practice for application of lime plaster finish
- IS: 2395 - Code of practice for painting, concrete, masonry and plaster surfaces (Parts 1 & 2)
- IS: 2470 - Code of practice for installation of septic tanks (Parts 1 & 2)
- IS: 2502 - Code of practice for bending and fixing of bars for concrete reinforcement
- IS: 2571 - Code of practice for laying in-situ cement concrete flooring
- IS: 2595 - Code of practice for radiographic testing
- IS: 2751 - Recommended practice for welding of mild steel plain and deformed bars for reinforced construction
- IS: 2974 - Code of practice for design and construction of machine foundations (Parts 1 to 4)
- IS: 3114 - Code of practice for laying of Cast Iron pipes
- IS: 3370 - Code of practice for concrete structures for the storage of liquids (Parts 1 to 4)
- IS: 3414 - Code of practice for design and installation of joints in buildings
- IS: 3558 - Code of practice for use of immersion vibrators for consolidating concrete
- IS: 3658 - Code of practice for liquid penetrant flaw detection
- IS: 3935 - Code of practice for composite construction
- IS: 4000 - Code of practice for High strength bolts in steel structures
- IS: 4014 - Code of practice for steel tubular scaffolding (Parts 1 & 2)
- IS: 4111 - Code of practice for ancillary structures in sewerage system (Parts 1 to 4)
- IS: 4127 - Code of practice for laying of glazed stoneware pipes
- IS: 4326 - Code of practice for Earthquake Resistant Design and Construction of Buildings
- IS: 4353 - Recommendations for submerged arc welding of mild steel and low alloy steels
- IS: 5329 - Code of practice for sanitary pipe work above ground for buildings
- IS: 5334 - Code of practice for magnetic particle flaw detection of welds
- IS: 5822 - Code of practice for laying of welded steel pipes for water supply
- IS: 7215 - Tolerances for fabrication of steel structures
- IS: 9595 - Recommendations for metal arc welding of carbon and carbon manganese steels
- IS: 10005 - SI units and recommendations for the use of their multiples and of certain other units

2.3.4 Construction Safety

- IS: 3696 - Safety code for scaffolds and ladder (Parts 1 & 2)
- IS: 3764 - Safety code for Excavation work
- IS: 7205 - Safety code for erection of structural steel work

3. CIVIL WORKS

3.1 General

- 3.1.1 National Building Code and State PW specifications shall be strictly followed for carrying out different items of the work for which no standard specifications are available and no alternate specification have been given under the description of works.
- 3.1.2 Where any provision of the State PW specification is repugnant to or at variance with any provision under BIS or description of work, technical specifications and conditions of contract, the provisions of the latter shall be deemed to supersede the provision of the former.

3.2. Earth Work

- 3.2.1 Specification
State PW specification shall be followed for earthwork excavation.
- 3.2.2 Conveyance
The excavated earth, blasted rubble etc., shall be conveyed and deposited in suitable places as directed by Engineer in charge within 150m of plant site on one side of the trench only.
- 3.3.3 Disposal of Surplus Earth
The excavated soil which is surplus to that required for refilling and after allowing for settlement will have to be removed, spread and sectioned at places shown on the site during execution for purpose of widening or levelling the road. The cost of removal of surplus earth after spreading/leveling/sectioning at site approved by the Engineer-in-charge to the disposal site will be measured under the relevant item of work in BOQ.

3.3. Shoring, Strutting and Baling out Water

The rate for excavation of trench work shall include charges of bailing out water wherever necessary and no extra payment will be made for any of these contingent works. While bailing out water, care should be taken to see that the bailed out water is properly channelized to flow away without stagnation or inundating the adjoining road surfaces and properties. For shoring and strutting, the rate for excavation for the first 2 m depth from G.L. shall include. Shoring and strutting beyond 2m depth from G.L., payment will be made as per respective item in BOQ.

3.4. Concrete

3.4.1. Specification

Concrete for use in the works shall generally comply with the relevant BIS. The concrete mix shall be in specified proportions satisfying the maximum aggregate size, water cement ratio and required cube strength and workability as per IS 456-2000. Such concrete must

be adequately vibrated to form solid mass without voids. The entire concreting works should be done only with the prior approval and in the presence of Engineer in charge.

3.4.2. Mixing of Concrete

The concrete shall be proportioned as far as cement and aggregates are considered by volume. The amount of water required being measured either by weight or volume the adjustments must be made to frequent intervals at the discretion of the Engineer or his assistant to account for the moisture content of the aggregates. The mixing operation shall be performed only in a mechanical concrete mixer and shall continue until the whole batch of uniform consistency and colour. The mixing of concrete shall be done in accordance with clause 8 and 9 of IS 456-2000.

3.4.3. Transporting, Placing and Compacting Concrete

- (a) Transportation, placing and compaction of concrete mix by mechanical vibrators shall be done in accordance with clause 12 of IS 456-2000. It is imperative that all concreting operations be done rapidly and efficiently with minimum re-handling and adequate manpower shall therefore, be employed to ensure this.
- (b) The forms shall be first cleaned and moistened before placing concrete.
- (c) The mix should not be dropped from such a height as it may cause segregation and air entrainment. When the mix is placed in position, no further water shall be added to provide easier workability.
- (d) No concrete mix shall be used for the work if it has been left for a period exceeding its initial setting time before being deposited and vibrated into its final position in the member.
- (e) While one concrete is being placed in position it shall be immediately spreaded and rammed sufficiently and suitable to attain dense and complete filling of all spaces between and around the reinforcement and in to the corners of form work for ensuring a solid mass entirely free from voids.
- (f) Construction joints required in any of the structural members shall be provided generally complying with clause 12.4 of IS 456-2000 and as directed by the Engineer in charge. The efficiency of tempering and consolidation will be judged by complete absence of air pockets, voids and honey combing after removal of form works.

3.4.4. Curing

Curing shall be done to avoid excess shrinkage or harmful effort to the members generally complying with clause 12.5 of IS 456-2000.

The method adopted shall be effective and any special method used must be approved by the Engineer and be subject to complete supervision.

Any deficiency in concreting such as cracking, excessive honeycombing, exposure of reinforcement or other fault which entail replacement of the defective part by fresh

concrete and whatsoever remedy reasonable required without hampering the structural safety and architectural concept, all at the cost of contractor.

3.4.5. Removal of Form Work

Removal of form work shall be done as per I.S.456/2000 and as directed by the engineer in such a manner that no damage is caused to the concrete work.

3.4.6. Testing of Concrete

- (a) During the course of construction works, preparation of test specimens, curing and casting of concrete shall be done in accordance with IS 1199 and IS 516 to ascertain the strength requirements and acceptance criteria indicated in IS 456-2000. The contractor shall provide all apparatus, labour and arrange to test the cubes at his own cost at the test laboratory decided by the Employer.
- (b) In addition to the above tests, any other test which may if desired by the Engineer in charge be carried out from time to time as per relevant specifications at the cost of contractor. In case the concrete does not meet the strength required, all corrective measures shall be taken at once at the contractor's cost.
- (c) The inspection and testing of structures shall be done in accordance with clause 16 of IS 456/ 2000.

3.5. Masonry

All masonry works such as Random Rubble / Coarse Rubble / Brick work must be done as per Bid schedule specification.

3.6. Plastering

- (a) Plastering would be 12mm, 20mm and 25mm thick cement plaster either plain or with water proof cement as may be specified.
- (b) The plastering items shall be executed in thickness and cement mortar of proportion as detailed in respective item in the BOQ. Similarly, the plastering shall be either ordinary or with water proof for components as specified in respective item in the BOQ.
- (c) In case of water proof plaster standard and approved water proofing compound shall be mixed in cement mortar in required percentage as directed and then the plaster is applied.
- (d) The finishing shall be either smooth or rough as may be directed by the Engineer unless otherwise specifically mentioned in the BOQ.
- (e) Neat finish wherever directed by the Engineer shall be done at no extra cost.
- (f) Curing and watering shall be done as directed and plaster shall be in alignment and level. Any substandard work is liable to be rejected and shall have to be re-done at contractors cost. Sand to be used shall be of approved quality only. Cost of all scaffolding shall be included in the rates quoted in the BOQ.

3.7. Flooring

40mm thick cement concrete 1:2:4 shall be provided for flooring. The size of metal shall not be more than 12mm and it shall be properly graded. A thin coat of very fine plaster shall be provided on top to give a smooth finish. The marking of false grooves to surfaces as directed includes the cost of labour.

3.8. Doors and Windows

- (a) Sizes shown on drawings are clear openings in masonry and not the shutter's size. These sizes shown on drawings are, therefore, inclusive of required frame sizes and doors, windows, etc., and shall be manufactured, accordingly. If sizes bigger than shown in drawings are manufactured, as instructed specifically in writing they shall be measured and paid for accordingly.
- (b) The work shall be executed as per the size of frame thickness of shutter type viz. Plain planked paneled, glazed, etc., and fixture, etc., as described in tender item. Iron bars for windows and ventilators are to be provided if specifically mentioned in the tender item at Contractor's cost. Specifications in State PW SR shall be applicable.
- (c) The design of shutters and quality of wood shall be got approved from the Engineer-in-charge before manufacture. The CW/TW to be used for woodwork shall be uniform in substance straight, free from large dead knots, flows flanks. The work shall be done as per specification of SoR/AR of State PW / PH latest edition. The joints shall be perfect.
- (d) Part of wood embedded in masonry shall be painted with the tar. The frames of doors, windows, ventilators, etc., shall have proper hold-fasts embedded in masonry.
- (e) Whenever iron bar is to be provided as per tender item the rate thereof is included in tender item. The painting shall be done as prescribed in tender item. No painting, however, shall be permitted till the woodwork is approved by the Engineer-in-charge.
- (f) Any substandard work not conforming to the specifications are liable to be outright rejected and Executive Engineer's decision in such cases shall be final and binding on the Contractor.
- (g) The mode of measurement shall be on area units as mentioned in BOQ.

3.9. Painting

The work shall be carried out as per the description of the tender item and as directed by Engineer-in-charge. It shall be white washing, distempering and /or cement painting. Shade and make shall be as directed by the Engineer and for decorative purpose, Engineer may ask for different shades to be provided for different components or different parts of the same component which the Contractor shall have to do within his tendered rate only at no extra cost to the Employer. Cost of priming coat as directed, scaffolding, etc., shall be included in the tender rate. The work shall be executed as per the specifications of PWD for painting. In general, all items of works must be done as per PW specifications and bid schedule specifications.

3.10. Wet Well

Diversion of Surface Flow for Isolating the Site of Work

- a. The contractor himself has to arrange for necessary diversion of surface flow for isolating the site of work for construction of collection well, septage pump house and other allied works. The bund for diversion should be well formed in such a manner that there may not be any breach during the progress of work and the same should also be maintained in good condition till the work is completed.
- b. The contractor will be personally responsible for any damages caused to the work due to any breach in the diversion formed during the progress of work.
- c. The Employer will not take any cognizance of any damage to the materials or the equipment required for the work and kept in the river bed or in the bank due to any cause whatsoever it may be. The contractor should take necessary precaution against floods, theft or any loss or damage occasioned by or arising out of act of God and in particular unprecedented floods etc. The contractor shall arrange for risk insurance at his cost for the above cause.

3.11. Earthwork Excavation

The levels in the drawings are only approximate for the guidance of the contractor in general. From the date of execution, the bed level and the sub soil water level as noted will be reckoned. Thus the payment will be regulated according to the sub soil water level observed.

In regard to the width of the excavation of work above or below water level, sketch will be furnished to the contractor and payment will be restricted as per section shown in the plans irrespective of the facts that the contractor excavates the same with more side slopes for his own convenience.

The contractor has to fix up and maintain necessary sight rails and ranging rods etc. as required by departmental officers for checking the various levels.

3.12. Excavation for Foundation:

Unless otherwise specified open well excavation shall be resorted to up to water levels as directed by the Engineer.

All precautionary measures for the safety of labourers while excavation shall be made as per the relevant BIS. for safety code for earth work

The quantities furnished in the BOQ are only approximate. Any omission or excess in quantities may arise during execution according to the site condition. Any alteration of work or any additional work during execution has to be done by the contractor. If no rate in the BOQ is applicable or derivable for the additional works, the rates will be arrived at as per rules and regulations governing for the working out of rates for supplemental item of work and will be paid to the contractor.

3.13. Buildings and Structures

All the building and structure works shall generally comply with the following Employer's Requirements unless otherwise specified elsewhere:

- i. All building works shall be of reinforced concrete framework.
- ii. All internal and external walls shall be in solid cement concrete blocks of concrete grade M15 and shall be provided as per IS: 2185 (Latest Revision) and shall be 200 mm thick or 230 mm thick brick masonry walls.
- iii. Toilet partition walls shall be in 100 mm thick solid concrete block or 115 mm thick brick masonry walls.
- iv. Finishes to concrete liquid retaining structures shall be :
 - i. F1 - External surfaces, buried
 - ii. F2 - External surfaces exposed and up to 300 mm below ground level
 - iii. F2 - Internal surfaces
 - iv. Finishes to other concrete structures shall be :
 - v. F1 - Buried
 - vi. F1 - Exposed, where plastering is specified
 - vii. F2 - Exposed
- v. All internal masonry surfaces finish shall have 12 mm thick plain faced cement plaster in cement mortar (1:4) with neat cement finish on top. Over this, one coat of primer and two coats of plastic emulsion paint of approved quality and shade shall be provided.
- vi. All external masonry and concrete with rough board finish shall have 20 mm thick sand faced cement plaster in two coats, base coat 12 mm thick in cement mortar 1:4 and finishing coat 8 mm thick in cement mortar 1:4. Waterproofing compound of approved make and quality shall be added to the cement mortar in proportions as specified by the manufacturer.
- vii. All external surfaces above ground level shall have one coat of primer and two coats of waterproof cement based paint of approved quality and shade. A coat of silicone water repellent paint shall also be applied thereon.
- viii. Toilet areas, walls and ceilings, shall have one coat of primer and two coats of plastic emulsion paint.
- ix. Toilet floor slab shall be filled with brick bat coba (broken bricks in lime) and provided with waterproofing as per the specifications of an approved specialist waterproofing company.

- x. The finished floor level in toilet areas shall be 25 mm below general finished floor level elsewhere in the building.
- xi. The flooring in all areas except toilets, staircases, pumping stations, chlorination building, centrifuge building, workshop, D.G.Room shall be in 250 mm x 250 mm x 20 mm thick marble mosaic tiles of approved make unless otherwise specified, shade and pattern and placed in cement mortar 1:4 to give overall thickness of 50 mm. Half tile skirting shall also be provided in these areas.
- xii. The flooring in the pumping stations, chlorination building, sludge dewatering building, maintenance workshop, D.G.Room shall be 60mm thick cement flooring with Metallic concrete hardener topping, under layer of 42mm thick cement concrete 1:2:4 (1 cement : 2 coarse : 4 graded stone aggregate 16mm thick nominal size) and top layer of 18mm thick metallic concrete hardener consisting of mix 1:2 (1 cement : 2 stone aggregate 6mm nominal size) by volume & mixed with metallic hardening compound of approved quality @ 3 kg/m². Including cement slurry and rounding off edges.
- xiii. Chlorine and chemical buildings should be acid resistant.
- xiv. The flooring in operator's room, loading/unloading bay, MCC cum Panel room shall be in 25mm thick Kota stone slab of approved shade and pattern and placed over 20 mm thick base of cement mortar 1:4 to give overall thickness of 45 mm. Half tile skirting shall also be provided in these areas.
- xv. Toilet areas shall have 450 mm x 450 mm x 25 mm thick polished Kota stone tiles placed in cement mortar 1:4 to give an overall thickness of 50 mm. 2100 mm high dado, in 150 mm x 150 mm x 6 mm thick glazed tiles (approved make, shade and pattern) placed in cement mortar 1:3 shall also be provided in these areas.
- xvi. The flooring along with skirting in administration cum laboratory building shall be 20 mm thick mirror polished, machine cut granite slab of approved shade and pattern placed in cement mortar (1:4). 150mm high skirting shall be provided in these areas. Granite stone shall be provided for laboratory platforms fixed over double sandwiched cuddappah support as directed and the edges of granite is to be embedded into the wall.
- xvii. The toilet facilities shall include at least :
- xviii. 2 Nos. Water closets with white porcelain pan minimum 580 mm long with low level flushing cistern of 10 litres capacity.
- xix. 2 Nos. Urinals of sizes 600 mm x 400 mm x 300 mm flat back type in white porcelain separated by a marble partition of size 680 mm x 300 mm.
- xx. 2 Nos. wash basins of size 510 mm x 400 mm in white porcelain with inlet, outlet and overflow arrangements.
- xxi. 2 Nos. mirror of size 400 mm x 600 mm wall mounted type fitted over wash basins.

- xxii. 2 Nos. plastic liquid soap bottles
- xxiii. 2 Nos. chromium plated brass towel rails minimum 750 mm long.
- xxiv. All stopcocks, valves and pillar cocks shall be heavy duty chromium plated brass.
- xxv. All fittings such as 'P' or 'S' traps, floor traps, pipes, down take pipes etc.
- xxvi. The sewage from toilet blocks shall be led to the wet well of terminal sewage pumping station if present or included under this contract or to the closest gravity sewer.
- xxvii. All staircases shall have 25 mm thick chequered mosaic tiles for treads and 25 mm thick plain mosaic tiles for risers of approved make and shade and half tile skirting set in cement mortar in 1:4 to give an overall thickness of 50 mm.
- All concrete stairs shall have aluminium nosing over 2 mm thick rubber strip of width same as nosing for the full length of the tread. Nosing shall be fixed with countersunk screws.
- xxviii. Stairways shall be provided to permit access between different levels within buildings. Staircase shall be minimum 1000mm wide unless specified otherwise. Staircases in general shall not be steeper than 40°. Staircases having space constraints may be steeper than 40°. The maximum vertical run for a single flight of stairs shall be 3.0 M.
- xxix. All roof tops and overhead tanks shall be made accessible with ladder provision. Vertical step ladders fitted with landing point extensions will be permitted where considered appropriate by the Engineer to access areas not frequently visited.
- Steel staircases shall be constructed of standard channel stringers with M.S. grating treads 25mm thick with non skid nosing. Steel Ladders shall be minimum 600mm wide and shall not exceed 6m of straight run. The ladders shall be painted with epoxy paint.
- xxx. All hand railing (3-rail) shall be provided with 6063-T6 Aluminium Alloy with an ultimate tensile strength of at least 207 MPa and yield strength of at least 172 MPa. The minimum height of hand railing shall be 1m and maximum spacing of verticals shall be 1.5 m.
- xxxi. The reinforced concrete roofs shall be made waterproof by application of an approved roof polythene / bitumen membrane / brick bat coba. The finished roof surface shall have adequate slope to drain quickly the rain water to R.W down take inlet points.
- xxxii. All roof floors shall have minimum 750 mm height solid concrete block parapet wall where accessible is provided and shall have minimum 300 mm height solid concrete block parapet wall where accessible is not provided.
- xxxiii. For roofing drainage, cast iron or uPVC rainwater down takes with C.I. bell mouth or uPVC bend and C.I. or uPVC 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 dia. down take pipe shall be provided.
- xxxiv. 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 rain water.
- xxxv. Building plinth shall be minimum 450 mm above average finished ground level around building or high flood level whichever is more.
- xxxvi. All doors, windows, rolling shutters shall have lintels above. Chajja protection to lintels on external walls shall be such as to prevent the rain water splashing into the building. Chajja projection of minimum 750 mm for rolling shutters, 600 mm for doors and 450 mm for windows shall be provided to prevent the rain water splashing into the building. Chajja shall be projected 150 mm on either sides from size of doors/windows/rolling shutters.
- xxxvii. All windows and ventilators shall have 25 mm thick Kota stone sills bedded in cement mortar (1:3).
- xxxviii. All doors and windows shall be painted with two coats of synthetic enamel paint over a priming coat (ready mixed Zinc Chromate Yellow primer of approved brand and manufacturer confirming to I.S.: 127-106, 341 and 340).
- xxxix.** All doors, windows and ventilators shall be made of aluminium confirming to latest version of IS: 1948. All fixtures for doors, windows and ventilators shall also be of aluminium. Aluminium grills shall be provided in all the windows. Doors shall be in two panel and both panels shall be **glazed/unglazed. Minimum weight of aluminium doors & windows shall be as follows**
- xl. Single Glazed Window : (Weights indicated shall be aluminium)
- xli. Openable
- | | | |
|---------------------------------------|---|--------------------|
| i. Outer Frame | : | Weight 0.70 kg/Rmt |
| ii. Shutter Frame | : | Weight 0.97 kg/Rmt |
| iii. Intermediate Mullion | : | Weight 0.97 kg/RMt |
| iv. Beading | : | Weight 0.31 kg/Rmt |
| v. Fixing Louvers windows/ventilators | | |
| vi. Outer Frame | : | Weight 0.46 kg/Rmt |
- xlii. Double Glazed Window
- | | | |
|---------------------------|---|--------------------|
| i. Outer Frame | : | Weight 0.72 kg/Rmt |
| ii. Shutter Frame | : | Weight 0.97 kg/Rmt |
| iii. Intermediate Mullion | : | Weight 0.98 kg/Rmt |
| iv. Beading | : | Weight 0.31 kg/Rmt |

- xliii. Sliding Windows
- i. Bottom & Top Frame : Weight 0.70 kg/m
 - ii. Shutter Frame : Weight 0.42 kg/m
 - iii. Interlocking Section : Weight 0.47 kg/m
- xliv. Aluminium Door
- i. Outer Frame : Weight 2.508 kg/Rmt
 - ii. Shutter Frame : Weight 2.508 kg/Rmt
 - iii. Bottom Stile : Weight 2.508 kg/Rmt
 - iv. Glazing shall be 5.5 mm thick glass.
- xlvi. Openings of the windows & ventilators shall be minimum 25% of the external wall area.
- xlvi. Ventilator shall be provided where height of floor is more than 3m.
- xlvi. All windows and ventilators shall have wire mesh. Frame of doors, windows and ventilators shall be of aluminium of standard rolled section. Doors, Windows and Ventilators shall be of size as per schedule to be submitted by the Contractor for approval of Engineer. The minimum size shall be as per below:
- a. Door of opening size 1.2m x 2.1m
 - b. Door of opening size 0.75m x 2.1m for toilets
 - c. Glazed windows of minimum size 1.2m x 1.2m
 - d. Ventilators of minimum size 0.6m x 0.6m
- xlvi. Rolling shutters shall be made of 80 x 1.25 mm MS laths. Rolling shutter shall be of minimum size 3m wide x 3.0m high. Rolling shutter shall be provided in MCC cum panel room, chlorine tonner shed, at entry and exit of the pump house for access to pumps, motors, valves, panels and as wherever required.
- xlvi. All concrete channels and ducts used for conveying liquid shall have inside finish of type F2. The width of concrete channels shall not be less than 500 mm. All open channels shall be provided with Aluminium hand railings (3-rail) or concrete walls to a minimum height of 1 m from the access surface elevation. All concrete surfaces of structures conveying raw sewage or primary effluent upstream of the aeration tanks shall be protected from corrosion with an approved internal epoxy lining.
- xlvi. Kerbs to be provided below the hand railing on the catwalks/pathways should be as per relevant sections of Factory Act. It shall not be less than 150mm.

- li. All exposed surfaces of inserts embedded in concrete shall be painted with two coats of enamel paint over one coat of red oxide zinc chrome primer. Surfaces in contact with concrete shall not be painted.
- lii. All structural steel members shall be painted with two coats of enamel paint over one shop and one field coat of red oxide zinc chrome primer.
- liii. All rooms in the treatment plant buildings shall be provided with appropriate sign boards indicating the function of the rooms involved written in and English Languages.
- liv. The design of buildings shall reflect the climatic conditions existing on site. Process buildings shall as far as possible permit the entry of natural light, and the use of glazed panelling shall be kept to a minimum and preference given to wall openings protected by weather canopies.
- lv. Emergency exit doorways shall be provided from all buildings in order to comply with local fire safety regulations .Stairways and paved areas shall be provided at the exit points.
- lvi. Toilet blocks in process buildings and control blocks shall be provided with a sink with two drinking water taps of 20 mm size with adequate inlet and outlet connections.
- lvii. All the walkways shall have minimum 1 m width and shall be covered with mosaic tiles. Walkways to be provided with 6063-T6 Aluminium Alloy hand railings.
- lviii. Sludge Tank shall be built in RCC. A. Employer will approve the type of material which shall be used for the construction digester domes depending upon the durability, corrosion resistivity, strength, ease in operation, functional requirements, economy, etc.
- lix. All concrete structures in contact with sewage/ shall be provided with full interior corrosion protection linings and/or coatings of appropriate material and thickness – to be approved by Employer. This also applies to all concrete structures in contact with any type of sewage sludge anywhere in the plant. For all civil structure of SeTP's coming in contact of septage, interior lining shall extend from the top of wall down to 1.0 meter below the lowest operating water level.
- lx. For structures containing water or process liquid, the top of the wall shall be atleast 0.5m higher than the maximum water surface level calculated at peak plant flow.
- lxi. The top level of internal plant roads and approaches shall be atleast 0.5m above the site High Flood Level. If the High flood level is more than Ground Level then road shall be constructed on the earthen embankment. Earthen embankment shall be constructed with side slope of atleast 2 horizontal to 1 vertical. Stone pitching shall be provided at both sides of the embankment as per IS: 8237. Top width of embankment shall be taken as 6.0m. Top level of embankment shall be 0.5m above high flood level. Excavated earth

from the plant can be used for embankment construction and if required, extra earth can be borrowed from the borrow pit as approved by Engineer.

3.14. Roadways, Pathways & Hard standings

A comprehensive network of roadways shall be provided around the treatment plant to link in with the existing road network and permit access to the plant for necessary maintenance, delivery of consumables and personnel access. All roads shall be of asphalt macadam/concrete and internal roads minimum of 2 lanes with each lane 3.50metres wide. Approach road and main road shall be minimum 6.0m wide or width of the existing road. Vehicular access shall be provided for all Plant structures and buildings. All roads shall be provided with drainage and shall be constructed to prevent standing water.

Paved pedestrian access ways shall be constructed to provide a network of logical routes interlinking plant areas. Damage to any existing roads on account of their use by the Contractor shall be made good to the satisfaction of the Engineer.

Hard standing areas with shading facility shall be provided to permit the parking of vehicles involved in the delivery of consumables from blocking site roadways during unloading or loading. The road system shall be designed such that vehicles involved in the delivery of consumables can follow a continuous route through the works and out again.

3.15. Site Drainage

The Contractor shall provide a site drainage system. The system shall comprise of the following:

- Storm Water Drainage
- Foul Drainage

3.15.1. Storm Water Drainage

Storm water drains adjacent to the existing and proposed roads (under this Contract) shall be sized for a rainfall intensity of 50 mm/hr, allowing for 100% runoff. Drains adjacent to roads shall be in stone masonry in CM (1:4) of appropriate thickness, topped with 75 mm thick M10 concrete and internally flush pointed in cement mortar (1:4), 20 mm thick. The minimum width of drain shall be 450mm.

The storm water drainage system shall be designed to cater the run-off from the existing plot areas and structures, if necessary depending upon the site topography. Also, finished ground level of the SeTP shall be decided based on the 100 Years Storm data and plinth level or Top of wall of any underground structure shall be 50 cm above the FGL.

3.15.2. Foul Drainage

The foul drainage system shall accept discharge from toilets, washrooms, offices and the laboratory. The foul drainage system shall be conveyed to either wet-well of the terminal septage

pumping station wherever exist or proposed under this contract or nearest public sewer wherever exist.

3.16. Cable and Pipe work Trenches

Cable and pipe-work trenches shall generally be constructed in reinforced concrete. However, 500 mm x 500 mm size or smaller trenches, not on fill may be constructed in 200 mm thick solid cement concrete blocks over 150mm thick M 15 PCC base. The trenches will be 20mm thick plastered internally with cement mortar (1:4) and externally in cement mortar (1:3).

All floor cut-outs and cable ducts, etc. shall be covered with M20 precast concrete covers (Heavy Duty) or MS grating as per direction of Engineer in outdoor areas and M.S. chequered plates, suitably painted of adequate thickness in indoor areas. All uncovered openings shall be protected with hand railing. The pipe, cable trenches shall be suitably sloped to drain off rainwater to a suitable location.

Layout of trenches outside the buildings shall allow space for construction of future trenches where necessary with due consideration for planning for future developments. This aspect shall be brought to the notice of the Engineer while planning the works.

3.17. Main Gate

Each proposed treatment plant shall have one main gate to access the plant irrespective of existing gate at the premises of existing plant site. Minimum width of main gate shall be 6m. Main gate shall have 1.5m wide wicket gate. Main gate shall have as external framework of GI pipes and internal framework of MS flats. Gate shall be fixed on RCC columns. The design and pattern of gate with drawing shall be submitted for approval of the Engineer. The gate shall have all necessary hinges, locking arrangement, rolling arrangement and painting complete, as approved by the Engineer.

3.18. Landscaping

The site shall be landscaped once the Works are substantially complete. Landscaping area shall be marked in the layout plan of STP site. The area of landscaping shall not be less than 33% of the proposed plant layout area.

Landscaping shall include planting of suitable trees and development of lawn/grassed areas. Landscaping in general shall meet ecological and environmental conditions of the site. Road widths shall determine the size of the tree height and spread to be selected for planting. Trees suitable for local conditions shall be selected as approved by the Engineer. Medicinal and fruit trees shall be avoided. Landscaping shall be maintained in good condition till the completion of the contract.

Tree Planting: Pits dug a few days in advance of actual planting shall be allowed to weather and be filled with top soil mixed with manure. Size of the pit shall be as per standard requirement.

Only one tree shall be planted in each pit. A guard made of bamboo with wire mesh or bricks or M.S. ring as approved by Engineer, shall be provided or applicable type as approved by the Employer.

3.19. Applications for Anti-Corrosive Internal Lining (Epoxy Coating) protection of Concrete Surfaces

Application limits of Anti-Corrosion Internal Lining for Concrete Surfaces:

1. All units will have to be provided with internal lining for the full internal surface area (Walls and base slab)
2. For the units handling the solids part such as: Gravity Sludge Thickener, Anaerobic Sludge digester and Digested Sludge Storage tank, internal lining shall be provided for the entire internal surface area.

Hydraulic Testing of Liquid Retaining Structures

In addition to the structural test of structures, the liquid retaining structures shall also be tested for water tightness test at full supply level as described in 10.1.1, 10.1.2 and 10.1.3 of latest revision of IS 3370 (Part I).

On completion of the structure and before its commissioning, the Contractor shall carry out a water tightness test for the maximum water head condition i.e. with the water standing at Full Supply Level (FSL). This test shall be carried out preferably in dry season and prior to internal lining in accordance with the procedure given below:

The water tightness test shall be carried out when the construction of liquid retaining structure is done and when it is possible to fill the structure and ensure that uniform settlement of the structure as a whole or as directed by the Engineer. Before the filling operations are started the structure shall be inspected by the Engineer and the Contractor's Representative and the condition of surfaces of walls, contraction joints shall be noted and it shall be ensured that the jointing material filled in the joint is in position and all openings are closed. The Contractor shall make necessary arrangement for ventilation and lighting of the structure by way of floodlights, circulators etc. for carrying out proper inspection of the surfaces and inner conditions if so desired by the Engineer. Records of leakages starting at different levels of water in the reservoir, if any, shall be kept.

The liquid retaining structure once filled shall be allowed to remain so for a period of seven days before any readings of drop in water level are recorded. The level of the water shall be recorded against the subsequent intervals of 24 hours over a period of seven days.

The total drop in surface level over a period of seven days shall be taken as an indication of the water tightness of the structure, which for all practical purposes shall not exceed 40 mm. Also there shall be no indications of the leakages around the opening or on the walls. If the structure does not satisfy the condition of test and the daily drop in water level is decreasing, the period of test may be extended for a further period of seven days and if the specified limit is then reached the structure may be considered as satisfactory.

The external faces of structure shall not show any signs of leakage and shall remain apparently dry over the period of observation of seven days after allowing a seven day period for absorption after filling.

In case the drop in level exceeds the permissible level limit and signs of leakage with the stipulated period of test, the Contractor shall carry out such additional works and adopt such measures as may be directed by the Engineer to reduce the leakage within the permissible limits. The entire rectification work that shall be carried out in this connection shall be at the Contractor's cost. The water required for subsequent testing shall be supplied to the Contractor free of cost (If it is the case), if the same is available near the site. Contractor shall have to make arrangement for filling emptying the structure at his own cost.

If the test results are unsatisfactory, the Contractor shall ascertain the cause and make all necessary repairs and repeat the water retaining structures test procedures, at his own cost. Should the re-test results still be unsatisfactory after the repairs, the structure will be condemned and the Contractor will dismantle and reconstruct the structure, to the original specification, at his own cost.

During testing and during defect liability period the impression marks created due to seepage shall be rectified and made good.

No separate payment shall be made for water tightness test and the cost thereof shall be deemed to be covered in the price quoted of different items of work of Sewage Treatment Plant.

3.20. Compound Wall

The compound wall (TYPE A or TYPE B) shall be constructed along the boundary of STP site (considering plant layout for intermediate and ultimate build out capacity and 33% landscaping area).

The compound wall shall be constructed along the boundary of STP site (considering plant layout for intermediate and ultimate build out capacity and 33% landscaping area).

Compound wall shall be of brick masonry of approved quality and type. The wall shall be min. 23 mm thick and the height shall be 2.75 meter above plinth level, excluding coping. Minimum foundation depth shall be 0.60m below plinth level. Necessary expansion joints shall be provided as per approved drawings. Brick Columns of 350mm X 350 mm to be provided at every 2.5 meter c/c distance.

Pilasters shall be provided along the length of the compound wall. Also coping, broken glass set, fabricated MS angles, GI barbed wire fencing 0.75 meter high on wall top shall be provided, all as drawings approved by the Employer's Representative. Brick work shall be carried out with masonry of CM 1:6 shall be provided on both side of the wall. All structural designs and Specifications shall confirm to relevant Codal provisions.

1. Contractor's Responsibility

The information given hereunder and provided elsewhere is given in good faith but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim whatsoever will be entertained on the plea that information supplied by the Engineers is erroneous or insufficient.

2. Construction Water

The Contractor shall make his own arrangement for the fresh water required for the manufacturing of the pipes, construction of civil works and testing of pipeline as well as for the potable water required for his factory & labour camps.

3. Construction Power

The Contractor shall make his own arrangement for supply of electrical energy required at his sites and the works from local electricity board/department. The Contractor is forewarned that there can be interruptions in power supply for reasons beyond the control of the local electricity board/department and therefore, the Contractor is advised to make his standby arrangement to provide and maintain all essential power supply for his work area at his expense. The Contractor shall not be entitled to any compensation for any loss or damage to his machinery or any equipment or any consequential loss in progress of work and idle labour.

4. Survey

The Contractor shall, at his own expense provide and maintain survey stations which he may be required to carry out the works and shall remove the same on completion of the works. The Contractor shall, at his own expense, carry out all the necessary surveys, measurements and setting out of the works and shall for this purpose engage qualified and competent engineering surveyors whose names and qualifications shall

be submitted to the Engineer for his approval. The Contractor shall for the purpose of checking the survey and setting out, provide to the Engineer all the assistance, which he may require. The surveyor shall be selected having appropriate experience and as far as possible, the same surveyor shall be provided throughout the contract period. Before commencing any work at any locations, the Contractor shall give the Engineer not less than two days' notice of his intention to set out or give levels for any part of the work in order that arrangements may be made for inspection. The Contractor shall provide for the sole use of the Engineer and his staff, all necessary survey instruments and other equipment and all technicians, labour and attendants which the Engineer may require for checking the setting out and marking of the works. The Contractor shall maintain in good working order at all time during the period of contract the instruments provided by him, for the proper setting out of the works. The Contractor shall make available at his own expense, any poles, staging templates.

5. Temporary Fencing

The Contractor shall, at his own expense, erect and maintain in good condition temporary fences and gates along the boundaries of the areas assigned, if any, to him by the Employer for the purpose of the execution of the works. The Contractor shall, except when authorized by the Engineer, confine his men, materials and plant within the site of which he is given possession. The Contractor shall not use any part of the site for purposes not connected with the works unless prior written consent of the Engineer has been obtained. Access shall be made to such areas only by way of approved gateways.

6. Return of Labour and Plant

The Contractor shall supply to the Engineer by 10 a.m. every working day a return of the men employed by him and his sub-contractors on the previous working day and all of the work on which they were engaged specifying also the number employed in each trade. He shall also supply monthly any other returns which may be required as to the number of men and constructional plant employed and the nature and type of the work done.

7. Sanitary Facilities

The Contractor shall provide and maintain in a clean and sanitary condition adequate W.Cs and wash places which may be required on the various parts of the site for use of his employees, to the satisfaction of the Engineer. The Contractor shall make all arrangements for the disposal of sewage or drainage in accordance with the directions of the Engineer. 8. Restricted Entry to Site the Contractor shall get the prior permission of the Engineer before any person not directly connected with the works to visit the site.

8. Existing Services

Drains, pipes, cables, overhead electric wires and similar services encountered in the course of the works shall be guarded from injury by the Contractor at his own cost, so

that they may continue in full and uninterrupted use to the satisfaction of the Employer and the Contractor shall not store materials or otherwise occupy any part of the site in a manner likely to hinder the operation of such services. Should any damage be done by the Contractor on any mains, pipes, cables or lines (whether above or below ground), whether or not shown on the drawings, the Contractor must make good or bear the cost of making good the same without delay to the satisfaction of the Engineer and of the Employer.

9. Local Roads and Haul Roads

The approach roads and other public roads in the state may be used by the Contractor to haul construction materials and equipment subject to restriction of load carrying capacity on the roads in particular over bridges and culverts. However, the Contractor will have to pay customary vehicles license and permit fees for use of public roads. The Contractor shall plan transportation of construction materials to site in such a way that road accidents are avoided.

10. Permission for Road Cuts

Wherever the Contractor considers that it is necessary to cut through an existing road or track he shall submit details to the Engineer for approval, a minimum of seven days before such work commence. In the event of cutting a road by the Contractor without permission from the Engineer the Contractor shall pay compensation as claimed by the owner of the road until it is restored at the cost of the erring Contractor. Trench Digging: Digging of trench by the Contractor beyond the length than that is specified by the Engineer shall invite penalty till such time the damage is restored.

PART 5

MECHANICAL WORKS

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GENERAL MECHANICAL REQUIREMENTS

1 Submersible Pumps (For Sewage & Treated Sewage)

1.1 General

Pumps and drives shall be rated for continuous duty and shall be capable of pumping the flow range specified in the specifications without surging, cavitations or excessive vibration to the limits specified. The pumps shall conform to IS code 8030-1996 (latest version). The pump shall meet maximum allowable shut off head. The pumps shall not overload the motors at any point on the maximum pump speed performance characteristic curve and the pump operating range within the limits of stable pump operation. The total head capacity curve shall be continuously rising towards the shut off as flow decreases throughout the entire curve from run out to shut off head with the highest at shut off.

Its total head capacity curve shall be continuously rising towards shut off with the highest at shut off, and its capacity shall be meeting to handling sludge volume.

- a) Submersible pumps shall be provided with 100% standby and equipped with variable frequency drivers. Pumps shall be suitable for single as well as parallel efficient operation at any point in between the maximum and minimum system resistances.
- b) The pumps shall be designed to handle solid sizes of up to 100 mm for the raw sewage application. Specific gravity of sewage is 1.02.
- c) Pumps shall run smooth without undue noise and vibration, cavitations, oil or water leaks over the range of operation. To ensure vibration free operation, all rotating components of pump shall be statically and dynamically balanced to BS 6861/.as per zones A& B of ISO 10816 -1.
- d) Vibration levels shall not exceed the levels given in BS 4675.
- e) The pump set shall be suitable for starting with discharge valve open and/or closed.
- f) The pump set shall be capable of withstanding the accidental rotation in reverse direction.

1.2 Features of Construction

Pump shall be centrifugal, vertical spindle, with open/semi-open impeller, non-clog, wear resisting, and single stage type.

Pump casing shall be of robust construction. Liquid passages shall be finished smooth and designed as to allow free passage of solids. The volute tongue shall be filed to a smooth rounded edge.

Double Mechanical seals (back to back) shall be provided to protect the motor from ingress of sewage along the shaft. The preliminary and secondary seals shall be oil-lubricated with tungsten carbide or silicon-carbide faces and they shall be equipped with an electrical monitoring system for seal failure detection. . Seals must be capable of withstanding rotation in either direction. A detector shall indicate when moisture is leaking past the first seal.

Impeller shall be non-clog semi open type ,having two vanes with smooth blunt edges and large water ways so as to allow free passage of the large size solids. It shall be free from sharp corners and projections likely to catch and hold rags and stringy materials.

The critical speed of the rotor shall be at least 30% above the operating speed.

Pump-sets shall have double bearings. Bearings shall be of the anti-friction type. Bearings shall be capable of taking the static weight of the rotating parts and any thrust generated by the operation of the pump. The bearing life shall be minimum 40,000 hrs of operation.

Each pump shall be complete with a cast iron delivery connection arrangement for fixing to the concrete floor of the suction well. The joint between the pump discharge flange and the delivery piping shall be made by merely lowering the pump into guide rails / rope from access level. It shall be provided with all necessary fixings for guiding the pumps during lifting/lowering. Each pump shall be provided with a SS 316 lifting chain conforming to BS 1663 and BS 4942.

Each pump shall be provided with an automatic coupling device for attaching the crane hook to the pump at low level, even whilst the pump is submerged, without the need for personnel to enter the well. This automatic coupling device shall easily and automatically couple and uncouple the hoist hook and be complete with necessary accessories. All links and cables shall be multi-stranded stainless steel.

The materials of construction for submersible pumps shall be as follows :

S. No.	Component	Material
	Impeller *	Stainless Steel : ASTM A 743 CF8M
	Casing *	Cast Iron to IS:210 Gr FG 200 with 1.5 to 2% Nickel
	Mechanical seal (Motor side and Pump side)*	oil-lubricated with tungsten carbide or silicon-carbide faces
	Shaft*	Stainless Steel : BS:970 Gr 316
	Bush*	Bronze IS 318 Gr. LT B2

	Guide rail pipe	Stainless Steel : BS:970 Gr 304
	Lifting Chain	Stainless Steel : AISI 316
	Fasteners and Foundation Bolts	Stainless Steel AISI 316

* Material test certificates from Government approved metallurgical laboratory shall be furnished by the Contractor

Each pump shall be tested at the manufacturers premises for the full operating range of the pump to BS 5316 Part 1 .Pump performance shall be within the tolerance limits specified in the above said BS.

2 Chemical Feeding Equipment

2.1 Chemical Dosing Pumps

- a) Chemical dosing pumps shall be piston, piston diaphragm or mechanical diaphragm type as specified. Pumps may be simplex or duplex arrangements to suit the capacity or process requirements. The pump design shall incorporate positive stroke return. The maximum stroking speed shall not exceed 100 strokes per minute (spm). Pump, motor and driving arrangement shall be mounted on a robust combined base plate.
- b) Pump liquid ends shall be selected for compatibility with the pumped liquid. Suction and discharge valves shall be the single ball type allowing a free flow self cleaning action. Ball and seat materials shall be resistant to abrasion.
- c) Pumps shall incorporate a variable stroke mechanism to allow the output to be varied while the pump is running. Stroke adjustment shall be manual or where specified by electrical or pneumatically controlled stroke positioner. A stroke length indicator and digital stroke counter shall be fitted. Pumps shall be driven by a flange mounted IP 55 motor, via an oil bath reduction gearbox and variable stroke mechanism giving step less adjustment between zero and maximum stroke length. Where flow proportional dosing is required the variation of output shall be achieved by varying the speed of the pump motor and not the pump stroke length.
- d) The normal operating range of dosing pump shall be not less than 6:1.

Mechanical Diaphragm	Diaphragm rigidly coupled to the drive train. Single suction Pumps and discharge valves. Glandless. Accuracy: $\pm 3\%$ of stroke.
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Piston Pumps	Cylinder and piston with packed gland. Double suction and discharge valves can be fitted for greater accuracy at high pressure. Accuracy: $\pm 1\%$ of stroke
Piston Diaphragm Pumps	Diaphragm hydraulically operated by liquid displaced by a plunger and protected from excess pressure via a relief valve. Accuracy: $\pm 2\%$ of stroke.

- e) Materials shall be selected to suit the chemicals being pumped. Liquid ends shall be polypropylene, 316 stainless steel, glass, or Hastelloy C. Diaphragm materials shall be butyl rubber, PTFE, or Hypalon and glands shall be PTFE or Neoprene.
- f) Each pump shall be provided with inlet and outlet isolating valves and where necessary, with pressure relief and non-return valves. Dosing pumps shall be provided with back pressure loading valves and pulsation dampeners in the delivery lines depending on the downstream conditions.
- g) A relief valve shall be incorporated in the delivery lines under conditions where the pump discharge pipe can be shut off or where pressure may rise to an excessive point. The relief valve shall be sized to handle the system pressure and to discharge maximum pump output freely, and shall be located in the discharge line between the pump and the first downstream isolating valve or in the case of dosing pumps the back pressure loading valve. Relief valves when used on pumps handling non-hazardous chemicals shall discharge the vented liquid to waste. When used on hazardous chemicals the valve outlet shall be piped back to the suction supply tank or bunded area. The open end of the return pipe shall be located where it is visible, so that any relief valve leakage/operation can be detected. Pump transferring/dosing chemicals to systems under pressure shall incorporate a pressure gauge on the pump delivery. Air cocks shall be provided for release of air where necessary.
- h) Unless otherwise specified flushing connections shall be provided at each pump inlet and flushing shall be manual. When flushing, water shall be discharged either locally through a drain valve or to the point of application of the chemical. Facilities shall also be provided for flushing chemical pump suction and delivery manifolds and delivery lines to point of application.
- i) Dosing pumps and motors shall preferably incorporate an integral reduction gearbox drive which shall be totally enclosed and oil bath lubricated. The gear box shall incorporate the cams for the diaphragm drive and shall be provided with filling and drain connections and visible oil level indication.
 - a. All dosing pumps shall have facility/terminals for pulse input & output (4-20 mA) to facilitate online control via plant PLC & SCADA.

2.2 Chemical Tank and Mixer

i. General

This tank shall be used to dissolve the polyelectrolyte to a constant concentration and feed the solution to the dewatering equipment. It shall be a vertical tank and shall be composed of tank main body, mixer, manhole, electrical level gauges, direct reading level gage, ladder, air exhaust pipe etc.

ii. Fabrication

The tank shall be made of corrosion resistant material.

The tank shall be provided with a removable cover to prevent chemical scattering, and also with a vent pipe.

The tank shall be provided with necessary mounting seats for overflow pipe, etc.

The motor-driven mixer shall be vertical speed reducer, direct-coupled type of 2-stage propeller type, as a rule and shall be constructed to endure continuous operation free from vibration, etc. The mixer shall be at the center or at a position off the center according as the tank being angular or circular.

The mixer shall be protected by electrical prevention of dry operation.

The tank shall be constructed to seal gas and splash from below at the area where the mixer shaft drive portion passes through.

iii. Materials

- (a) Main Tank body : RCC with acid resistant tiles.
- (b) Mixer frame : SS316
- (c) Mixer shaft : SS316
- (d) Mixer Blade : SS316L

iv. Accessories (per Unit)

- (a) Foundation bolt and nut x 1 set
- (b) Air vent pipe x 1 set
- (c) Mixer x 1 unit
- (d) Direct reading level gauge x 1 unit

2.2.1 Requirements

3 Induction Motor (Submersible Pump)

3.1 Performance and Characteristics

The submersible motor shall conform to IS: 9283:1979 and the submersible cable shall conform to clause no. 4.4 of the IS: 9283:1979. The motors shall be suitable for operating on a 415 V, 50 Hz, 3 phase, Ac supply. Pump motor shall be of the squirrel cage submersible type, protected to IP 68. Motor for submersible pump shall be capable of start up and operation in the event of a completely flooded wet well. Motor cooling for submersible pump must be achieved by a cooling jacket, using the pumped media to cool the motor. The pump impeller must be equipped with a system to ensure a pumped flow of liquid through the cooling jacket and also incorporate a device to prevent the liquid channels from blocking with hair and foreign material. This motor shall be capable of starting 10 times per hour. The insulation class of motor winding shall conform to class F. Additionally the specific requirements mentioned in the following clauses shall also be met.

Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously under the following supply conditions :

Variation of supply voltage from rated motor voltage	±10%
Variation of supply frequency from rated frequency	±5%
Combined voltage and frequency variation	±10%

The starting current of motor shall not exceed 200% of rated full load current for star/delta starting and 600% of rated full load current for DOL starting, under any circumstances.

Motors shall be suitable for full voltage direct-on-line starting or star-delta starting.

Motors shall be capable of starting and accelerating the load with the applicable method of starting, without exceeding acceptable winding temperatures, when the supply voltage is in the range 85% of the rated motor voltage to maximum permissible voltage.

The locked rotor current of the motor shall not exceed 600% of full load current (subject to tolerance as per the applicable standard) unless otherwise specified.

Motors shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage, in either direction of rotation. The motor vibrations shall be within the limits specified in applicable standard unless otherwise specified for the driven equipment.

Except as mentioned herein, the guaranteed performances of the motor shall be met with tolerances specified in applicable standard, IS: 9283-1979.

Motor insulation shall conform to Class F and the maximum temperature rise shall not exceed 95deg C , when measured by winding resistance method and 85 deg C , when measured by

thermometer method for an ambient temperature of 45 deg C. The motor windings shall be protected with a waterproof material and shall incorporate a thermal sensor in each phase to safe guard against high winding temperatures. The thermal sensor shall be connected into the control circuit of the starter and signals taken for continuous monitoring of winding temperatures. The motor shall incorporate a cut out device to detect the presence of any liquid in the motor enclosure, in the form of non resetting moisture switch. The terminal connections for the power and protective circuits shall be housed in a completely sealed and water proof junction box, complete with all external corrosion resistant cable glands. The pump units shall be provided with power and protection circuit cables of sufficient length to reach from the motor junction box to the local isolator located at the panel floor level.

Protection against increase in stator winding temperature (150°C) bearing temperature, leakage in stator housing and terminal box shall be provided. Minimum three number thermistors in series are to be provided to sense the stator winding temperature. Sensors are to be provided to detect if leakage of sewage into the oil housing is above 30 % concentration.

Bimetallic thermal switch to trip the motor against increase in temperature shall be provided.

The power rating of the motor shall be larger of the following:

115% of the power input to the pump at duty point at a speed corresponding to the frequency of 48.5 Hz.

Maximum Power input while operating single pump corresponding to the speed of 50 Hz.

Motor shall be offered for routine and type tests in accordance with IS: 4029 and IS: 325 at the manufacturer's works.

3.2 Submersible Cable

The submersible cable shall conform to clause no. 4.4 of the IS: 9283:1979. The power cable shall be PVC insulated and PVC sheathed, flexible, 3.5 core flat type. The size of the conductor shall be adequate for continuous use under water and air. The half core shall be used for earthing.

The control cable shall be PVC insulated PVC sheathed, flexible, flat type and shall be adequate for continuous use under water and air. The control cable for stator winding temperature sensor (Thermistors) 3 core x 2.5 sq. mm copper conductor and for bimetallic thermal switch 2 core x 2.5 sq. mm copper conductor shall be provided.

In case a joint is required to be made between the lead cable supplied with the motor and the user's cable connectors, a detailed procedure of cable jointing to make a watertight joint shall be provided by the manufacturer.

The size of the conductor and length of cable should be suitably selected so that the voltage drop at motor terminals does not exceed 3 percent of the rated voltage.

3.3 Earthing

Earthing of the motor shall be done in accordance with the relevant provisions of IS: 3043:1966. For the purpose of earthing these motors, earthing connection may be made to discharge pipe.

3.4 Insulation

Any joints in the motor insulation such as at coil connections or between slot and end winding sections, shall have strength equivalent to that of the slot sections of the coil.

The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid and tropical climate. The tropicalising treatment shall be as per the applicable standard.

The stator winding shall be made from high conductivity annealed copper conductor, PVC insulated winding wires conforming to IS: 8783:1978 for wet type motors. The stator winding shall be of high conductivity annealed copper enameled insulated wires conforming to IS: 4800 (Part-VII):1970 for dry type motors.

3.5 Temperature Rise

The temperature-rise test of the motor shall be taken with the motor coupled to the suitable pump to give the full load output of the motor. When the various temperatures are stabilized, the set is stopped and the temperature-rise of the stator winding by the resistance method shall not exceed 35°C. During the test, the temperature of the cooling water may not exceed 35°C. As the cable resistance will also be substantial, it is necessary that while calculating the temperature rise by resistance method, due care is taken to account for the correct hot and cold resistance of windings.

3.6 Constructional Features

The motor shall be suitable for continuous use in fully or partially submerged condition. A built in cooling system must allow the motor to operate continuously at its rated output regardless of whether the electric motor is submerged or not, by providing either external or internal cooling arrangement.

3.7 Terminal Box

Terminal box shall be of weather proof construction to eliminate entry of water and dust. The terminals shall be of the stud type with necessary plain washers, spring washers and check

nuts. They shall be substantially designed for the current carrying capacity and shall ensure ample phase to phase and phase to ground clearance.

4 Gate –controlled Weir

These Gates are downward opening type and shall be used for flow splitting, Decanting of reservoir or a tank OR For maintaining precise level control in a reservoir or a tank.

The gates shall have minimum following features:

Suitable for seating and unseating Head

Flange /Flat back frame design

Metal to Metal sealing on 3 sides

Manual lift mechanism to enable single person operation with effort not to exceed 20 Kgs.

The material of construction of Gate –controlled Weir shall be complied with “Clause 7.8 Sluice Gate”.

5 Sluice Gate

Design Requirements and Construction Features

The construction of sluice gates shall be in accordance with the specification and generally as per IS: 13349. All sluice gates shall be of the rising spindle type.

Frame

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.

Seating Faces

Seating faces shall be made of full width, solid section; dove-tail strips of stainless steel. They shall be secured firmly by means of counter sunk fixings in finished dove-tail grooves in the frame and slide faces in such a way as to ensure that they will remain permanently in place, 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 as required providing contact between the slide and frame facing when the gate is in closed position.

Lifting Mechanism

Sluice gate shall be operated through suitable lifting mechanism which shall incorporate suitable gearing if required, to keep the torque requirement within 7 kg.m.

Lifting mechanism shall incorporate a strong locking device suitable for use with a padlock or padlock and chain.

Lift mechanism shall be provided with a suitable position indicator to show the position of the gate at all times.

Wall Thimbles

The cross section of the thimble shall have the shape of the letter 'F'.

Lifting Lugs

Lifting lugs shall be provided for all gates.

Flush Bottom Seal

When sluice gates are provided with flush bottom seals, the wedging device and facing along the bottom edge of the slide and frame shall be omitted.

A solid square cornered, resilient rubber seal shall be provided on the bottom facing of slide. The seal shall be securely fastened to the bottom face of the slide by a retainer bar and corrosion resistant metal fasteners. The top surface of the bottom facing of frame shall be flush with invert of the gate opening. Bottom facing of the slide shall be accurately machined to make contact with the seal when the slide is closed.

1 No. of Portable type of electric actuator for closing and opening of sluice gates shall be provided at SBR Basins in STP, so that the closing and opening operation time shall be maximum of 10 minutes

Suitable arrangement shall be made on all the sluice gates or actuators such that the actuator is capable of operating all sizes of sluice gate, under this contract.

The material of construction of sluice Gate shall be as follows:

S. No.	Component	Material
	Wall Thimble	Cast Iron : IS 210 Gr. FG 200
	Frame and Slide	Cast Iron : IS 210 Gr. FG 200
	Seating faces	Stainless Steel : ASTM Countersunk fixing A276 type 316
	Wedge	Stainless Steel : ASTM A743 CF8M or SS316
	Stem	Stainless Steel: ASTM extension A276 type 316
	Stem nut	Stainless Steel : ASTM A743 CF8M
	Stem Coupling	Stainless Steel : ASTM A276 type 316

S. No.	Component	Material
	Fasteners, anchor	Stainless Steel : ASTM bolts and nuts A276 type 316
	Lifting mechanism, Pedestal gear house cover and stem guide	Cast Iron : IS 210 Grade FG 200
	Lift nut	Bronze : ASTM B 148 (CA952, CA954 or CA958)

6 Mechanically Raked Coarse Bar Screen

6.1 General

The screen shall be installed in raw sewage inlet channel, and the screen shall be of the front raking type.

The screen shall be capable of performing the duties set out in this Specification. All the materials and sub-assemblies used shall be suitable for outdoor application. They shall be constructed so that maintenance is kept to a minimum.

There shall not be any moving part, sprocket, bearings, etc. continuously immersed in sewage. All lubricating points shall be conveniently accessible from the deck level.

The screen shall be suitable for discharging 75% of the screened material lifted from the screen into the chute.

The screen shall be designed such that in case of heavy accumulation of solids the same is to be removed gradually without overloading or damaging the screen bars or mechanism.

6.2 Frame work

The frame work of the screen shall be of robust construction with intermediate cross bracing. The lower ends and sides of the frame shall be grouted in concrete. Each screen shall have an independent canopy at the top for weather protection.

6.3 Screen bar assembly

Screen bar assembly shall be fitted across the screen chamber. Screen shall have a series of vertically oriented bars spanning the inlet channel and spaced as specified. Bars shall be sufficiently rigid to prevent vibrations in stream wise and lateral modes and to withstand the maximum differential head that will occur with the screen totally blinded. Bars shall have

tapered cross section to prevent jamming of screenings between bars. Bars shall have supports only at both ends. The bar spacing shall be 20 mm.

6.4 Rake carriage

The rake carriage shall comprise a stiffened frame work to which is attached replaceable rake tines. The rake tines shall be suitable to accommodate bulky screenings. Rake carriage shall incorporate suitable devices to enable the rake to ride over any small obstacles wedged in the screen and automatically stop the drive motor in the event of the rake jamming against a large obstruction. There shall not be any mechanical damage resulting from obstruction wedged in the screen bars. The rake carriage shall always come to rest in a parked position with the rake above the sewage level.

The screen shall be cleaned automatically through an adjustable timer. The rake lowered will clear screen bars at the beginning of a cycle and accurately engage with the screen bars at the bottom of the channel. The tine profile and rake motion shall be designed to elevate screenings to the discharge chute at deck level without debris falling back or being forced through the screen. The rake shall be suitable for levating debris encountered at any level. Rake tines shall be replaceable.

The screenings shall be discharged from the unit by a wiper mechanism down to a discharge chute leading to a conveyor belt. Arrangement shall be such as to ensure that screenings are discharged to the discharge chute leading to the conveyor. The rake tines shall then be retracted and the unit ready for the next cycle.

6.5 Rake Lifting Mechanism

Lifting mechanism shall consist of a SS 316 wire rope or chain and C.I. sprocket.

6.6 Inspection Platforms

An inspection platform shall be provided for periodic checking and maintenance of the drive and other critical parts. A ladder with handrails for access to this platform shall be fixed. Suitable hand rails shall be provided for safety on the inspection platform and also at deck level.

6.7 Dead plate

Mild steel dead plate extending from the top of the bars to the deck level shall be provided to ensure that screenings do not fall back. Dead plate shall be made of minimum 5 mm thick plate. The clearance between the tines and the dead plate shall not exceed 5 mm.

6.8 Driving Mechanism

The driving mechanism shall consist of a sturdy reduction gear unit driven through multiple 'V' belts or directly by an electric motor. Motor shall be mounted in such a way that the tension of

the 'V' belts can be adjusted. A manually reset torque limiter shall be provided between the motor and gear unit, incorporating a limit switch to cut off the supply to motors in the event of an overload.

6.9 Gear Reducer

The reducer shall be sized and selected with a minimum service factor of 2.0 times the motor nameplate horse power rating in accordance with applicable American Gear Manufacturer's Association Standards. The reducer shall have a life of 40,000 hours based on the motor name plate horse-power. The reducer shall have an efficiency of not less than 90% based on reducer input.

All gear meshes shall be oil lubricated. All gears shall be provided with an oil reservoir for instant lubrication on starting. The gear reducer housing shall be provided with an oil level indicator and oil drain with necessary fittings.

The gear reducer shall be of cast iron construction. The reducer housing shall also include suitable lifting lugs and external gear train inspection covers for each gear train. The gears shall be matched for maximum tolerance variation. The gear reducer shall be suitable to reduce the motor asynchronous speed to achieve the required speed of raking.

6.10 Control System

The screening operation shall be carried out through adjustable timers which are adjustable at site for 0-60 minutes for interval between two operations.

Control system for the conveyor shall be designed to achieve the following:

Conveyor shall be started when any of the rakes starts its upwards travel.

Conveyor shall be stopped with a time delay (by adjustable timer) after rake is stopped.

Weatherproof, lockable, emergency mushroom headed stop push buttons shall be provided near each motor for screen and conveyor belt, operation of stop push button, and overload prevention for screen and belt conveyor shall be included in the control scheme.

6.11 Conveyor System

For the disposal of screenings, a common motor driven endless belt conveyor shall be provided. The conveyor shall be designed in accordance with IS 11592 or equivalent. The conveyor and chutes shall be suitable for handling occasional heavy objects which will cause shock loads.

The construction of the frame and support shall be robust and torque resistant. Belt conveyor shall be of 20 deg. trough type complete with drive assembly structures, idlers, pulleys and belt cleaners. Idlers and pulley shall be provided with anti-friction bearings.

The belt material shall be two poly nylon or equivalent with minimum 3 mm neoprene covering on carrying side. Splicing shall be employed to make the belt endless. The belt shall operate over three roll twenty degree, troughing idlers. The idlers shall rotate on precision type, deep groove, single row ball bearing with built-in close fitting triple labyrinth grease seal. The ends of the outer shell shall be counterbored and a full length centre tube journalled concentricity. The outer shell, centre tube and precision die formed steel ends shall be brazed into an integral unit to provide concentricity. The ends of the centre tube shall be bored concentrically with each other after roll assembly to provide correct bearing alignment and to provide prestressing of boring. The centre tube shall be grease fit after assembly. Troughing idlers shall have means of adjustment or ensuring belt tracking. On the return run the belt shall operate over flat roll idlers having bearing, shaft and lubrication arrangements as above for carrying idlers. Spacing of idlers shall be of 1200 mm on carrying run and 2400 mm on return run.

The head and tail pulleys shall be manufactured from welded steel/any alloy steel and shall be provided with rubber lagging. Lagging for drive pulleys shall have herringbone grooving. Pulleys shall be equipped with taper lock bushings. The tail pulley shall incorporate a screw rake for adjusting belt tension. Head and tail pulleys shall be adequately guarded.

Shafting for pulleys shall be of heat treated carbon steel. They shall be forged, ground and polished to obtain close diameter tolerances. The head shaft shall be provided with roller bearing pillow blocks.

The belt conveyor shall be driven by a squirrel cage, TEFC motor. A V-belt drive arrangement shall be provided between the motor and a helical speed reducer, the latter shall be mounted on the end of the head shaft. The driving pulley shaft shall have back stops to prevent backward movement of the belt.

The conveyor shall be supported on 150mm channel sections with 14 gauge steel deck plate between the two runs of the belt and the necessary supports to the floor. The floor supports shall be made out of steel plates having minimum 6 mm thickness. The conveyor shall be protected from weather by a 'dog box' type canopy.

An adjustable belt scraper shall be provided on the hopper end of the conveyor belt. The scraper and attachments shall be of fibreglass/fibre reinforced plastic/PVC.

Screenings discharge chutes shall be provided to transfer screenings from the screens to the troughed belt conveyor and from the conveyor discharge to skip. The latter chute shall extend beneath the belt scraper and shall allow access for maintenance of the belt scraper. Chutes shall be designed to minimize the accumulation of rags and stringy materials.

The conveyor shall be fitted with an emergency stop operated by wire rope at foot level. Two Nos. belts way switches shall be provided on conveyor.

6.12 Portable Screenings Container

Portable screenings containers made of galvanized steel shall be provided to store the screenings until time of pick up. The container shall have capacity of approximate 2.0 cu.m and shall be of a convenient height to permit the discharge of screenings directly into the container without having to transfer the screenings manually. The containers shall have hinged covers and their design shall permit their being lifted by an overhead hoist or packer truck. The container will have four wheels each of about 20 cm diameter and two of which shall be swivel castors. The maximum height of container including wheels shall be 66 cms. The sides shall be constructed of 12 gauge steel. The bottom of container shall be made of 5 mm plate steel. The containers shall be reinforced with 50 mm x 50 mm x 5 mm angle.

6.13 Motors

Motors shall be squirrel cage type conforming to IS 325. The power rating of motor shall be at least 125% of maximum power requirement. The other features of motors shall be as follows :

Type of duty	:	Intermittent (S4)
Method of Starting	:	DOL
(iii) Class of insulation	:	F (Temperature rise limited to class B)
Type of enclosure	:	TEFC
Degree of protection	:	IP 55

The material of construction of Mechanical Raked Screen shall be as follows :

S. No.	Component	Material
(i)	Screen Bar	Stainless steel SS316L
(ii)	Frame (Side and Bottom Portion)	Stainless steel SS316L
(iii)	Raked tines	Stainless steel SS316L
(iv)	Fasteners including Anchor bolts	Stainless Steel : ASTM A 276-Type 316
(v)	Screen canopy	Stainless Steel: BS:970 Gr 304

(vi)	Chutes	Mild Steel - Galvanized
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7 Mechanical Fine Bar Screen

The screen shall be installed in inlet channel to grit chamber, and the screen, shall consist of continuously moving perforated stainless steel SS316 L panels.

OR inclined Bar screen at 45 degree and the minimum bar thickness shall be 8mm. Other specification shall be same as above clause 7.9 except for bar spacing of 6 mm.

The aperture size of the screen shall be 6 mm.

7.1 Construction

Frame :

The frame shall consist of two lateral stainless steel 316L plates connected by means of cross braces.

Chain wheels :

The machine shall work on the endless chain principle and incorporate chain wheels at the top and bottom. The top wheels shall be keyed onto the main drive shaft. The bottom wheels shall be carried on stub shafts incorporating a sealed bearing of suitable synthetic material.

Chain :

The chain shall be constructed in stainless steel with the screen panels directly attached.

Screen Panels :

Minimum 3mm thick panels of SS 316L construction shall incorporate 6mm diameter perforations. These panels shall be carried on the chains. The panels shall be specially formed to give a very rigid construction and shall create steps to enable larger screenings to be removed.

Seals :

Polypropylene sealing brushes shall be incorporated at each side and across the bottom of the screen to prevent screenings from by-passing the screen panels.

Screenings Discharge :

Screenings shall be discharged on the downstream side of the unit and shall be removed from the screen panels by a heavy duty rotating brush. The brush material shall be polypropylene.

Screenings are delivered down an enclosed chute.

Two nos. screening collection containers (wheeled) of suitable capacity shall be supplied with the screens.

Enclosure

The entire assembly shall be enclosed in reinforced fiber glass housing. A hinged front cover shall be provided to give access to the rotating brush assembly and screen discharge area. A sliding inspection hatch shall also be incorporated.

Drive Unit

The drive to the main shaft shall be TEFC weatherproof IP55 motor fitted with an anti-condensation heater. The motor shall be flanged to a shaft mounted gear unit giving the final output speed. This shall produce a linear speed for the screen panels of about 3 m/min.

The drive shall be protected from mechanical overload by an electrical current sensing device in the screen control panel.

The drive shall have an electronically controlled automatic on line jam removal system.

Overload prevention switches shall be provided to annunciate screen jamming.

Suitable conveyer arrangement shall be provided to transfer the screenings to the nearest container/trailer.

A spray system shall be provided to backwash the screen panels and to help in cleaning the screenings. Water / treated sewage shall be used for back wash purpose.

8 Screening Compactor

8.1 General

The screenings compactor shall be capable of continuous and intermittent duty compacting and conveying raw wastewater coarse screenings.

The screenings compactor shall come equipped with a local unit control panel (U.C.P.) with protection and control circuitry and a selector switch (Hand/Off/Auto). When the selector switch is in the "hand" position, the compactor shall be controlled locally by the Operator. When the selector switch is in the "off" position, the compactor shall not operate. When the selector switches is in the "Auto" position, the compactor shall be controlled by an ultrasonic level sensor.

For automatic operation, the compactor operation shall be by ultrasonic level sensor. The sensor shall detect when the screenings hopper is full and shall cause the compactor to run.

The duration of the run cycle shall be controlled by a field adjustable timer adjustable from 0 to 10 minutes.

The screenings compactor and local unit control panel shall be furnished with protection circuitry and devices to stop the operation of the unit, and to generate alarm signals, for the following conditions: high hydraulic pressure, low hydraulic pressure, delayed ram return, and early ram return. Failure or jamming of the compactor shall cause the compactor to stop and an alarm signal shall be generated.

A lockout/stop switch shall also be provided that shall cause the compactor to stop immediately.

8.2 Material of Construction

The screenings compactor shall consist of a feed hopper inlet chamber, pressing and dewatering cylinder, resilient cone section, discharge pipe friction cylinder, hydraulic pressing ram, and hydraulic power pack. A local control panel and equipment supports shall also be provided.

The screenings compactor shall be designed to receive screenings conveyed from the bar screen and shall reduce the volume and water content by means of a pressing action. Solids to be pressed shall be gravity fed to an inlet hopper and pressing zone where a hydraulically powered ram presses the screening into the resilient cone and friction cylinder. Water drainage shall be piped back to the sump.

Cylinder: The pressing zone and hydraulic ram housing shall consist of a 10-inch I.D. heavy duty Type 316 stainless steel cylinder. The cylinder shall be horizontally mounted. A rectangular solids inlet hopper shall be top mounted in the cylinder casing. The cylinder shall be supported by a fixed rear foot assembly and an adjustable front leg assembly allowing a 25 centimeter adjustment range for the purposes of press inclination.

Hydraulic Section:

A hydraulic cylinder shall be fitted within and affixed to the basic unit. The hydraulic cylinder shall be fitted via link bearings to a press plate which contacts the screenings to be pressed. The hydraulic cylinder shall be rated at 5 tons capacity at an oil pressure of 100 bar. The piston rod shall be hard chrome plated steel rod.

The hydraulic cylinder shall be driven by a remote mounted hydraulic power pack unit consisting of a hydraulic gear pump, heavy-duty, 1,800 RPM, 460 volt, 3 phase, 60 Hz motor. The hydraulic power pack shall be self-contained oil tank, pressure gauge, pressure limiting valve, and reciprocating valve.

Movement of the hydraulic cylinder shall be actuated by pressure regulation of the reciprocating valve. The recirculation system shall be equipped with a replaceable oil filter system. Two (2) hydraulic hoses shall connect the power pack to the cylinder.

Water Drain:

Drained water from bottom slots in the pressing zone of the compactor and in the resilient cone shall be collected in a SS 316 stainless steel collection pan having. Drain slots shall be of sufficient size to prevent plugging and fouling.

Friction Cylinder:

The compactor shall be furnished with a flanged I.D. Type 316 stainless steel friction cylinder which shall extend a distance of approximately 3 meter unless otherwise recommended by the manufacturer from the edge of the cylinder/resilient cone discharge flange. Supports for the friction cylinder shall be furnished. The friction cylinder shall be curvilinear.

Screening Hopper:

The screenings hopper mounted on top of the cylinder shall be fabricated of Type 316 stainless steel.

All nuts, bolts, washers and fasteners shall be Type 316 stainless steel.

8.3 Local Control Panel

The screenings compactor shall be provided with a Local Unit Control Panel (U.C.P.) consisting of required circuitry and devices enclosed in a corrosion resistant (i.e. stainless steel, plastic, or fiberglass) NEMA 4X or IP68 enclosure and located adjacent to the compactor unit .The local control panel shall house the compactor controls, main circuit breaker, motor starter, control transformer and other devices as specified or required for a complete and operable system. Identified terminal strips shall be provided for the connection of external conductors. All control devices on individual equipment items shall be interconnected to an equipment base-mounted junction terminal box. All equipment shall be ready for service after connection of conductors to equipment, controls, and local control panel.

The control panel shall, as a minimum include the following:

On/off switch for "hand" compactor operation.

Lockout/stop switch.

Panel mounted run status light and individual alarm lights for high hydraulic pressure, low hydraulic pressure, early ram return and delayed ram return.

Alarm reset button (common).

Dry contacts for future common alarm output and connections for remote on/off input.

Audible alarm horn rated for 85 dB at a distance of 10 feet minimum. Alarm

shall sound for any of the aforementioned alarm conditions.

The Unit Control Panel (U.C.P.) shall be either free standing or wall mounted .The panel shall be anchored to withstand Seismic Zone IV shaking in accordance with the Uniform Building Code (latest edition).

The contractor can provide alternative type screening compactor retaining the basic objective of the compaction.

9 Trolley and Chain Pulley Block

The chain pulley block shall be operated on the lower flange of the bridge girder.

The load chain shall be made of alloy steel as per IS:3109. It shall be heat treated to give ductility and toughness so that it will stretch before breaking. It shall be of welded construction with a factor of safety not less than 5.

The hand chains, SS 316, for the hoisting and traverse mechanism shall hang well clear of the hook and both the chains shall be on the same side. The hand chain wheel shall be made from pressed sheet steel and shall be provided with roller type guarding to prevent snagging and fouling of the chain.

All the gearing shall be totally encased. Proper lubricating arrangements shall be provided for bearings and pinions. Gears shall be cut from forged steel blanks. Pinions shall be of heat treated alloy steel. Gears shall be as per BS 436/IS:4460.

The trolley track wheels shall be rim toughened, heat treated carbon steel or low alloy steel or C.I. and shall be single flanged and shall have antifriction ball bearings. The wheels shall be machined on their treads to match the flanges of the track joints.

The travelling trolley frame shall be made of rolled steel conforming to IS:2062. The side plates of trolley frame shall extend beyond wheel flanges, thus providing bumper protection for the wheels. The two side plates shall be connected by means of an equalizing pin.

Axles and shafts shall be made of carbon steel and shall be accurately machined and properly supported.

The lifting hooks shall be forged, heat treated alloy or carbon steel of rugged construction. They shall be of single hook type provided with a standard depress type safety latch. They shall swivel and operate on antifriction bearings with hardened races. Locks to prevent hooks from swiveling shall be provided. Hook shall be as per BS:2903/IS:3815

The brake for the lifting gear shall be automatic and always in action. It shall be of screw and friction disc type self-actuating load pressure brake. Brakes shall offer no resistance during hoisting.

10 Hand Operated Hoists and Trolleys

Manual hoists shall be complete with hand-chain, trolley, pulley block, hook, hand and load chains, brake and other accessories. They shall comply with the latest applicable standards, regulations and safety codes in the locality where equipment will be installed.

Each hoist shall be operated on a monorail (I-Beam). The factor of safety shall not be less than 5. The load chain may be heat-treated to give ductility, toughness and conforming to I.S. 3109/B.S.1663/B.S.3114. The load wheel is to be made from heavy duty malleable castings. The hand chain is to Conform with B.S. 6405:1984 and hand chain wheel may be made from pressed sheet steel with roller type guarding. Gears shall be cut from solid cast or forged steel blanks or shall be stress – relieved welded steel construction.

Pinions shall be of forged carbon or heat treated alloy steel. Strength, Quality of Steel, heat treatment, face, pitch of teeth and design shall conform to BS-436, BS-545 and BS-721. Spur and helical gears must comply with B.S. 436 and worm with B.S. 721. Bearing must be ball and roller type conforming to I.S. 2513/B.S., 2525-32:1954.

Proper lubricating arrangements are to be provided for bearings and pinions. The brake for the lifting gear shall be automatic and always in action.

The proof testing of each chain pulley block is to be carried out as per latest applicable standards. The safe working load is to be marked in such way that is clearly visible from the operating level.

11 Grit Removing Equipment

The grit removing mechanism shall be of moving rake type to collect and removal settled grit effectively, with proper circumferential speed, and it shall be installed grit chambers. The grit removal unit shall be equipped with Oil & Grease removal mechanism. Slotted pipe skimmer shall be provided to remove the oil and grease from the tank surface and suitable mechanism shall be provided to collect the scum/grease for further treatment and safe disposal.

Each of the grit collector in the chambers shall be equipped with the following mechanism :

Mechanical support beams.

Rotating vertical pipe shaft.

Torque arms, rake blades and scoops.

Drive head along with induction motor with mechanical indicating arrangement shall be provided. Mechanical trip contacts and electrical overload relays shall be provided. One set of push button shall be provided near the motor.

Classifier Mechanism :

The mechanism shall consist of the followings:

Chain and sprocket with guard.

Reciprocating rake with hangers.

A.C. motor.

Local push button shall be provided.

Organic Return Pump

Each of the grit removal equipment shall be provided the Vertical propeller pump with suitable motor, starter, etc. shall be provided. The design of the pump and the piping on the inlet and outlet side has to be such that there are minimum number of bends as they are liable to be choked with organic matter. One set of push button shall be provided near the pump set. The suspended organic matter washed in the degritting system will be returned to the distribution chamber. Impeller shall be of SS CF8M and shaft shall be of SS 316L.

(e) In the event of tripping of working grit equipment drive (motor), the sizing of this equipment (including motor) shall be done in such a way that it shall take the overhead to remove the excess grit collected after starting of the tripped grit removal equipment.

12 Membrane Diffusers

The type of membrane diffuser shall be as below

- a) Fine Bubble tubular Membrane Diffusers
- b) Disc Fine Bubble Aeration System

12.1 Fine Bubble tubular Membrane Diffusers

Provide a removable header arrangement that provides complete mixing of basin contents.

Space diffusers evenly along each header to provide full floor coverage.

Furnish all components necessary to provide a complete mixing system within each Pre-Aeration Tank. Work shall include but not necessarily be limited to the following:

Flanged connections (SS 316) at the upstream side of each drop leg for connection to an isolation butterfly valve.

Stainless steel Drop legs (SS 316).

Slip joint connections to the air distribution header (SS 316).

Stainless steel Air distribution headers (SS 316).

Diffuser connectors (SS 316).

Diffusers (Cylindrical, elastically membrane type) in silicon rubber material with anti-microbial coating.

Anchored Supports (SS 316)

Gaskets.

Header joints (SS 316).

Bolts, nuts and washers (SS 316).

Space diffusers evenly along the air headers.

Provide two tubular diffusers at each header connection. Mount to a reinforced tee located on the bottom centerline of the header. The reinforced Tee shall be adjustable to allow accurate alignment of the diffuser.

The Diffusers should be able to withstand high blower air and water temperature.

12.2 Diffuser Assembly

Field Oxygen transfer efficiency: minimum 18.0 %.

Non-clog, tubular design with inverted air reservoir.

Bottom deflector to prevent debris from entering diffuser assembly.

Full profile end caps to prevent air blow off.

Stainless Steel 316 L construction.

Minimum length: 650 mm.

Installation pitch: 100 -600 mm.

Provide orifice flow control to ensure orifice head loss is at least 2.5 times the head loss in the air header at all air flow rates in the diffuser's design operating range.

Space diffusers along air header to provide uniform mixing of the pre-aeration tank contents.

12.3 Air Header and Droplegs

(a) Header and drop legs shall be constructed of 316 L stainless steel.

1. Fabricate air distribution header in sections up to a maximum of 12 meters in length.

2. Bottom elevation of the air distribution header shall be same throughout the tank.

3. Provide removable end cap at header ends.

4. Design connections between sections of the air distribution header to allow individual header sections to rotate independently of adjacent header sections.

5. Header dimensions shall conform to dimensional tolerances specified in ASTM A554-89 and ASTM A530-87.

(b) Furnish a drop leg from the air main connection at the top of the tank.

1. Provide a slip joint connection between the drop leg and distribution header.

2. Support the drop leg from the connection at the air header.

(c) Use factory welding only; field welding shall not be allowed.

1. Wire brush outside of each weld area.

2. Remove all discoloration and deposits left by welding by pickling.

3. Factory weld all diffuser connections. Stiffen both the diffuser connectors and the headers to withstand a moment of 56.5 N.m at the connector without permanent deformation.

(d) Passivate all SS 316 assemblies and parts after fabrication by immersion in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid at 60° C for a minimum of 15 minutes.

1. Neutralize by immersion in a tri-sodium phosphate rinse.

2. Submit certificate that this has been done.

12.4 Supports and Anchors

- (a) Provide wall and floor mounting supports for all drop legs and air headers as necessary to anchor firmly on the wall and to the bottom of the tank and as specified herein.
- (b) Anchor supports to concrete walls and floors using stainless steel expansion bolts sized and spaced as required for the loads encountered.
- (c) Design supports to allow leveling the air header and diffuser assemblies to within specified tolerances.
- (d) Provide expansion couplings in the drop legs and air headers as necessary to accommodate anticipated thermal expansion and contraction.

The raw wastewater temperature is expected to vary between 20 and 35 degrees Centigrade.

The ambient air temperature is expected to vary between 10 and 45 degrees Centigrade.

The aeration air will be compressed to a pressure of approximately 0.55 bar.

Submit expansion coupling design as well as computations for sizing.

12.5 Spare Parts (Uninstalled Shelf Spares)

Provide spare parts in the quantities indicated. The cost of the same deemed to be included in Contractors quoted price.

<u>Item</u>	<u>Quantity</u>
Diffuser Assemblies	10%
Orifice Inserts	10%

12.6 Installation

- (a) Install all components in accordance with the manufacturer's instructions and recommendations.
- (b) Install all diffusers to within +/- 10 mm of a common horizontal plane.

12.7 Field testing

- (a) All Fine bubble diffused aeration systems will be field tested.

(b) Testing will verify the installation as well as the diffuser's ability to deliver the specified air flow rates at the manufacturer's stated pressure loss. Testing will also verify the uniformity of mixing provided.

(c) Leveling tests:

Introduce clear water into each tank to the top of the diffuser elements.

Check the level of the diffusers to document that all element horizontal surfaces are within 10 mm of a common horizontal plane and at the specified elevation.

12.8 Leakage and distribution of flow tests:

After successful completion of the leveling tests, raise the water level to 50mm above the manifold.

Visually inspect the water surface to ensure that the airflow is uniformly distributed across the tank.

Pressure test:

All of air supply pipe line shall be tested by pressure. Test pressure shall be at least 2 times higher than normal operation pressure.

If client is unsatisfied any test result, repeat the test until the installation is essentially void of air leaks.

Repair any leaks in the elements holders, elements, pipes or the like.

12.9 Disc Fine Bubble Aeration System

Design:

The Disc type membrane diffuser shall be developed specifically for Releases 1~3mm fine bubble in the wastewater treatment plant. All materials have been selected for their ability to withstand the effects of the chemical, bio-chemical agents and 0~100°C used in wastewater tank. The diffuser can be placed in an evenly distributed grid system over the entire aeration tank bottom. Air can be easily through the air orifice and integrated non-return valve into the wastewater. The air orifice design to maintain the diffuser standard airflow input prevented the max. Air enters to damage diffuser membrane. The membrane shall be secured onto the support dish with a constrict flex rim and retaining ring designed to increase the tension on the point of engagement as the diffuser air rate increases.

Construction:

The materials of construction for both support dish and membrane diaphragm are non-corrosive and UV resistant. The support dish shall be upward facing convex plastic (Glass filled reinforced Polypropylene) for working without any acid dosing requirements and integrated non-return valve designed for back-flow prevention while airflow is interrupted. The membrane diaphragm which covers the dish is made of high grade EPDM resistant to the usual sewage ingredients. The membrane shall be further fastened to the support dish with a U-type retaining ring without special tools for fastening or replacement the membrane.

Aeration system shall be retrievable grid, Disc / Tubular type membrane fine bubble aeration system

The fine bubble aeration system will comprise:

Stainless steel (SS316) droplegs and Headers.

PVC manifolds and air distributors.

PVC diffuser holders and retainer rings.

Stainless steel supports and anchors

Bolts, nuts and gaskets for aeration system flange connections.

Air distributor purge systems.

Disc / Tubular type Membrane diffusers with integral O-ring gaskets and sub plates.

The following design features will be incorporated in the fine bubble aeration system:

Fabricated manifold with fixed threaded union joints for connection to the air distributors.

Manifold sections connected with fixed threaded union or flanged joints to prevent rotation or blow apart.

Manifold, distributor connections and supports designed to resist thrust generated by expansion/contraction of the air distributors over a temperature range of 70°C

Air distributors perpendicular to the air manifold

Fabricated distributors with single diffuser holders solvent welded to the crown of the air distributor for complete air seal and strength.

Distributors and holders designed to resist a dead load of 90kg applied vertically to the outer edge of the diffuser holder.

Air distributor sections joined with positive locking fixed threaded union or flange type joints for all submerged header joints to prevent blow apart and rotation. Bell and spigot, slip on or expansion type joints are not acceptable for submerged joints.

Threaded union joints designed with spigot section connected to one end of the distribution header, a threaded socket section connected to the mating distribution header, an "O" ring gasket and a threaded screw on retainer ring. Solvent welding shall be done in the factory.

Air distributor support spacing at a maximum of 2400mm.

All supports designed to allow for thermal expansion and contraction forces over a temperature range of 70°C and to minimize stress build up in the piping system

Supports designed to be adjustable without removing the air distributor from the support.

Diffuser assembly comprising: diffuser membrane with integral 'O' ring, sub-plate, holder, retaining ring and air flow control orifice.

Integral check valve incorporated into the membrane diffuser assembly

PVC support plate incorporated to form an air plenum under the diffuser and support for the membrane when the air is off

Retainer ring threads designed with minimum cross section of 3mm and to allow for one complete turn to engage threads.

A liquid purge system to drain the entire submerged aeration piping system for each aeration grid including airlift purge eductor line and manual control valve.

Two parts by weight of titanium dioxide per 100 parts of resin will be added to PVC compounds for manifolds, air distributors, joints and PVC diffuser assembly components to minimize ultraviolet light degradation.

All PVC joints will be factory solvent welded. Field solvent welding will NOT be permitted.

Circular membrane diffuser discs with integral O-ring will be manufactured of EPDM synthetic rubber compound with precision die formed slits. Thermoplastic materials (i.e. plasticized PVC or polyurethane) are not acceptable.

Carbon black will be added to the EPDM material for resistance to ultraviolet light.

The maximum tensile stress on the diffuser will be limited to 10 psi (69 kPa) when operating at 2.4 SCFM/sq. ft. (43.9 Sm³/h per m²) of material. Proportionately thicker material is to be furnished for larger diameter disc diffusers to limit the maximum tensile stress and to resist stretching.

Supports and anchors, spare parts, installation method, field testing, leakage and flow distribution tests shall be same as per above clause nos. 7.18.3 to 7.18.7.

12.10 Air Blowers

Compressor blowers shall be of the tri/twin lobe Roots type, each provided with inlet filter and silencer, pressure reducing valve, pressure gauges, pressure relief valve, drain, air flow

indicator and acoustic bend or silencer in the delivery branch. Bearing housings and gear boxes shall be separated from the blower housings by air spaces. The units shall be complete with a self contained oil cooling system for the bearings. The blowers shall be housed in a separate sound proof room to reduce the noise level or inside acoustic enclosure. The noise level shall not exceed 85 dBA at 1 meter from the Blower.

The capacity of blower shall be as per the air requirement of incoming sewage. The blowers shall be supplied with Variable Frequency Control. Directly coupled design shall be preferred. VFD motors shall be suitably derated.

The bearings shall be generously designed to give long operational life. Bearings at the drive end may be oil or grease lubricated. The gears and bearings at the non-drive end shall be oil lubricated. Bearings shall be provided with oil throwers to prevent leakage of oil. The blower shall be arranged for horizontal inlet and vertical outlet, delivery velocity not exceeding 25 m/s and each blower shall be provided with following components but not limited to:

Common base frame for Blower & Motor.

Inlet silencer and filter.

Discharge Silencer & non-return valve in delivery branch.

Butterfly valves in both inlet and delivery branches.

Pressure relief valve or excess pressure safety device.

Bellows type couplings on inlet and delivery branches.

Acoustics Enclosure.

V-Belt drive arrangement with Belt Guard.

Isolating valves, Pressure reducing valves & Pressure gauges

Air Flow meters, Temperature gauges.

Water trap.

The interconnecting pipe work shall be flanged to BS EN 1092-1/BS: 4504. A drain cock shall be provided at the lowest point in the each delivery pipe work along with reflux valve. Individual stop valves and safety valves shall be provided for each unit

Blowers shall be driven by squirrel cage motors through a matched V-belt drive. Motors shall be mounted on slide rails mounted on a common bed plate, to facilitate the tensioning of the belts. Blowers shall not run above 1000 rpm.

Each delivery branch shall include a drain at the lowest part and a reflux valve. Each blower shall contain one inlet air pressure, one discharge air pressure, and one discharge air temperature gauge. The pressure gauges shall be calibrated in kPa absolute and be of the compound type. The gauges shall have circular dials, minimum 100 mm diameter with black figures on white background. Pressure gauges shall be furnished with pulsation damper. Temperature gauges shall be manufactured with standard temperature bulb.

Appropriate cooling arrangement shall be provided at the blower discharge line so as to bring down the outlet air temperature within tolerable limits, so as to safeguard the life of fine bubble diffusers and satisfactory performance of the same.

TESTS

Sl. No	Tests	Specs
1	Hydrostatic tests	Twice the maximum working pressure
2	Performance test	As per BS : 1571
3	Strip test	Clearances with tolerance limit
4	Mechanical balancing	ISO 1940 Gr. 6.3 or better
5	Visual Inspection	Before painting

Acoustical Enclosure

Provide a factory assembled acoustical enclosure around the entire blower. Disassemble the enclosure as necessary for shipment. Provide either removable or hinged doors for access to all blower parts and components for servicing and maintenance. Size access panels to allow easy access by a single operator. Hinges, fasteners and appurtenances shall be stainless steel.

Provide clear, transparent Lexan or plastic windows to visually observe gauges and lever arms of the variable guide vanes and diffusers.

Mount an auxiliary exhaust fan and thermostat on the acoustical enclosure to provide air circulation after blower shutdown or when the temperature inside the enclosure exceeds 40oC.

The free field A-weighted sound pressure level measured in four quadrants at 1 metre distance from the enclosure shall average 85 dBA, or less. Measure with a Type 1 instrument suited for checking compliance with Environmental and Occupational Noise Rating Recommendations.

12.11 Mechanical Submersible Mixer

General

Mechanical floating mixer and related equipment accessories shall consist of a motor, direct-drive impeller driven at a constant speed, an integral flotation unit, and impeller volute.

Performance

Each mixer shall have a zone of complete mix and a direct pumping with a recirculation. Complete mix shall be defined as maintaining biological suspension of all mixed liquor suspended solids with design MLSS or less without the introduction of air.

(c) Mixer Drive Motor

The motor shall be rated for 415 volt, 50 hertz, three-phase service. The motor shall be standard efficiency, vertical P base design, totally enclosed fan cooled TEFC, and generally rated for severe duty. The motor shall in all cases equal or exceed standard NEMA specifications. A minimum service factor of 1.15 shall be furnished.

The motor winding shall be nonhygroscopic, and insulation shall equal or exceed NEMA Class "F". A labyrinth seal shall be provided below the bottom bearing to prevent moisture from penetrating around the motor shaft. A condensate drain shall be located at the lowest point in the lower-end bell housing. Unit shall have a one-piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the propeller. The shaft shall be manufactured from high quality stainless steel. Motor bearings shall be regreasable. Sealed bearings are not acceptable.

(d) Motor Mounting Base

The motor shall be securely mounted onto a solid 304 stainless steel base which is integral with the motor base extension. All submersed wetted motor mounting base components shall be constructed of 304 stainless steel.

(e) Flotation

Each unit shall be equipped with a modular float constructed of fiber reinforced polyester skin FRP or equivalent with a central float passage of a size to allow installation and removal of the pump impeller. The float shall be foamed full of polyurethane foam of the closed cell type, and shall be totally sealed to prevent the foam from being in contact with the external environment.

(f) Impeller

The impeller shall be designed to pump the liquid from near the surface and direct it down toward the vessel/basin bottom. The impeller shall be a two-blade marine type precision casting of 316 stainless steel and shall be specifically designed for the application intended. It shall be dynamically and hydraulically balanced. The propeller must be attached to the motor shaft with a hardened stainless steel pin and set screw. Impeller shall be capable of being reversed to

cause back flow liquid movement without causing damage to the mixer chassis and without causing upflow liquid damage to the motor bearing and windings. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed.

(g) Intake Volute Assembly

The impeller shall operate in a volute made of 304 stainless steel plate

(h) Vibration

The entire rotating assembly including the motor rotor, shaft, shaft accessories, and impeller shall be dynamically balanced within 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing. Measurements shall be taken at a frequency equivalent to the motor RPM. Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads.

(i) Cable Mooring System

Each unit shall be provided with a maintenance cable mooring system complete with mooring cable, clips, thimbles, quick disconnects, anchors, and extension springs as shown on the drawings. Mooring cable, anchors, and hardware shall be 304 stainless steel. Field attachment of mooring points to the tank shall be the responsibility of the installing contractor.

(j) Cable Mooring Electrical Service Cable

Each unit shall include conductor power cable wired into the motor conduit box and terminating at the basin wall. Electrical cable shall be supplied with kellems grips at the motor and basin wall terminations. Electrical cable floats for flotation of electrical service cable shall be provided. Attachment of cable and supply of junction box/disconnect at the basin wall shall be the responsibility of the installing contractor. 304 stainless steel adhesive anchors for attachment of mooring system components to the basin wall shall be provided.

13 Dewatering Equipment

Sludge from thickener shall be dewatered through dewatering units like centrifuge, filter press, belt press etc.

The Dewatering Machine and its peripheral equipment shall include but not necessarily be limited to the following;

Powder or liquid Coagulant (polyelectrolyte) storage tanks.

Mixers and solution tanks.

Coagulant service tanks.

Supply line & flush line.

Chemical feeding pumps.

Water supply pumps.

Sludge feeding pumps.

Dewatering Centrifuge

Belt conveyor.

Cake hopper.

Flow meters for feeding Sludge, and for feeding chemical solution.

Control valves on sludge feeding line, and on Chemical feeding line.

Drain system

Dewatered cake shall be conveyed by a belt conveyor to cake hopper for carrying out for disposal as appropriate as directed by Employer's Representative.

13.1 Decanter Centrifuge

The centrifuge shall comprise a conical cylindrical bowl and scroll feed horizontally mounted in bearings on a frame. The centrifuge bowl and scroll support frame shall be mounted on a fabricated steel sub-frame.

The bowl and scroll shall be made from stainless steel AISI 316 material. The leading faces of the scroll shall be protected against abrasive wear by the application of a suitable hard-coated material.

The whole rotating assembly shall be enclosed by a Stainless steel (AISI316) fabricated casing incorporating a Centrate discharge hopper and outlet pipe, and a rectangular solids hopper which shall discharge the dewatered sludge into the disposal system.

The rotor shall consist of a solid bowl which is conical-cylindrical in shape and which rotates about a central shaft. An inner scroll shall be provided to convey separated sludge from the periphery of the cylindrical bowl to the beach at the conical end of the rotor.

The main scroll bearings shall be arranged for lubrication by an external lubrication system. Wherever practicable greasing nipples shall be arranged together as a battery. The complete rotating assembly shall be dynamically balanced and test certificates provided.

Sludge shall be fed into one end of the rotor through a centrally positioned feed tube and dispersed to the bowl through an inlet chamber.

The bowl shall be provided with an adjustable 360° peripheral weir at its cylindrical end to control the depth of the Centrate in the rotor.

The fixed outlet castings of the rotor shall be designed to collect the centrate and dewatered sludge from the rotor. Baffles within the casing shall direct the separate phases to the relevant discharge points and prevent cross-contamination.

The centrifuge shall be mounted on heavy-duty vibration isolators, located between the machine and the supporting steelwork or foundations, to damp vibrations and prevent vibration transmission. Two axis vibration monitors shall be provided to stop the centrifuge automatically when excessive vibration is detected.

Provide a factory assembled acoustical enclosure around the entire centrifuge assembly. Disassemble the enclosure as necessary for shipment. Provide either removable or hinged doors for access to all centrifuge parts and components for servicing and maintenance. Size access panels to allow easy access by a single operator. Hinges, fasteners and appurtenances shall be stainless steel.

The free field A-weighted sound pressure level measured in four quadrants at 1 metre distance from the enclosure shall average 85 dBA, or less. Measure with a Type 1 instrument suited for checking compliance with Environmental and Occupational Noise Rating Recommendations.

Flexible connections shall be provided on the sludge fed system and the Centrate system at the centrifuge. The dewatered sludge discharge system shall incorporate flexible chutes.

(e) (i) Variable Speed Drive

A variable speed drive shall be provided to accelerate the rotor to operational speed and maintain that speed during the centrifuge's duty period. The bowl drive shall be electric or hydraulic and shall be coupled to the drive shaft by a multiple 'V' notch belt drive.

(e) (ii) Differential Scroll Drive

The scroll drive shall be provided with a separate drive mechanism to control its rotation in the same direction but at a different speed to the outer bowl. The differential speed shall be adjustable.

The drive shall be linked to the main bowl drive by an epicyclic gearbox. The differential speed of the scroll shall be automatically and manually adjustable so that the moisture content of the dewatered sludge can be controlled as required.

For safe operation, contractor shall provide control panel showing proper Sequence of operation with interlocking.

Chutes and interconnecting piping shall be provided with flexible joint (minimum 10 mm flexible in all direction) to avoid vibration.

The dewatered sludge cake shall have a dry solid content of 20% or better.

14 Progressing –Cavity Pumps (for centrifuge feed pumps)

Pumps shall be of the type in which a pumping action is generated by a helical rotating eccentrically within a resilient stator in the form of a double internal helix. The eccentric motion of the rotor shall maintain a constant seal across the stator as it travels through the pump to give a uniform positive displacement.

Pumps shall be arranged generally with a single shaft seal at the suction end. Mechanical seals shall be used. If a flexible shaft is used to accommodate the eccentric motion, a corrosion resistant shroud shall be fitted to prevent fiber build-up on the shaft. Enlarged inspection access holes shall be fitted to the suction chambers of all pumps for periodic removal of accumulated debris. The shaft bearing shall be positively isolated from the fluid being pumped.

The rotor material shall be selected for corrosion and abrasion resistance for the fluid being pumped, and for prolonged service life. Hard chrome or other approved coatings shall be not less than 250 micron thickness and shall be diffused in to the base material. The rotor shall

Generally be single-stage and shall incorporate not less than 3600 of twist, but for high-head applications, it may be necessary to use more than a single-stage. The stator shall be of a resilient material selected for chemical and abrasion resistance for the fluid being pumped. Pump speed shall suit the application, where variable delivery output is needed; the pump shall be provided with a variable-speed drive. The size and speed range of the pump shall ensure that the highest expected duty point shall lie within the available speed range.

Pumps shall normally be driven by a fixed-speed electric motor through reduction gearing and the combined drive shall be continuously rated. Pump and motor shall preferably be mounted in-line on a common base plate. Alternatively, the drive motor may be top-mounted above the pump to minimize floor area, and shall be connected by external V-belts and pulleys. V-belt drives shall have full guards of the type that allow the belts observed without removal of the guard. Facilities shall be provided for ready adjustment of belt tension.

Coupling guards shall be provided, which shall be rigid, securely fixed, and designed so that removal is not necessary during normal operation, routine maintenance and routine inspections.

All motor enclosures shall be provided with ingress protection to IP55. Motor anti-condensation heaters shall be provided and shall be suitable for use on a 220V single-phase, 50Hz supply. All bearing shall have a B10 design life of not less than 40,000 running hours and shall be designed for loading 20% in excess of calculated maximum loading.

Pumps shall be fitted with individual dry-running protection to initiate pump trip. Dry-running protection by 'under-current' monitoring or 'pipeline-intrusive' device shall not be used.

Material of Construction;

S. No.	Component	Material
1	Pump Housing	CI IS210 Grade220 or 260
2	Rotor	SS AISI 316(HCP)
3	Shaft	SS AISI 316(HCP)
4	Stator	Nitrite black
5	Type of drive	V belt & Pulleys
6	Base plate	MS fabricated
7	Seal type	Gland packing

Pumps models (handling water) shall be selected such that when handling sludge it meets the required duties of the viscous liquid. Pumps shall be selected which gives the required duties close to best efficiency point.

15 Drainage Pump set

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

The pump shall run without undue noise and vibration.

The power rating of the pump motor shall not be less than the power required for start up.

Pump shall be submersible type with double mechanical seals. Motor shall be of IP 68 protection.

It shall be suitable for handling turbid water. Pump and motor shall have common shaft.

Delivery pipe of drainage pump sets shall be of size 40 NB and as per IS 1239, heavy class. Required length of pipes and fittings shall be provided. Pumping main shall be common for two pumps.

Level switch to start and stop the pump automatically shall be supplied with the pump. A level indicator shall also be provided.

The capacity, total head and range of operating head of drainage pump set shall be as specified in particular mechanical requirements.

The material of construction of pumps shall be as follows :

S. No.	Component	Material
(i)	Impeller	Stainless Steel :ASTM743CF8M
(ii)	Casing	Cast Iron : IS 210 Gr. FG 200
(iii)	Shaft	Stainless Steel: BS:970 GR 410

16 Fire Extinguishers

Portable fire extinguishers are to be provided for all units/buildings as per the requirement of Tariff Advisory Committee (TAC) or meeting the requirement of local regulations whichever is more stringent.

All the extinguishers shall be of TAC approved.

17 Propeller Exhaust Fan

The fan should comply with IS 2312.

The blades shall be of mild steel and properly balanced so as to avoid noise and vibration.

The blade and blade carriers shall be securely fixed so that they do not loosen in operation. The means provided for securing the fan mounting or fan casing to the wall partition or window shall be such as to provide a secure fixing without damage to the fan or wall.

Suitably designed guards shall be fitted to the inlet and the outlet side to prevent accidental contact. No flammable material shall be used in the construction of fan. Moulded parts, if used, shall be of such materials as to withstand the maximum temperature attained in the adjacent component parts.

The fan shall have protective insulation or be capable of being earthed. A fan with protective insulation may be of all insulated construction or have either double insulation or reinforced insulation. Each fan should be provided with a 10 sq.mm mesh bird screen. The sheet used for the cowl should be 14 G.

18 Air-conditioning Equipment

The air conditioning units shall be of split type, with the outdoor condensing unit mounted on the terrace of the room or grouted on external side of the wall with suitable brackets.

This equipment shall be provided in the SCADA room, conference room and administration office.

19 Valves

Valves shall be as per internationally recognized standards. Flanges shall be machined on faces and edges. Flanges shall conform to ISO 7005, IS 6392 ,BS EN 1092-1/ BS 4504.

Valves shall be double flanged type and the faces shall be parallel to each other. The flange face should be at right angles to the valve centreline. Back side of valve flanges shall be machined or spot faced for proper seating of the head and nut.

Valves buried or installed in underground chamber, where access to a handwheel would be impractical, shall be operated by means of extension spindle and/or keys. Wherever extension spindle is provided, the valve shall also be provided with suitable headstock.

Valve of diameter 450 mm and above shall be provided with lifting eyes and shall have detachable bolted covers for inspection, cleaning and servicing.

Valve shall be suitable for frequent operation as well as operation after long periods of idleness in either 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.

Valves shall be free from sharp projections which are likely to catch and hold stringy material.

All the valve shall be of 10 bar rating.

All the valves on the suction and delivery side of the Intermediate sewage pumping station shall be of Knife gate type.

All the valves on the suction and delivery side of the Return activated sludge pumping station and for sludge application shall be of Knife gate type.

All the valves provided at the delivery side of the Intermediate pumping station shall be motor operated.

2 sets of ladders shall be provided in the raw sewage pumping station to facilitate access of valves.

Telescopic valves shall be provided in sludge storage tanks for sludge withdrawal purpose.

19.1 Electric Actuator – deleted (not used)

20 Domestic Water Pump sets

The Pump shall be of Centrifugal type, self priming and monoblock type, All the necessary piping with union, bends and tees shall be provided. Suction and discharge isolation valves and non-return valves on the discharge side shall be forged steel. Piping shall be as per IS: 1239 heavy class.

21 Quality

All the equipment, to be supplied under this contract, have to be as per the List of Approved Makes or the experienced manufacturer. The equipment of only those manufacturers, who have sufficient proven experience of manufacturing the respective equipment of similar capacity, shall be considered. The respective equipment should have been manufactured, supplied on at least 5 installations, commissioned successfully and should be running satisfactorily since at least last 5 years continuously.

22 Warranty

A. Comply with the requirements of each type of Equipment and specification mentioned elsewhere in this document.

B. Warrant all components to be free of defects in materials or workmanship for 12 months from date of satisfactory completion of performance test.

C. Individual warranties by component manufacturer in lieu of single source responsibility by the main Equipment manufacturer shall not be acceptable.

D. Items which fail during the warranty period, excluding expendable items, shall be replaced without cost to the Employer.

E. Provide manufacturer's guarantee and warranty certificates prior to equipment start-up

23 Pipelines, Pipe work and Fittings

23.1 Applicable codes

The following codes and standards unless specified herein shall be referred to, or equivalent to the approval of Employer's Representative.

23.2 Materials

IS	210		Specification for grey iron casting
:			

IS :	290	Specification for coal tar black paint
IS :	456	Code of practice for plain and reinforced concrete
IS :	458	Specification for pre cast concrete pipes (with and without reinforcement)
IS :	516	Method of test for strength of concrete
IS :	638	Specification for sheet rubber jointing and rubber insertion jointing
IS :	783	Code of practice for laying of concrete pipes
IS :	816	Code of practice for use of metal arc welding for general construction in mild steel
IS :	1367	Technical supply conditions for threaded steel fasteners
IS :	1387	General requirements for the supply of metallurgical materials
IS :	1500	Method for Brinell hardness test for metallic materials
IS :	1536	Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage
IS :	1537	Specification for vertically cast iron pressure pipes for water, gas and sewage
IS :	1538	Specification for cast iron fittings for pressure pipes for water, gas and sewage
IS :	1916	Specification for steel cylinder pipes with concrete lining and coating
IS :	2078	Method for tensile testing of grey cast iron
IS :	3597	Method of tests for concrete pipes

IS :	3658	Code of practice for liquid penetrant flow detection
IS :	5382	Specification for rubber sealing rings for gas mains, water mains and sewers
IS :	5504	Specification for spiral welded pipes
IS :	3589	Specification for Steel pipes for water and sewage
IS :	6587	Specification for spun hemp yarn
IS :	7322	Specification for specials for steel cylinder reinforced concrete pipes
IS :	4984	Specifications for HDPE pipes for water supplies and sewerage
IS :	14333	Specifications for HDPE pipes for sewerage Application
IS :	8329	Specifications for DI pipes
IS :	9523	Specification for ductile iron fittings for pressure pipes for water, gas and sewage
IS :	11906	Recommendations for cement mortar lining for cast iron, mild steel and ductile iron pipes and fittings for transportation of water
IS :	12820	Specification for dimensional requirements of rubber gaskets for mechanical joints and push-on joints for use with cast iron pipes and fittings for carrying water, gas and sewage

23.3 Code of Practice

IS :	783	Code of practice for laying of concrete pipes
IS :	3114	Code of practice for laying of cast iron pipes
IS :	3764	Excavation work - Code of Safety

IS : :	4127	Code of practice for laying of glazed stoneware pipes
IS : :	5822	Code of practice for laying of electrically welded steel pipes for water supply.
IS : :	12288	Code of practice for laying of ductile iron pipes

23.4 Materials for Pipelines

Each pipeline shall be constructed in a material compatible with the fluid conveyed through that pipeline, i.e. the materials used in the pipes which are or can be in contact with the untreated or treated sewage, shall not contain any matter which could impart taste or odor or toxicity or otherwise be harmful to health or adversely affect the sewage conveyed. Nor shall any pipe be adversely affected by the fluid being conveyed through that pipe.

Pipe work and valve materials for the following duties shall be as follows or equivalent to the approval of the Employer's Representative:

TABLE 13.1 PIPE WORK AND VALVE MATERIALS

Application / Location	Material
Chlorine: Drum connections	cadmium plated 70/30 copper nickel CN 107, BS 2871 : Part 1
Chlorine gas or liquid	flanged or welded carbon steel, CAF flanged joints
Chlorine gas lines below atmospheric pressure	polyvinylidene fluoride (PVDF) with solvent welded or flanged joints/ Class E UPVC in concrete covered ducts outside building.
Chlorine solution	Inside building and in exposed areas, rubber lined carbon steel Valves shall be globe type with forged steel bodies, monel spindles, stainless steel seats and PTFE gland packing or carbon steel, monel plug, PTFE sleeved plug UPVC/HDPE

Application / Location	Material
Polyelectrolyte dosing line	
Water: Service water	GI (below 80mm), ductile iron (80mm and above)
Air: Process Air	Mild steel Galvanised , for exposed or buried service and Stainless steel AISI 316 for submerged service.

23.5 Un plasticised PVC Pipes and Fittings

Unplasticised polyvinyl chloride pipes, fittings and specials shall be to BS 3505 for potable water and BS 4346: Part 1 for fittings.

The pipes shall be of the spigot and socket type with approved gasket type flexible joint. The rubber gaskets shall be to BS 2494, Class C.

Where PVC pipes, fittings and specials are to be connected to cast iron, stainless steel or steel pipes, 'Viking Johnson' type flange adaptors or stepped couplings shall be used.

23.6 Polyethylene Pipes

Polyethylene pipes shall comply with BS 6437. The welding method shall be adapted to international standard and contractor shall obtain the approval of the Employer's Representative before proceeding with such works.

23.7 Rubber Hosing

Rubber hosing shall conform to BS 5119, Type 2. It shall be capable of handling chlorine and sulphur dioxide solutions at a working pressure of 12 bar.

23.8 Copper Tubes and Fittings

Copper tubing and fittings for work above ground level shall comply with BS 2871 and BS 864: Part 2 respectively and be jointed with capillary joints. For underground location the copper pipe shall be to BS 2871: Part 1.

23.9 Flanged Joints

All flanges shall comply with BS EN 1092-1/BS 4504. The nominal pressure rating for particular flanges shall be at least equal to the highest pressure rating of the pipes or fittings to which they are attached, but with a minimum nominal pressure of PN 10. All flanges shall be provided with all necessary nuts, bolts, washers and gaskets. In general, valves shall have flanged body ends.

All flanged joints which are buried or in chambers shall be protected with Densomastic and Densotape wrapping, applied in accordance with the manufacturer's instructions.

Flanges shall be installed on the pipes in the factory and field welding of flanges shall only be allowed with the approval of the Employer's Representative.

Where pipework outside pumping stations and surge vessel chambers is cathodically protected, an insulated flange shall be incorporated at the first flange inside the structure. These flanges shall be tested to ensure that electrical insulation is achieved.

23.10 Gaskets and Joint Rings

Joint rings shall be manufactured to conform with BS 2494 and shall be of chloroprene rubber or other approved synthetic material suitable for temperatures up to 80°C.

Gaskets may be inside the bolt circle type and shall comply with BS 4865: Part 1. Alternatively the gasket shall be to the full diameter of the flange, drilled to suit the appropriate bolt provisions.

Chloroprene rubber with a hardness of 71 to 80 IRHD shall be used.

Joints shall be made in accordance with manufacturer's instructions or as specified herein.

Until immediately required for incorporation in a joint, each rubber ring or gasket shall be stored in the dark, free from the deleterious effects of heat or cold, and kept flat so as to prevent any part of the rubber being in tension.

Only lubricants recommended by the manufacturer shall be used in connection with rubber rings and these lubricants shall not contain any soluble constituent, shall be suitable for the climatic conditions at the Site and shall contain an approved bactericide.

After cleaning the flanges the gaskets shall be fitted smoothly to the flange and the joint shall be made by tightening the nuts to finger pressure first. Thereafter the final tightening of the nuts shall be made by gradually and evenly tightening bolts in diametrically opposite positions using standard spanners.

Graphite grease shall be applied to the threads of bolts before joints are made.

23.11 Flexible Couplings and Flange Adaptors

Flexible couplings and flange adaptors shall be of the Viking Johnson or similar approved pattern and be assembled in accordance with the manufacturer's instructions and protected, if buried or in chambers with Densomastic and Densotape wrapping applied in accordance with the manufacturers' instructions. Flexible joints shall be harnessed or tied where necessary

23.12 Storage & Shipment

23.12.1 Protection of Pipes and Fittings for Shipment

Except where otherwise specified all items shall have received their complete protective coatings before dispatch from the manufacturer's works and shall be additionally protected by approved means for the period of transit, storage and erection, against corrosion and accidental damage.

For the protection of pipe linings and in particular for protecting cement mortar linings from drying out, protective metal or timber Disc / Tubular type shall be fitted over the ends of pipes and fittings. Similar timber protective Disc / Tubular type shall be attached to all flanges of pipes and fittings, by means of bolts specifically provided for the purpose and which shall be discarded when the item is incorporated in the Works. The sleeves and flanges of flexible joints shall be wired together in suitable bundles.

23.12.2 Storage of Pipeline Materials

Pipes and fittings shall be stored raised off the ground, and shall be carefully supported, cushioned and wedged. Pipes shall not rest directly on one another and shall not be stacked more than four pipes high or two pipes high in the case of pipes of 500 mm diameter or over. Special care shall be taken to ensure that flexible pipes are cradled and supported in a manner that prevents any distortion of the pipes.

Couplings and joints (and all components thereof) and other similar items shall be stored in dry conditions, raised from the ground in sheds or covered areas.

Storage areas shall be carefully set out to facilitate unloading, and checking of materials with different consignments stacked or stored separately with identification marks clearly visible.

Where items to be stored have a limited shelf life or require special storage arrangements, the method of storage shall be to the approval of the Employer's Representative and in accordance with the manufacturer's instructions.

All pipes and fittings supplied as spares shall have end covers which are proof against the entry of sand and vermin. Mortar lined pipes and fittings shall have end covers which form a complete seal, provision being made to accommodate the effects of temperature changes. Pipes and fittings supplied as spares shall have a temporary white external finish and shall be stored sheltered from the direct rays of the sun.

End covers and protection shall not be removed until incorporation of the pipes and fittings into the Works.

23.13 Transportation of Pipes and Fittings

Any vehicle on which pipes are transported shall have a body of such length that the pipes do not overhang. Large pipes shall be placed on cradles and the loads properly secured during transit. The pipes shall be handled in accordance with the manufacturer's recommendations.

Approved slings shall be used and all hooks and dogs and other metal devices shall be well padded. Hooks engaged on the inner wall surface at pipe ends shall not be used. Steadying ropes shall be employed. The positions of lifting slings shall ensure that stresses and tendency towards deformation in the pipes are kept at a minimum.

Pipe handling equipment shall be maintained in good repair and any equipment which in the opinion of the Employer's Representative may cause damage to the pipes shall be discarded.

Under no circumstances shall pipes be dropped, be allowed to strike one other, be rolled freely or dragged along the ground.

23.14 Inspection of Pipes and Fittings

Before incorporating into the Works each pipe shall be brushed out and carefully examined for soundness. Damaged pipes which in the opinion of the Employer's Representative cannot be satisfactorily repaired shall be rejected and removed from Site.

Damage to pipe coatings or linings shall be repaired to the satisfaction of the Employer's Representative.

23.15 Built-in Pipe work and other Plant

The pipes and other Plant in water retaining structures shall, wherever possible, be built in as the work on the structure proceeds. The Contractor shall ensure that delivery of the requisite pipe work and other Plant is in accordance with the requirements of the programme.

Where a pipe subject to thrust passes through a concrete structure or where an external seal is required, a puddle flange shall be used. The puddle flange dimensions shall be to BS EN 1092-1/BS 4504 but shall be undrilled. The exterior of the pipe shall be cement washed symmetrically about the puddle flange by the manufacturer for a length at least equivalent to the thickness of the wall through which it passes.

The Contractor shall be responsible through every stage of the Works for checking the correctness of the setting of built-in Plant and shall satisfy himself they are positioned in accordance with his approved drawings.

23.16 Pipe laying

23.16.1 Carting & Handling

Pipes and fittings /specials shall be transported from the factory to the work sites at places along the alignment of pipeline as directed by the Employer's Representative. Contractor shall be responsible for the safety of pipes and fittings/specials in transit, loading/unloading. Every care shall be exercised in handling pipes and fittings/specials to avoid damage. While unloading, the pipes and fittings/specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber skids with steadying ropes or by any other approved means. Padding shall be provided between coated pipes, fittings/specials and timber skids to avoid damage to the coating. Suitable gaps between pipes should be left at intervals in order to permit access from one side to other. In case of spigot socket pipes, care should be taken regarding orientation of pipes while unloading. As far as possible pipes shall be unloaded on one side of the trench only. The pipes shall be checked for any visible damage (such as broken edges, cracking or spalling of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage to preclude it from being used shall be discarded. Dragging of pipes and fittings/specials along concrete and similar pavement with hard surfaces shall be prohibited.

23.16.2 Storage

Each stack of pipes shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars of suppliers wherever possible. Storage shall be done on firm level and clean ground and wedges shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes laid lengthwise and crosswise in

alternate layers. The pyramid stack shall be made for smaller diameter pipes for conserving space in storing them. The height of the stock shall not exceed 1.5 m.

Fittings/Specials shall be stacked under cover and separated from pipes.

Rubber rings shall be stored in a clean, cool store away from windows, boiler, electrical equipment and petrol, oils or other chemicals. Particularly in the field where the rubber rings are being used it is desirable that they are not left out on the ground in the sun or overnight under heavy frost or snow conditions.

23.17 Laying

23.17.1 Excavation

Before excavating the trench the alignment of pipeline shall be approved by the Employer's Representative. The excavation of trenches and pits for manholes/ chambers shall be carried out in accordance with the Employer's Requirements described elsewhere and shall be done such that it does not get far ahead of the laying operation as approved by the Employer's Representative.

To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, red lanterns and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for the traffic to use the roadways. The relevant Indian Standards and the rules and regulations of local authorities in regards to safety provisions shall be observed.

Suitable fencing shall be provided along the sides of trenches and pits. The posts of fencing shall be of timber securely fixed in the ground not more than 3 m apart and they shall not be less than 75 mm in diameter or less than 1.2m above surface of the ground. There shall be two rails, one near the top of the post and the other about 450mm above the ground and each shall be from 50mm to 70mm in diameter and sufficiently long to run from post to post to which they shall be bound with strong rope. The method of projecting rails beyond the post and tying them together where they meet will not be allowed on any account. All along the edges of the excavation trenches a bank of earth about 1.2 m high shall be formed where required by the Employer's Representative for further protection.

The road metal and also the rubble packing shall first be stripped off for the whole width of the trench/pit and separately deposited in such place or places as may be determined by the Employer's Representative.

During excavation, large stones and rubble shall be separated and removed from the excavated soil and stacked separately. The material from excavation shall be deposited on either side of the trench leaving adequate clear distance from the edges of the trench and pit, or as may be necessary to prevent the sides of the trench pit to slip or fall, or at such a distance and in such a manner as to avoid covering fire hydrants, sluice valves, manholes and covers etc. and so as to avoid abutting the wall or structure or causing inconvenience to the public and other service organizations or otherwise as the Employer's Representative may direct.

Contractor shall take into account additional excavation if any as the Employer's Representative may require in order locating the position of water pipes, drains, sewers etc. or any other works which may be met with, in or about the excavation of trenches/pits while quoting the rates for excavation of trenches /pits while quoting the rates of excavation. Such service lines if met with during excavation shall be properly maintained by Contractor, by means of shoring, strutting, planking over, padding or otherwise as the Employer's Representative may direct, and shall be protected by the Contractor from damage during the progress of the work. All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure /pipe line of water, gas, sewage etc.

Utmost care shall be taken to see that the width of the trench at the top of pipe is not more than the minimum requirement. In case additional width is required it shall be provided only in the top portion from the ground level upto 300 mm above the top of pipe. If any extra width is provided in the area below this portion, Contractor shall have to provide remedial measures in the form of lime concrete or rubble masonry otherwise at the discretion and to the satisfaction of the Employer's Representative. If rock is met with, it shall be removed to 15 cm below the bottom of pipes and fittings/specials and the space resulting shall be refilled with granular materials and properly consolidated. Bottom of trenches/pits shall be saturated with water well rammed wherever the Employer's Representative may consider it necessary to do so.

Wherever a socket or collar of pipe or fitting/ special occurs, a grip is to be cut in the bottom of the trench or concrete bed to a depth of at least 75 mm below the bed of the pipe so that the pipe may have a fair bearing on its shaft and does not rest upon its socket. Such grip shall be of sufficient size in every respect to admit the hand all around the socket in order to make the joint and the grip shall be maintained clear until the joint has been approved by the Employer's Representative.

When welding is to be carried out with the pipes and specials in the trench, additional excavation of not more than 60cm in depth and 90 cm in length shall be made at joints in order to facilitate welding.

The excess excavated material shall be carried away from site of works to a place up to a distance as directed by the Employer's Representative. This shall be done immediately so as not to cause any inconvenience to the public or traffic. If the instructions from Employer's Representative are not implemented within seven days from the date of instructions to cart the materials and to clear the site, the same shall be carried out by the Employer's Representative and any claim or dispute shall not be entertained in this respect.

23.17.2 Dewatering

During the excavation, if subsoil water is met with Contractor shall provide necessary equipment and labourers for dewatering the trenches. The Contractor shall also make necessary arrangement for the disposal of drained water to nearby storm water drain or in a pit if allowed by the Employer's Representative. In no case the water shall be allowed to spread over the adjoining area. Before discharging this water into public sewer/drain, the Contractor shall take necessary permission from the local authorities.

23.17.3 Special Foundation in Poor Soil

Where the bottom of the trench and sub grade is found to consist of material which is unstable to such a degree that in the opinion of the Employer's Representative, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, a suitable foundation for the pipes, consisting of piling, timbers or other materials, in accordance with relevant drawings to be prepared by the Contractor and as instructed by the Employer's Representative shall be constructed.

23.17.4 Wooden Shoring

Contractor shall suitably design polling boards, waling and struts to meet different soil conditions that might be encountered in excavating trenches/pits. The horizontal and vertical spacing of struts shall be such that not only the sides of trenches shall be prevented from collapse but also easy lowering of pipe in trenches shall be ensured without creating undue obstructions for the excavation of the work. Any inconvenience and/or delay that might be caused in lowering pipes in trenches as a result of adopting improper spacing of struts by Contractor shall be his sole responsibility. No part of shoring shall at any time be removed by Contractor without obtaining permission from the Employer's Representative. While taking out shoring planks the hollows of any form must simultaneously be filled in with soft earth well rammed with rammers and with water.

The Employer's Representative may order portions of shoring to be left in the trenches /pits at such places, where it is found absolutely necessary to do so to avoid any damage which may be caused to buildings, cables, gas mains, water mains, sewers etc. in close proximity of the excavation, by pulling out the shoring from the excavations. The Contractor shall not claim, on any reason whatsoever, for the shoring which may have been left in by him at his own discretion.

23.17.5 Steel Plate Shoring

Where the subsoil conditions are expected to be of a soft and unstable character in trench/pit excavation, the normal method of timbering may prove insufficient to avoid subsidence of the adjoining road surfaces and other services. In such circumstances, the Contractor will be required to use steel trench sheeting or sheet piling adequately supported by timber struts, waling etc., as per the instructions, manner and method directed by the Employer's Representative. Contractor shall supply pitch, drive and subsequently remove trench sheeting or piling in accordance with other items of the Employer's Requirements.

23.17.6 Boning Staves and Sight Rails

In laying the pipes and fittings/ specials the centre for each manhole / chamber or pipeline shall be marked by a peg. Contractor shall dig holes for and set up two posts (about 100 x 100 x 1800 mm) at each manhole/chamber or junction of pipelines at nearly equal distance from the peg and at sufficient distances there from to be well clear of all intended excavation, so arranged that a sight rail when fixed at a certain level against the post shall cross the centre line of the manhole/chamber or pipe lines. The sight rail shall not in any case be more than 30 m apart; intermediate rails shall be put up if directed by the Employer's Representative.

Boning staves of 75 mm x 50 mm size shall be prepared by Contractor in various lengths, each length being of a certain whole number of meters and with a fixed tee head and fixed intermediate cross pieces, each about 300 mm long. The top-edge of the cross piece must be fixed below the top-edge of the tee-head at a distance equal to the outside diameter of the pipe or the thickness of the concrete bed to be laid as the case may be. The top of cross pieces shall indicate different levels such as excavation for pipe line, top of concrete bed, top of the pipe etc. as the case may be.

The sight rail of size 250 mm x 40 mm shall be screwed with the top edge resting against the level marks. The center line of the pipe shall be marked on the rail and this mark shall denote also the meeting point of the center lines of any converging pipes. A line drawn from the top edge of one rail to the top edge of the next rail shall be vertically parallel with the bed of the pipe, and the depth of the bed of pipe at any intermediate point may be determined by letting down the selected boning staff until the tee head comes in the line of sight from rail to rail.

The post and rails shall be perfectly square and planed smooth on all sides and edges. The rails shall be painted white on both sides, and the tee-heads and cross-piece of the boning staves shall be painted black.

For the pipes converging to a manhole/chamber at various levels, there shall be a rail fixed for every different level. When a rail comes within 0.60 M of the surface of the ground, a higher sight-rail shall be fixed for use with the rail over the next point.

The posts and rails shall in no case be removed until the trench is excavated, the pipes are laid and the Employer's Representative gives permission to proceed with the backfilling.

23.17.7 Laying of Pipes and Fittings/Specials

All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure/pipeline of water, gas, sewage etc. After excavation of trenches, pipes shall not be lowered unless the dimensions of trenches and bedding work for pipes at the bottom of the trenches are approved and measured by Employer /Employer's Representative. Pipes and fittings/specials shall be carefully lowered in the trenches. Special arrangements such as cranes, tripods with chain pulley block for lowering the pipes and fittings/specials shall be made by Contractor. In no case pipes and fittings/specials shall be

dropped. Slings of canvas or equally non-abrasive material of suitable width or special attachment to fit the ends of pipes and fittings/specials shall be used to lift and lower the coated pipes and fittings/specials. The pipes and fittings /specials shall be inspected for defects and be rung with a light hammer preferably while suspended to detect cracks. If doubt persists, further confirmation shall be done by pouring a little kerosene/dye on the inside of the pipe at the suspected spot. No sign of kerosene/dye should appear on the outside surface. Pipes and fittings/specials damaged during lowering or aligning shall be rejected by the Employer's Representative.

All the pipes are to be laid perfectly true both in alignment and to gradient specified. In case of spigot and socket pipe the socket end of the pipe shall face upstream, except when the pipeline runs uphill in which case the socket ends should face the upgrade. The laying of pipes shall always proceed upgrade of a slope. After placing a pipe in the trench, the spigot end shall be centered in the socket and the pipe forced home and aligned to required gradient. The pipes shall be secured in place with approved backfill material tamped under it except at the socket. Pipes and fittings/specials which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipes and fittings/specials of proper dimensions to ensure such uniform space. Precautions shall be taken to prevent dirt from entering the jointing space. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Employer's Representative. During the period that the plug is on, the Contractor shall take proper precautions against floating of the pipe owing to entry of water into the trench. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long radius curves are permitted the deflection allowed at joints shall not exceed $2\frac{1}{2}^{\circ}$. In case of pipes, with joint to be made with loose collars, the collars shall be slipped on before the next pipe is laid. The pipes shall be laid such that the marking on pipes appears at the top of the pipes.

The cutting of pipe for inserting valves, fittings, or specials shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe cutting machine shall be used.

23.17.8 Thrust Blocks

Thrust Blocks shall be provided, to counteract hydraulic thrust, at places wherever directed by the Employer's Representative. Structural design of thrust block along with drawing shall be submitted by the Contractor for approval of Employer.

23.17.9 Jointing

Jointing for pipes and fittings/specials shall be done in accordance with the relevant Employer's Requirements depending upon the type of pipes being used.

23.17.10 Testing and Commissioning

Testing and commissioning of pipes shall be done in accordance with the relevant Employer's Requirements.

23.17.11 Backfilling

Trenches shall be backfilled with approved selected excavated material only after the successful testing of the pipeline. The tamping around the pipe shall be done by hand or other hand-operated mechanical means. The water content of the soil shall be as near the optimum moisture content as possible. Filling of the trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressure does not occur. Backfilling shall be done in layers not exceeding 30 cm. Each layer shall be consolidated by watering, ramming, care being taken to avoid damage to the pipeline. In case of the mild steel pipes/specials, the spiders provided during assembly and welding shall be retained until the trench is refilled and consolidated. Where timbers are placed under the pipeline to aid alignment, these timbers shall be removed before backfilling.

The Contractor is requested to provide the method of Backfilling compaction test and evaluation value and obtain the approval from the Employer's Representative.

23.17.12 Reinstatement of Road/Footpath

Reinstatement of road/footpath shall be done as per the requirements of local authorities and the Employer's Requirements after completion of work.

23.17.13 Clearing of Site

All surplus materials, and all tools and temporary structures shall be removed from the site as directed by the Employer's Representative and the construction site left clean to the satisfaction of the Employer's Representative.

23.18 HDPE Pipes

23.18.1 Scope

This specification covers the requirements for successfully designing, manufacturing, supplying, laying, jointing and testing at works and site of High Density Polyethylene Pipes used for water supply.

23.18.2 Applicable Codes

The manufacturing, testing, supplying, laying, jointing and testing at work sites of HDPE pipes shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases the latest revision of the Codes shall be referred to. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern.

Code No.	Title/Specification
IS 4984	High Density Polyethylene Pipes for water supply
IS 14333	High Density Polyethylene Pipes for Sewerage
IS 8008	Injection moulded HDPE fittings for potable water supplies
IS 2530	Methods of test for polyethylene moulding materials and polyethylene compounds GRP Pipes, Joints and Fittings for use for Potable Water Supply
IS 5382	Rubber sealing rings for gas mains, water mains and sewers.
IS 4905	Methods for random sampling
IS 7328	High density polyethylene materials for moulding and extrusion
IS 7634	Laying & Jointing of Polyethylene (PE) Pipes
IS 9845	Method of analysis for the determination of specific and/or overall migration of constituents of plastics material and articles intended to come into contact with foodstuffs
IS 10141	Positive list of constituents of polyethylene in contact with food stuffs, pharmaceuticals and drinking water.
IS 10146	Polyethylene for its safe use in contact with foodstuff, Pharmaceuticals and drinking water.

23.18.2.1

Others Codes not specifically mentioned here but pertaining to the use of HDPE pipes form part of these Specifications.

23.18.3 Designation

Pipes shall be designated as per IS 14833, according to the grade of material, followed by pressure rating and nominal diameter, for example, PE 63 PN 10 DN 200 indicates a pipe pertaining to material grade 63 having a pressure rating 1.0 MPa and outside nominal diameter 200 mm.

23.18.4 Colour

The colour of the pipe shall be black.

23.18.5 Materials

The material used for the manufacturer of pipes should not constitute toxicity hazard, should not support microbial growth, should not give rise to unpleasant taste or odour, cloudiness or discoloration of water. Pipe manufacturers shall obtain a certificate to this effect from the manufacturers of raw material by any internationally reputed organization as per the satisfaction of the Employer's Representative.

23.18.6 Raw Material

- (a) Raw material used to manufacture the HDPE pipes shall be 100% virgin PE compound or Natural black PE resin confirming to IS: 4984/14333, IS: 7328 and ISO: 4427 for this a certification has to be given by the resin manufacturer as per IS: 4984/14333. The resin proposed to be used for manufacturing of the pipes should also comply with the following norms as per ISO 9080
- (b) The resin should have been certified by an independent laboratory of international repute for having passed 10,000 hour long term hydrostatic strength (LTHS) test extrapolated to 50 years to show that the resin has a minimum MRS of over 10MPa. Internal certificate of any resin manufacturer will not be acceptable.
- (c) Certificate for having passed the full scale rapid crack propagation test as per ISO 13478. High density Polyethylene (HDPE) used for the manufacture of pipes shall conform to designation PEEWA-45-T-006 of IS 7328. HDPE conforming to designation PEEWA-45- T-012 of IS 7328 may also be used with the exception that melt flow rate (MFR) shall not exceed 1.10 g/10 min. In addition the material shall also conform to clause 5.6.2 of IS 7328.
- (d) The specified base density shall be between 941.0kg/ m³ and 946.0kg/ m³ (both inclusive) when determined at 27°C according to procedure prescribed in IS 7328 The value of the density shall also not differ from the nominal value by more than 3 kg/ m³ as per 5.2.1.1 of IS 7328. The MFR of the material shall be between 0.41 and 1.10 (both inclusive) when tested at 190°C with nominal load of 5 kgf as determined by method prescribed in IS 2530. The MFR of the material shall also be within ± 20 percent of the value declared by the manufacturer.

The resin shall be compounded with carbon black. The carbon black content in the material shall be within 2.5 ±0.5% and the dispersion of carbon black shall be satisfactory when tested as per IS 2530.

23.18.7 Anti-oxidant

The percentage of anti-oxidant used shall not be more than 0.3 percent by mass of finished resin. The anti-oxidant used shall be physiologically harm less and shall be selected from the list given in IS 10141

23.18.8 Reworked Material

No addition of **Reworked/ Recycled Material** from the manufacturer's own rework material resulting from the manufacture of pipes is permissible and the vendor is required to use only 100% viegin resin compound.

23.18.9 Maximum Ovality of Pipe

The outside diameter of pipes, tolerance on the same and ovality of pipe shall be as given in IS 4984/14333. Ovality shall be measured as the difference between maximum outside diameter and minimum outside diameter measured at the same cross section of the pipe, at 300 mm away from the cut end. For pipes to be coiled the ovality shall be measured prior to coiling. For coiled pipes, however, re-rounding of pipes shall be carried out prior to the measurement of ovality.

23.18.10 Wall Thickness

The minimum & maximum wall thickness of pipe for the three grades of materials, namely PE63, PE80, and PE100 shall be as given in table 3, 4, & 5 respectively in IS:4984/14333.

23.18.11 Length of Straight Pipe

The length of straight pipe used shall be more than 6 m or as agreed by Employer's Representative. Short lengths of 3 meter (minimum) up to a maximum of 10% of the total supply may be permitted.

23.18.12 Coiling

The pipes supplied in coils shall be coiled on drums of minimum diameter of 25 times the nominal diameter of the pipe ensuring that kinking of pipe is prevented. Pipe beyond 110mm dia shall be supplied in straight length not less than 6m.

23.18.13 Workmanship / Appearance

Pipes shall be free from all defect including indentations, delaminating, bubbles, pinholes, cracks, pits, blisters, foreign inclusions that due to their nature degree or extent detrimentally affect the strength and serviceability of the pipe. The pipe shall be as uniform as commercially practicable in colour opacity, density and other physical properties as per relevant IS Code or equivalent International Code. The inside surface of each pipe shall be free of scouring, cavities, bulges, dents, ridges and other defects that result in a variation of inside diameter from that obtained on adjacent unaffected portions of the surface. The pipe ends shall be cut clearly and square to the axis of the pipe.

23.18.14 Handling, Transportation Storage and Lowering of pipes

During handling, transportation, storage and lowering, all sections shall be handled by such means and in such a manner that no distortion or damage is done to the section or to the pipes as a whole.

The following procedures should be followed so as to eliminate potential damage to pipes and fittings and to maintain maximum safety during unloading, lifting and lowering.

Pipes must not be stored or transported where they are exposed to heat sources likely to exceed 60°C.

Pipes shall be stored such that they are not in contact with direct sunlight, lubricating or hydraulic oils, petrol, solvents and other aggressive materials.

Scores or scratches to a depth of greater than 10% or more of wall thickness are not permissible; any pipes having such defects should be strictly rejected.

PE pipes should not be subjected to rough handling during loading and unloading operations. Rollers shall be used to move, drag the pipes across any surface.

Only polyester webbing slings should be used to lift heavy PE (>315mm) pipes by crane. Under no circumstances, chains, wire ropes and hooks be used on PE pipes.

Pipes shall not be dropped to avoid impact or bump. If any time during handling or during installation, any damage, such as gouge, crack or fracture occurs, the pipe shall be repaired if so permitted by the competent authority before installation.

During coiling care should be taken to maintain the coil diameter at or above the specified minimum to prevent kinks. Coiling shall be done when the pipe attains the ambient temperature from the extruder. In uncoiling or recoiling care should be taken that sharp objects do not scour the pipe.

When releasing coils, it must be remembered that the coil is under tension and must be released in a controlled manner. The end of the coil should be retained at all times, then the

straps released steadily, one at a time. If the coil has bands at different layers of the coil, then they should be released sequentially starting from the outer layers. The amount of the energy locked up in the coil will depend on the size of the pipe, the SDR of the pipe, and the size of the coil.

Straight lengths should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set

Bare coils shall be wrapped with hesian cloth for long distance (> 300Kms) transportation. The truck used for transportation of the PE pipes shall be exclusively used of PE pipes only with no other material loaded – especially no metallic, glass and wooden items. The truck shall not have sharp edges that can damage the Pipe.

Pipes manufactured at factory are to be carried to the site of work directly or stacked suitably and neatly along the alignment/road side/elsewhere near by the work site or as directed by the Employer's Representative.

Damages during transit, handling, storage will be to the Contractor's account and replacement for such pipes has to be made by the Contractor without any extra cost as directed by the Employer's Representative.

23.18.15 Lowering, Laying and Jointing of Pipes

Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Employer's Representative shall be laid.

While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. In most cases, the bedding is not required, as long as the sharp and protruding stones are removed, by sieving the dug earth, before using the same a backfill material. While laying in rocky areas suitable bed of sand or gravel should be provided. The fill to about 10 to 15 cm above the pipe should be fine sand or screened excavated material. Where hard rock is met with, bed concrete M15, 15 cm or 20cm thick sand bed as approved by the Employer's Representative may be provided

As PE pipes are flexible, long lengths of fusion-jointed pipes having joints made above ground can be rolled or snaked into narrow trenches. Such trenches can be excavated by narrow buckets.

During the pipe laying of continuous fusion jointed systems, due care and allowance should be made for the movements likely to occur due to the thermal expansion/contraction of the material. This effect is most pronounced at end connections to fixed positions (such as valves etc) and at branch connections. Care should be taken in fixing by finishing the connections at a time the length of the pipe is minimal (lower temperature times of the day.)

For summer time installations with two fixed connection points, a slightly longer length of PE pipe may be required to compensate for contraction of the pipe in the cooler trench bottom.

The final tie-in connections should be deferred until the thermal stability of the pipeline is achieved.

The flexibility of polyethylene pipes allows the pipe to be cold bend. The fusion jointed PE pipe is also flexible as the plain Pipe. Thus the total system enables directional changes within the trench without recourse to the provision of special bends or anchor blocks. However, the pipe should not be cold bend to a radius less than 25 times the OD of the pipe.

The Installation of flanged fittings such as connections to sluice/air/gate valves and hydrant tees etc., requires the use of stub ends (collars/flange adaptors complete with backing rings and gaskets. Care should be taken when tightening these flanges to provide even and balance torque.

Provision should be made at all heavy fittings installation points for supports (such as anchoring of the flange in the soil) for the flange joint to avoid the transfer of valve wheel turning torque on to the PE flange joint.

PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done

When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.

However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.

Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95% maximum dry density.

23.18.16 Jointing of Pipes

The pipe shall have a jointing system that shall provide for fluid tightness for the intended service conditions. Appropriate jointing for HDPE pipe as per IS 4984/14333 shall be selected considering site and working condition, pressure and flow of liquids

Bedding, Backfilling and Compaction

Bedding

In case of sandy strata no separate bedding is required. However the bottom face / trench bed where pipe shall be placed shall be compacted to provide a minimum compaction corresponding to 95% of maximum dry density. The pipe bedding should be placed so as to give complete contact between the bottom of the trench and the pipe.

Back Filling

Backfilling should be placed in layers not exceeding 15cm thickness per layer, and should be compacted to a minimum of 95% maximum dry density. The refilling should be done on both sides of pipe together & height difference in earthfill on each side should not be more to cause lateral movement of pipe.

Most coarse grained soil are acceptable. This may comprise of gravel or sand. However silty sand, clayey sand, silty and clayey gravel shall not be used unless proposed to be used in conjunction with gravel or clean sand.

It is very important that the pipe zone backfill material does not wash away or migrate in to the native soil. Like wise, potential migration of the native soil in to the pipe zone backfill must also be prevented.

Heavy earth moving equipment used for backfilling should not be brought until the minimum cover over the pipe is 90 cm in the case of wide tracked bulldozers or 120 cm in the case of wheeled roaders or roller compactors.

Compaction

Vibratory methods should be used for compaction. Compaction within distances of 15 cm to 45 cm from the pipe should be usually done with hand tempers. The backfill material should be compacted not less than 95% of maximum dry density.

23.18.17 Thrust Block

RCC thrust block should be suitably designed & provided at bends and at places of reduction in cross section to take care of trust

23.18.18 Fittings & Specials

All HDPE fittings/ specials shall be fabricated in accordance with IS: 8360 (Part I & III). PE Injection moulded fittings shall be as per IS: 8008 (Part I to IX). All fittings/specials shall be fabricated or injection moulded at factory only. No fabrication or moulding will be allowed at site, unless specifically permitted by the Employer's Representative. Fittings will be butt welded on to the pipes or other fittings by use of heat fusion.

Bends

HDPE bends shall be plain square ended conforming to IS: 8360 Part I & III Specifications. Bends may be fabricated by jointing several small sections of pipes to reach the required angle.

Tees

HDPE Tees shall be plain square ended conforming to IS: 8360 Part I & II Specifications. Tees may be equal tees or reduced take off tees. Tees may be moulded or fabricated from pipes elements.

Reducers

HDPE Reducers shall be plain square ended conforming to IS: 8008 Part I & VII Specifications. Reducer must be moulded.

Flanged HDPE Pipe Ends

HDPE Stub ends shall be square ended conforming to IS: 8008 Part I & VII Specifications. Stub ends will be welded on the pipe. Flange will be of slip on flange type as described below.

Slip-On Flanges

Slip-on flanges shall be metallic flanges covered by epoxy coating or plastic powder coating. Slip-on-flanges shall be conforming to standard mating relevant flange of valves, pipes etc. Nominal pressure rating of flanges will be PN10.

23.18.19 Welding Procedure

Jointing between HDPE pipes and specials shall be done as per the latest IS: 7634 part II. Method of jointing between the pipes to pipes and pipes to specials shall be with butt fusion welding using automatic or semi automatic, hydraulically operated, superior quality butt fusion machines which will ensure good quality butt fusion welding of HDPE pipes. If approved by the concerned Employer's Representative, jointing with PP compression fittings may be carried out for smaller diameters of PE pipes (up to 110mm).

23.18.20 Tests to Establish Portability of Work

Pipe specimen shall be subjected to tests specified below in order to establish the suitability of these pipes for use in carrying potable water:

Smell of the extract

Clarity of the colour of the extract

Acidity and alkalinity

Global migration UV absorbing material Heavy metals

V) Unreacted monomers (styrens) and Biological tests

23.18.21 Hydraulic Testing

Pipes shall be given different hydraulic tests for ensuring quality of manufacture as per relevant IS.

23.19 GRP pipes and Fittings

23.19.1 Resin System

The pipe shall be manufactured from corrosion resistant vinyl ester resin to meet or exceed one of the following ASTM Standard Specifications for “Fibreglass/GRP” Pipe:

Manufacturing Method	ASTM Designation
A. Filament Wound	ASTM D 2996
B. Centrifugal Cast	ASTM D 2997

Resin shall be suitable for the services specified, and shall be noted by the vendor in his proposal. The resin system used for the interior liner, the structural wall, fittings, and adhesives shall be polyester, vinylester or epoxy, with suitable curing agents so that it meets the performance requirements and temperature limits in this Specification.

The interior wall of the pipe shall be constructed so as to have smooth, resin-rich surface. The resin shall be selected on the basis of proven resistance to the transported medium and shall not contain any filler except as required for viscosity control or fire retardant. Glass fibre shall be of highest commercial quality. Pipe shall be free from any defects such as indentations, cracks, bubbles, pin holes, resin rich or starved area etc.

23.19.2 Dimension and tolerance

The pipe shall have a minimum 2.54 mm thick inner resin liner and a exterior surface shall have a resin rich layer of 1.6 mm thickness. The liner shall have a minimum 65 percent by weight resin content. Dimensions and surface finishes shall be measured in accordance with ASTM D3567 and ASME/ANSI B46.1.

The pipe shall have a minimum reinforced wall thickness as specified below

Pipe Diameter: Wall thickness (mm)

300 or less 5 mm

300 to 500 8 mm

The average wall thickness of the pipe shall not be less than the nominal wall thickness published in the manufacturer literature, current at the time of purchase. The minimum wall thickness at any point shall not be less than 87.5% of the nominal wall thickness, when measured in accordance with ASTM D3567.

Flange bolt hole sizes and the number of bolt holes and bolt hole circles for up to 600 mm nominal pipe size shall comply with ASME/ANSI B16.5.

Unless otherwise defined, specified face-to-face, centerline-to-face, and centerline-to-centerline dimensions of special fabrications (spools) shall have a tolerance of + 6 mm. The lateral offset of flanges from the pipe centerline and rotation of flanges shall be limited to 3 mm. The flange face alignment shall be within 1.5 mm of the required position when measured across the flange face. These tolerances shall be doubled for piping 450 mm nominal size and larger.

23.19.3 Fillers

Siliceous sand may be used as fillers as specified in cell classification. Siliceous sand shall conform to ASTM C33, except that the requirements for gradation need not apply.

23.19.4 Additives

Resin additives such as pigments, dyes or coloring agents may be used provided they do not detrimentally affect the performance of the pipe. The pipe exterior must contain a UV inhibitor.

23.19.5 Fittings

Flanges, bends, reducers, tees, wyes and other fittings may be compression-molded, manufactured from mitered section of pipe, or manufactured by the filament wound process, using thermosetting polyester, vinylester or epoxy resin and fiberglass reinforcement such that the resistance to chemical attack, the pressure rating, and the temperature rating, are equal to or better than that of the pipe.

Flanges on GRP piping shall normally be kept to a minimum.

Except for compression-molded fittings, all pipe, fitting, and flange surfaces that are exposed to the fluid shall have a smooth, uniform, resin-rich liner with a thickness of 0.51 mm + 0.13 mm. The interior liner shall be reinforced with either non-woven polyester fibers or glass veil surfacing mat. Polyester or glass veil liner reinforcement is not required on 100 mm and smaller fittings at the mitered joints, provided all gaps at the joints are completely filled with resin to act as an effective corrosion barrier and to prevent the presence of any exposed glass fibers.

All machined or cut surfaces shall be post-coated with catalyzed resin, except for bonding surfaces for field points and mechanical RTR (fiberglass) threads. Post-coating shall be performed within four hours of machining or other surface preparation.

Threads shall be per ASME/ANSI B1.20.1 and shall conform to the requirements of ASME/ANSI B31.3, paragraph A 314.2.2. Threaded joints are not permitted in piping manufactured using any kind of fillers, such as reinforced plastic mortar piping (RPMP).

Adhesive-bonded joints shall be bell-and-spigot type and shall not require a field-applied overwrap to develop the required strength.

Flanges shall be flat-faced, or flat-faced with a confined O-ring gasket groove.

All pipe, fittings and flanges for a particular installation shall be manufactured or supplied by the same Vendor to avoid incompatibility due to intermixing of products from different manufacturers.

23.19.6 PCV piping and fittings

PVC piping shall be of CPVC in accordance with ASTM F-441, Schedule 80 for pressure service and, Schedule 40 for non-pressure service. PVC used shall be of Type1 Grade1 compound as stated in ASTM D-1784.

Dimension and tolerances shall be as per manufactures specification measured in accordance with ASTM Method D-2122.

Plastic pipes, fittings, and plastic valves that do not have built-in protection from Ultraviolet (UV) light (exposed to sunlight) shall be shielded by painting with an exterior-grade, water-based emulsion, or tapewrap with UV resistant pressure sensitive tape utilizing adhesive that shall not affect the plastic material.

Pipes shall have marking including manufacture's name material tolerance, material designation code, nominal pipe size, schedule size with pressure rating.

23.19.7 Supports

Flexibility requirements of CPVC piping system shall be as follows:

Flexibility, support and anchoring requirements shall be in accordance with ASME B31.3 Chapter VII. This requirement also applies to off-plot applications.

Flexibility, if required, shall be provided by using bends, loops, offsets, bellows, expansion joints and slip joints.

Cold spring is not permitted in CPVC piping systems.

Nonburied metal valves including metal valves in buried valve boxes shall be supported independently of CPVC piping. In buried condition, metal valves 4 inch in size and larger shall be supported independently of CPVC piping.

CPVC pipe shall be carried through a metallic sleeve in a valve box wall. CPVC sleeve is acceptable provided the sleeve shall have mechanical characteristics and properties at least similar to that of the pipe passing through the sleeve. The space between the pipe and sleeve shall be sealed with approved flexible waterproof mastic sealant.

The distance between the valve box wall and the back of the CPVC flange, inside the valve box, shall be not less than 150 mm to permit work access.

CPVC piping joints shall be clear of concrete anchor blocks.

24 SPECIFICATIONS FOR LCV TRUCK MOUNTED SEWAGE SUCTION-CUM-BLOW BACK MACHINES FOR EMPTYING CESS PITS / SEPTIC TANKS

24.1 GENERAL

The equipment will be a Truck Mounted Mobile Unit suitable for suctioning the silt / slurry y from sewer manholes, cesspits, septic tanks etc. by Vacuum Suction System and emptying the tank by Blow-back facility using the same suctioning pump in Compressor mode or by gravity discharge from the rear door.

24.2 SYSTEM DESCRIPTION

The Suction Unit mounted on vehicle comprises of the following:

Drive System

Tank

Vacuum-cum-Compressor Unit

Accessories

24.2.1 DRIVE SYSTEM

The Engine of the Truck Chassis is utilized to drive the vacuum pump through a suitable drive arrangement. The Hydraulic pump is driven through the side PTO of the truck gear box.

24.2.2 TANK

The cylindrical tank and Dish ends are fabricated out of 6mm thick MS Plates conforming to IS:2062 grade. The tank has a capacity of 3000 Ltrs. The tank is installed in an inclined position to facilitate flow of material towards the discharge end and is mounted on an appropriate sub-frame, which in turn is bolted to the truck chassis. The tank has Blow-Back arrangement for discharge of material from the sludge tank

using the same Vacuum-cum-Compressor Pump. The tank is also provided with a rear discharge door, which can be opened manually for discharge of collected material by gravity. Adequate sealing and locking arrangement is provided to render the door leak proof.

Level Indicators made of thick transparent acrylic tubing is provided on the tank in positions convenient for the operator to view. The tank exterior is spray painted with a coat of superior quality anti-corrosive primer and two coats of enamel paint of reputed make. The tank interior is coated with two coats of anti-corrosive epoxy primer.

24.2.3 VACUUM-CUM-COMPRESSOR UNIT

The Exhauster / Compressor is of proven design with capacity of 432 Cu.M/Hr of airflow and is capable of generating vacuum of 700 mm Hg (90% Vacuum) and alternatively pressure of 1.5 Bar. The unit is utilized for operating under vacuum for suctioning sludge through a 75mm dia. suction hose and alternatively in pressure mode for discharging by Blow back the sludge / silt from the tank without tipping/ opening of the doors through a 4 way valve for change over from suction operation to pressure mode.

Under the pressure mode, compressed air can be also injected into the Sewer Manhole, Septic Tank, etc for Blow-back and agitate the sludge/ slurry before suction.

24.2.4 ACCESSORIES

Lockable type hose storage boxes are provided on either side of the tank to facilitate storage and transportation of suction hoses, tools, etc.

4 Nos.15 Mtrs. Long heavy duty, PVC flexible suction hoses of 75mm internal diameter and fitted with quick action couplings are provided along with the equipment.

24.2.5 TRUCK CHASSIS

The Machine is suitable for mounting on 7 Ton GVW Truck Chassis of TATA/Ashok Leyland / Eicher Motor or equivalent fitted with PTO and Two Seater Driver's Cabin.

24.3 DATA SHEET

1. Type Sewer Suction Machine with Blow Back arrangement.
2. Tank Capacity 3000 Ltrs (Sludge)
3. Exhauster / Compressor

Reputed ISO Certified Company

FAD : 432 CuM/Hr; Vacuum : 90% Max; Over Pressure : 1.50 Bar; 4. Truck Chassis 2 Axle GVW 7 Ton GVW with Non-Sleeper Drivers Cabin fitted with PTO

25 WEIGHBRIDGE

25.1 Codes, Regulation and Standards

Weighbridges shall conform in design, materials and performance, except where otherwise specified, with the current issue of the following, prevailing on the effective date of the Order and as amended by this specification.

- Indian Standard IS-1436 (1991): Weighbridges – Specification
- IS-9281 Part 1 of 4 (1979) : Specification for Electronic Weighing System

Weighbridges shall conform to the local Indian Standards for Weights and Measures. Stamping by the statutory authorities shall be the responsibility of the vendor.

Compliance with this specification shall not relieve vendor of the responsibility to supply equipment suited to meet the specified service conditions and applicable regulations.

25.2 Descriptions

Weighbridges shall be supplied to record the tare weight of Septage Vacuum Sucker vehicles entering the loading stations and to record the gross weight on exit. They shall meet the requirements of the Indian Weights and Measures Ministry and shall have class 3 calibration.

The loading stations shall have one no. of weighbridge.

The weighbridge shall have a weighbridge Room located near it to control vehicle movements and to manage the associated export documentation. The Weighbridge Room shall be equipped

with terminal and printer connected to server and/or Control room. The weighbridge system shall issue weighing tickets to the drivers and also record the data in system.

Weighbridge terminals, monitors, PC's and printers shall be integrated seamlessly into a single system that shall transmit information to the Contractor.

Contractor shall ensure bi-directional Weighbridges which are complete in all respects to be installed. It shall include, but not be limited to, the following:

Low profile weighbridge platforms with load cell systems.

A digital weight indicator for weighbridge, desktop type.

A ticket printer for weighbridge, desktop type.

The personal computer for weighbridge, desktop type.

Interface port to transmit information.

- Interconnecting cables (armoured), fittings and junction boxes between load cells and terminal box in the weighbridge Room.
- Interconnecting cable between terminal box in weighbridge Room and indicator / keyboard / printer.
- Lightning protection.
- Std. 20 kg weights for 25 % capacity of weigh bridge with W & M stamping for calibration purpose.
- Earthing system.
- Painting.
- Nameplates and tagging.
- Foundation bolts.
- Testing, inspection and certification.
- Weights and measures for calibration.
- Packing.
- Documentation as required
- Commissioning spares (itemized list required).
- Site supervision for construction, installation at site, testing and commissioning.

- Spares as per OEM for Warranty Period and 5 years CAMC.
- Dimensional details drawing giving foundation base requirement including loading details

25.3 Technical Requirements

25.3.1 Type of Weighbridge

All weighbridges shall be surface mounted type.

Weighbridges shall be fitted with tyre curb upstands on each side of the platform.

The weighing system shall be by compression type load cells.

The vendor shall state the over-loading rating - without damage.

25.3.2 Construction

All weighbridges shall be of steel platform construction.

Bump restrictors shall be supplied to suppress excessive longitudinal movement.

The weighbridge shall operate as follows:

When a steady weight indication is displayed by the indicator, the printer shall print the date, time, consecutive number, code and the weight of the load on the weighbridge.

When the vehicle returns for tare or gross weighing, it shall be identified and the data recorded at the first weighing shall be re-presented to the operator. The system shall recognize this operation as a second weighing, either automatically or by the operator pressing "Second Print" button.

The printer shall then print the first and second weights and the calculated net weight, together with the identifying data.

25.3.3 Digital Indicator

The weigh system shall be connected to microprocessor based, programmable type, solid-state digitising equipment to provide an in-line indication of weight. It shall be linked to a tabulating machine for printing the weights against various other data. Auto-zero facility shall be provided.

9.4.2 The indicator shall be a compact, self contained console, suitable for desk-top mounting and with facilities for interfacing with other modules or data process equipment if required.

The relevant figures shall be clearly displayed in 20 mm high numerals.

Zero balancing, to compensate for spillage etc. on the weighbridge, shall be provided instantly and automatically by pressing a "ZERO BALANCE" push button. Coloured indicators shall be provided to show when the system is off zero.

Electronic Weigh Bridge with Digital Indicator having Ethernet redundant connectivity for interfacing with control room system for exchange of weight data with weigh bridge PC. In case of problem with assigned weigh bridge PC same shall be able to operate from other PC.

One point 110 V AC +1 %, 50 +1% Hz UPS supply will be provided.

25.3.4 Print Out Unit

The following shall be the minimum information printed by the print-out unit : Date, Consecutive number, Code, Weights in kilogram's: 1st weight, 2nd weight, computed net weight, Shipping location and code, Receiving location and code, Contractor name and code, Truck number, Time-In and Time-Out. Standard Size and Format shall be finalized in discussion with Engineer

25.3.5 Cabling

The Contractor shall supply the appropriate cables of suitable length between the load cells and the weigh house equipment, o terminal box is required in the weigh house between the load cell cable and the indicator system cabling, then this shall also b provided.

25.3.6 Documentation

The Contractor shall ensure that all the information/Manual/Guide to be available at SeTP throughout O&M phase. Majorly following documents shall include, but not be limited to the following:

- (a) Completed data sheets, which are attached with this specification, with supplier data added.
- (b) A detailed scope of supply that fully describes the equipment and it's working.
- (c) General arrangement drawings with dimensions, make, and type selected.
- (d) Foundation load data

- (e) Complete list of special tools (if required)
- (f) All utility consumptions such as power requirement.

25.3.7 TECHNICAL DATA SHEET FOR LOAD CELL

Following are the technical data sheet depicting information required for the works. Contractor shall improve it further for the efficient working of the system on approval from Engineer/Employer

Minimum pre load	Zero
Nominal load	20 MT per load cell
Max. Usable load	20 MT per load cell
Max. Load without damage	150 % of rated capacity
Destructive load	225 % of rated capacity
Repeatability	Better than ± 0.010 % FS
Creep, after 30 min.	Better than ± 0.017 % FS
Non-linearity	Better than ± 0.025 % FS
Hysteresis	Better than ± 0.020 % FS
Temperature effect on zero balance	± 0.0015 % FS
Temperature effect on rated output	± 0.002 % FS
Rate of temperature change	-10 C to 60 C
Input resistance	As per requirement of the system/Manufacturer to specify
Output resistance	As per requirement of the system/Manufacturer to specify
Recommended supply voltage	15 v
Side Load Discrimination	500:1
Material of Construction	High Alloy Tool Steel

25.3.8 SYSTEM

Guaranteed system accuracy better than +/- 0.025 % FS

26 APPROVED MAKES

List of approved makes for Mechanical Equipment / Items:

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
1	Submersible Pumps	Grundfos Pumps ITT Corporation Ltd CRI Pumps WILO Pumps EBARA
2	<i>Not used</i>	
3	Knife edge gate valve	Flowtek Valves & Controls Flosteer Engineers Pvt Ltd. Jash Engineering
4	Non-return valve	Kirloskar Brothers Ltd. Indian Valve Company (IVC) Crawley & Ray
6	<i>Not used</i>	
7	Chain pulley block	Hercules Hoists Ltd. Safex Engineers Pvt. Ltd. Tractel INDEF ABUS
8	<i>Not used</i>	
9	Mechanical fine screen	Jash Engineering Limited Johnson Screens Hans Huber AG, Germany. Headworks, USA
10	Mechanical raked Coarse bar screen	Jash Engineering Limited Johnson Screens Hans Huber AG, Germany. Macmet india ltd

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
		Taprogge
11	Grit chamber mechanism	Smith & Sowmy EIMCO Milton Roy India Voltas India Pvt.Ltd Shivpad Engineers Pvt. Ltd
12	Air blowers	Everest blowers Kay International Limited Swam Pneumatics Pvt. Ltd.
13	<i>Not used</i>	
15	PE Dosing Pump	Milton Roy India Grundfos pumps Metachem Corporation
16	Centrifuge	ALFA LAVAL, Humboldt Wedag Pennwalt India Limited
17	Belt conveyor system	Jash Engineering Limited Macmet india ltd Kpack System Pvt. Ltd
18	Progressive Cavity type sludge pump	Roto Pumps IMO Pumps Chandra Helicon Pumps UT Pumps and Systems Ltd.
19	Agitator & Anoxic Tank Mixer	Elastomer Lining Works Pvt. Ltd. Gansons Ltd. Hemalathaa Hi-Tech Industries REMI Milton Roy India
20	Sluice gates	Hfontain Crawlay & Ray Jash Engineering Limited Macmet india ltd Taprogge

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
21	Diffusers	EDI ITT SSI Rehau OTT

List of Approved Makes for Electrical Equipment / Items:

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
1	Transformers	M/s ABB M/s BHEL M/s Siemens M/s Areva T&D M/s Crompton Greaves Limited M/S Volt Amp M/S Bharat Bijlee M/s Kirloskar Electric M/s EMCO
2	11 kV RMU	M/s Siemens M/s ABB M/s Areva M/s Schneider Electric
3	Protective Relays	M/s ABB M/s Schneider Electric M/s L&T M/s GE M/s Siemens M/s Areva T&D

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
		M/s Easun Reyrolle
4	Current Transformers	M/s ABB M/s Areva T&D M/s Siemens M/s CGL M/s Kappa M/s Ind Coil M/s Pragati M/s Jyoti
5	Voltage Transformers	M/s ABB M/s Areva T&D M/s Siemens M/s CGL M/s Kappa M/s Ind Coil M/s Pragati M/s Jyoti
6	PCC's/MCC's/PDB's/ LV Switchgears& Control gears	M/s Schneider Electric M/s ABB M/s. Siemens M/s GE M/s L&T M/s C & S Electric

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
7	L.T Power Capacitors	M/s BHEL M/s ABB, M/s CG Power Systems M/s Universal M/s Madhav M/s Shreem M/s L&T M/s Manohar
8	Diesel Engines	M/s Cummins M/s Caterpillar M/s Kirloskar Oil Engines
9	Alternators for DG Sets	M/s Kirloskar Electric M/s CGL M/s BHEL M/s Jyoti M/s Stamford
10	Variable Frequency Drives	M/s Siemens M/s ABB M/s Schneider Electric M/s L&T
11	Lighting Fixtures and Accessories	M/s Philips M/s ABB M/s Crompton Greaves Limited M/s Wipro M/s Bajaj Electricals M/s GE
12	Power Cables and Wires	M/s Universal Cables

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
		M/s Polycab M/s Havell's M/s CCI M/s Finolex M/s NICCO
13	MLDB's , LDB's, SDB's, MCB's, RCCB's	M/s Havells M/s Standard M/s Legrand M/s L&T M/s Siemens
14	Switches , Plugs, Sockets	M/s Legrand M/s Havells M/s Anchor M/s Cona
15	Ceiling Fans	M/s Havells M/s Crompton M/s Orient M/s Bajaj M/s Usha
16	11KV Cables	M/s RPG M/s KEI M/s Gloster M/s Universal M/s Nicco M/s Polycab
17	11kV Cable termination	M/s Raychem M/s Mahindra

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
		M/s REPL M/s 3M
18	Selector switches	M/s Kaycee M/s Siemens
19	LED Indicating Lamps	M/s Teknic M/s Vaishno M/s Siemens
20	Terminal Block	M/s Elmex M/s Connectwell
21	Control fuses	M/s Siemens M/s GE
22	Push Button	M/s Siemens M/s L&T M/s Teknic, M/s Mathura Switchgears M/s Schneider
23	Meters (Ammeter, Voltmeter)	M/s AE M/s Rishabh M/s Meco M/s Enercon M/s IMP
24	Cable Trays	M/s Indiana M/s Patni M/s Reliance M/s Sadhana
25	Digital Multifunction Meters/ Load Manager	M/s Secure M/s AE

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
		M/s Conzerv

List of Approved Makes for Instrumentation and Control Equipments / Items:

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
1	Ultrasonic Type Level Measuring System	Emerson Process Management Siemens Yokogawa E & H
2	Fullbore Electromagnetic Flow Measuring System	ABB Emerson Process Management Siemens Krohne Marshall
3	Pressure Transmitter	ABB Emerson Process Management Siemens Yokogawa
4	Variable area flowmeter	ABB Chemtrols. Emerson Process Management
5	Chlorine Measuring System	Emerson Process Management ABB Yokogawa E & H
6	Oxygen Measuring System	Emerson Process Management

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
		ABB Yokogawa E & H
7	Lightning Protection Unit	Erico MTL Instruments OBO Bettermann Pepperl and Fuchs Phoenix Rittmeyer
8	Digital Pressure Indicator & Digital Flow Indicator & Integrator	ABB Eurotherm DEL Masibus Radix Electrosystems Yokogawa Blue Star Pvt. Ltd.
9	Programmable Logic Controller (PLC)	ABB Rockwell Automation Schneider Electric Siemens Honeywell Allen Bradley
10	Battery Charger	AE Aplab Chhabi HBL Life

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
		Masstech
11	Batteries	Amar Raja Chloride India Exide Global Yuasa Standard
12	Instrumentation Cables	Asian Cable Corporation of India Ltd. Delton Cables LAPP Finolex Thermopads Udey Pyro Cables

Note:

Other Makes, if offered, are subject to Approval by the Employer/ Employer's

Representative based on the Submission of the following documents by the bidder:

Demonstrate that proposed makes by bidder are superior / equivalent to the approved makes.

Copies of Type Test Certificate not older than 5 years for the items offered.

List of Clients to whom already the items have been supplied along with the year of Supply and Value of Orders

Copies of Performance Certificate from the User's for the items in last five years.

Copy of latest ISO Certification for the Manufacturer

Details of Manufacturing Facilities

Turnover of the Manufacturer

Manufacturers full contact information

PART 6

ELECTRICAL WORK

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1 ACSR CONDUCTOR

1.1 SCOPE

This specification covers the design, material, constructional features, manufacture and testing at the VENDOR'S Works and delivery to Site of Aluminium Conductor Steel Reinforced (ACSR) conductors and steel wires.

1.2 CODES AND STANDARDS

The design, material, construction, manufacture, inspection and testing of conductors shall comply with all currently applicable statutes, regulations and safety codes in the locality where the conductors will be installed. The equipment shall also conform to the latest applicable standards. Nothing in this Specification shall be construed to relieve the VENDOR of this responsibility.

The conductors shall conform to latest standards specified in Data Sheet-A. In case of conflict between the standards and this Specification, this Specification shall govern.

1.3 MATERIAL

Aluminium strands of ACSR conductor shall be hard drawn from 99.5% pure electrolyte aluminium rods with 60% IACS conductivity. The VENDOR shall specify the guaranteed minimum and average values of conductivity.

Chemical composition of the material shall comply with the requirements of relevant Standards.

The surface of conductor shall be clean and dry and free from any excess grease that may be used in its fabrication. The surface strands shall be smooth and free from burrs and other projections which may be cause for increasing corona losses when the conductor is used on extra high voltage lines.

The conductor shall be of heavy duty type and designed to operate within set temperature limits and to withstand thermal and electromechanical forces developed due to short circuits.

1.4 GALVANISING

The steel wire strands of ACSR conductor shall be hot dip galvanised. Zinc coating shall be evenly and uniformly coated complying with relevant standards as specified in Data Sheet-A for heavily coated wires.

The zinc used for galvanizing shall be electrolytic high grade zinc of not less than 99.95% purity.

1.5 GREASING

When specified in Data Sheet-A, the steel core and the inner layer of aluminium wires, (where more than one aluminium layer exists), shall be protected with a special grease in order to provide additional protection against corrosion due to saline pollution. The grease shall fill the whole space between wires within circumscribed cylinder at inner aluminium layer or at steel core, if the conductor has only one aluminium layer.

The grease shall be chemically neutral with respect to aluminium and steel. It shall withstand weather conditions given under Project Data and permanent temperature of 85 °C or as per maximum allowable conductor temperature whichever is higher without alteration of its properties.

1.6 **TESTS**

All tests on the required number of samples of raw materials and finished conductor as stipulated in the relevant standards shall be carried out. No manufacture shall be commenced prior to PURCHASER'S/ENGINEER'S written approval of the test certificates regarding raw materials.

1.7 **PACKING**

Conductor shall be wound on non-returnable wooden drums made of seasoned and sufficiently strong wood, and conforming to relevant standards specified in Data Sheet-A. At least 12 mm clearance from the conductor to outer edges of the drum shall be provided prior to lagging.

All drums shall be painted inside and outside with aluminium paint. All drums shall have a layer of water-proof paper around the drum under the conductor and another layer over the conductor and under the lagging.

Each drum shall be marked with the following information:

- i) Manufacturer's name.
- ii) Batch of manufacturer.
- iii) Size and type of conductor.
- iv) Net weight of conductor in Kg.
- v) Gross weight of conductor in Kg.
- vi) Length of conductor in Metre

Drums shall have barrel of at least 1000 mm diameter with centre hole of 100 mm dia.

1.8 DATASHEET A1

SL. NO.	ITEM	UNIT	
1.0	<u>GENERAL</u>		
1.1	1.8.1.1 Application		
1.2	Code name		
1.3	Quantity	1.8.1.2 M	
1.4	Whether atmosphere corrosive	Yes/No	
1.5	If yes, type of corrosive atmosphere : Salt laden / Ammonia etc.		
2.0	<u>CONDUCTOR DATA</u>		
2.1	Material and Stranding		
	1.8.1.3 a) Aluminium	Number Dia. of each	6 /4.72mm
	b) Copper	Number Dia. of each	No
	c) Steel	Number Dia. of each	7/1.57mm
	d) Al Alloy	Number Dia. of each	No
2.2	Minimum ultimate tensile Strength	KN.	32.41
2.3	Greasing required (Ref. Clause 5.1)	Yes/No	
2.4	Length per drum	M	
3.0	<u>SYSTEM DATA</u>		
3.1	Voltage	V	11
3.2	No. of phases		3
3.3	Sub-conductors per phase	No.	
3.4	Ambient temperature	°C	50
3.5	Continuous current per sub Conductor	A	
3.6	Short time current per sub conductor	kA Sec	

1.9 DATASHEET A2

SL. NO.	ITEM		
1.0	<u>APPLICABLE STANDARDS</u>		
1.1	ACSR Conductors		IS 398 / IEC 1089
1.2	Copper conductors		NA
1.3	Galvanization of steel wires		IS 4286
1.4	Reels and drums for bare wire		IS / IEC
2.0	<u>NOTES</u>		
2.1	Equipment, raw material, tests etc. shall in general conform to		IS / IEC

2 HV DROP OUT FUSE

2.1 SCOPE

This specification covers requirements of H V drop out fuses of 11 kV.

2.2 CODES AND STANDARDS

The design, material, manufacture, inspection, testing and performance of drop out fuses shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards. Nothing in this specification shall be construed to relieve the VENDOR of his responsibility.

Drop out fuses shall conform to the latest applicable standards specified in Data Sheet-A. In case of conflict between the standards and this specification, this specification shall govern.

2.3 GENERAL CONSTRUCTION FEATURES

Fuse assembly shall be complete with fuse carrier, post insulators, jaw and hinge, live parts, terminals, channel base, all fixing bolts, nuts and washers. Fuse links of specified current rating shall be supplied for use with these fuse assemblies.

All materials used in the manufacture of drop out fuse shall be suitable for conditions specified and shall withstand variations of temperature and atmospheric conditions without deterioration or distortion of any kind in any part. All non-metallic parts of fuse carrier shall be tough, non-ignitable insulating materials.

Similar parts, especially removable, shall be interchangeable. The design of the fuse for given voltage rating and breaking capacity shall be capable of using a range of fuse links of different current ratings.

For supporting HV drop out fuses BIDDER may make use of one or two insulators.

Mounting of drop out fuses shall be such that its isolation/ removal/ replacement shall be easy. It shall have positive guides for this purpose. After removing the fuse barrel by an operating pole fuse shall be replaceable.

Bird proof construction feature shall be provided.

It shall be possible to adjust spring pressure of the top contact to ensure consistent performance.

All current carrying parts shall be of copper alloy. The contacts shall be of gun metal brass or phosphor bronze. The contact surface shall be silver plated to ensure low contact resistance.

Fuse-links shall be of such construction as to prevent danger from overheating, arcing and scattering of hot metal of powder or emission of flame, when operating in service.

When the fuse link ruptures or when the fuse carrier is pulled downwards, the carrier shall swing free to an inverted position. The carrier shall be brought to cushioning stop to eliminate shock on the carrier and lower insulator unit.

The base channel and all ferrous parts shall be hot-dip galvanised.

HV drop out fuse base channel shall bear a name plate describing the major technical particulars. Fuse base, fuse link and fuse carrier shall bear the markings as per IS.

2.4 ACCESSORIES

An operating rod with provision at the top for switching and removing fuse carrier shall be provided. The rod shall be minimum 6.0 meter long unless otherwise stated in Data Sheet-A. The Bidder shall furnish the rod dimensions and rating commensurate with the required grade of insulation. The rod shall be provided with terminal and screw for earthing the rod.

Multi-bolt (bimetallic) terminal clamps shall be provided at the top and bottom of fuse base contacts suitable for connection to the PURCHASER'S conductors specified in Data Sheet-A.

Fuse kit shall be supplied, consisting of fuse-link assembly, refusing tool and any other item necessary to restore the fuse units to service after an operation.

2.5 EARTHING

H.V. Drop out fuse frame shall have two earthing terminals.

2.6 TESTS

(a) Type tests as specified in the IS shall be carried out on one unit or type test certificates shall be forwarded for approval.

(b) Certified type test reports including time-current curves shall be submitted with the bid.

(c) Type tests as specified in the applicable standards shall be carried out on one unit after the award of contract if required by the PURCHASER, otherwise available type test certificates of similar rating and type carried out in last 5 years shall be forwarded for approval.

(d) H.V. withstand test.

(e) Operational check up tests.

Instruments used for testing and inspection shall have valid calibration and accuracy traceable to National Standards.

2.7 DATASHEET A1

SL. NO.	ITEM	UNIT	
1.0	General		
1.1	Application		
1.2	Quantity		1
1.3	Number of phases		3
1.4	Ambient temperature	°C	40
1.5	Vertical break mounting structure/pole/wall		Pole
1.6	Phase spacing	mm	
1.7	Indoor/outdoor		Outdoor
1.8	Type class 1/class 2 (is-9385 part ii)		
2.0	Rating		
2.1	Nominal voltage/max voltage	kV	11/12
2.2	Rated current		
	i) Fuse base	A	
	ii) Fuse links		
	a) Continuous	A	
	b) Max. breaking current (rms)	kA	
3.0	Insulation level		
3.1	Voltage class	kV (RMS)	
3.2	One minute power frequency dry/wet withstand voltage	kV (RMS)	
3.3	Impulse withstand voltage 1.2 x 50μsec wave	kV (PEAK)	
4.0	Accessories		

SL. NO.	ITEM	UNIT	
4.1	Terminal clamps for purchaser's conductor		
	a) Conductor size		
	b) Material		
4.2	Earthing terminal for purchaser's conductor		
	a) conductor size		
	b) material		
4.3	Operating rod		
	a) System voltage	kV	
	b) Length of rod	m	

2.8 DATASHEET A2

SL. NO.	ITEM		
1.0	<u>APPLICABLE STANDARDS</u>		
1.1	High voltage fuse		<input type="checkbox"/> IS : 9385 <input type="checkbox"/> IEC : 60282-2
1.2	Porcelain post – insulators for Systems with normal voltage Greater than 1000v		<input type="checkbox"/> IS:2544
1.4	Recommended practice for hot dip galvanizing of iron and steel		<input type="checkbox"/> IS: 2629
1.5	Boards blanks for sley bottom, race, cap and box back of cotton looms		<input type="checkbox"/> IS: 9794

SL. NO.	ITEM		

3 DISTRIBUTION TRANSFORMER

3.1 SCOPE

This specification covers the general design, material, construction features, manufacture, inspection and testing at the VENDOR's / his SUB-VENDOR's works, delivery to site and performance testing of mineral oil immersed, natural air-cooled, outdoor type, double wound 125 kVA, 11 kV distribution transformers and accessory equipment.

3.2 CODES AND STANDARDS

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the VENDOR of his responsibility.

The equipment shall conform to the latest edition of applicable standards and code of practice mentioned in Data Sheet-A. In case of conflict between the applicable standards and this specification, this specification shall govern.

3.3 GENERAL CONSTRUCTIONAL FEATURES

All material used shall be of best quality and of the class, most suitable for working-under the conditions specified and shall withstand the variations of temperature and atmospheric conditions, overloads, over-excitation, short-circuits as per specified standards, without distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

The transformer construction shall be suitable for seismic data as specified in this specifications.

3.3.1 Tanks

The exterior of tank and other steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather-resistant nature, preferably of distinct colour from the prime and finish coats. The final coat shall be of a glossy, oil and weather resisting non-fading paint of specified shade. The interior of the tank shall be cleaned by shot blasting and painted with two coats of heat resistant and oil insoluble paint.

Steel bolts and nuts exposed to the atmosphere shall be galvanised.

3.3.2 Vacuum and pressure test

Various Vacuum & Pressure Tests for tank, conservator, radiator, pipes etc. shall be as per IS specified in data sheet A

The tank cover shall be suitably sloped so that it does not retain rain water.

The material used for gaskets shall be cork neoprene or approved equivalent.

3.3.3 Core

The magnetic circuit shall be constructed from high grade cold-rolled non-ageing grain oriented silicon steel laminations and shall be of 'core' type.

The insulation structure for the core to bolts and core to clamp plates shall be such as to withstand BIL & Lightning Impulse Voltage.

3.3.4 Winding

Windings shall be of electrolytic Copper of 99.99% purity unless specifically approved by the PURCHASER.

Winding shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service.

The completed core and coil assembly shall be dried in vacuum and shall be immediately impregnated with oil after the drying process to ensure elimination of air and moisture within the insulation.

3.3.5 Internal earthing

The framework and clamping arrangement of core and coil shall be securely earthed inside the tank by Copper strap connection to the tank.

3.3.6 Termination

Transformers shall be fitted either with bushing insulators or air insulated cable box with air insulated disconnecting chambers, as specified in Data Sheet-A.

The neutral of the star-connected winding shall be brought out to a separate bushing terminal. The neutral bushing shall be provided on the tank side to facilitate lead of the earth conductor down to the ground level. For transformers 1000 kVA and above, tank mounted Epoxy resin cast insulators shall be provided for supporting the neutral earthing bar of specified section, along its run from the neutral bushing to ground-level. Neutral shall also be extended to cable box /bus duct flange as applicable.

3.3.7 Bushings

Bushings shall be designed and tested to comply with the applicable standards specified in Data Sheet-A. If type test certificates are not available, these tests shall also be carried out in addition to the routine tests.

Bushing rated for 400A and above shall have non-ferrous flanges and hardware.

Fittings made of steel or malleable iron shall be galvanized.

Whenever specified in Data Sheet-A, bushings shall be supplied with terminal connector clamp suitable for connecting the bushing terminal to the PURCHASER's specified conductor/cable.

3.3.8 BUSHING CURRENT TRANSFORMERS

Whenever specified in Data Sheet-A, bushing shall be supplied with current transformers.

Secondary leads, including tapings, shall be brought to a weatherproof terminal box near the bushing.

Bushing C.T. nameplate shall be mounted on the tank adjacent to the terminal box.

3.3.9 Cable boxes and disconnecting chamber

When specified in Data Sheet-A, cable boxes shall be supplied to suit the PURCHASER'S specified cables.

When specified in Data Sheet A, disconnecting chamber shall be provided to enable the transformer to be removed without unsealing the cables. The disconnecting chamber shall be air insulated and complete with seal-off bushings, removable flexible connectors/links and removable covers.

Phase to phase and phase to ground clearances within the chamber shall be such as to enable either the transformer or cable to be subjected separately to Basic Insulation Level (BIL). Clearances shall be subject to the PURCHASER's approval.

3.4 ELECTRICAL AND PERFORMANCE REQUIREMENTS

Transformers shall operate without injurious heating at the rated kVA at any voltage within + 10 percent of the rated voltage of that particular tap.

Transformers shall be designed for 110% continuous overfluxing withstand capability.

Overloads shall be allowed within the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tap/changers or other auxiliary equipment shall apply.

Noise level of transformers shall be as per latest NEMA standard.

Neutral of low voltage side shall be rated as per % mentioned in data sheet A.

3.4.1 Oil

Transformers shall be supplied complete with transformer oil, It shall be "PCB free and polycyclic Aromatic Hydrocarbons free mineral oil" OR Synthetic ester Oil as per IS / IEC specified in Data Sheet A.

3.5 **FITTINGS AND ACCESSORIES**

The following standard fittings shall be provided:

- (a) Two earthing terminals with the earthing symbol
- (b) Oil level gauge indicating oil level at minimum, 300C and maximum operating temperature
- (c) Air release device (for non sealed type transformer)
- (d) Rating and terminal marking plate
- (e) Plain breathing device for non-sealed type transformer which would not permit ingress of rain water and insects
- (f) Drain cum-sampling valve (3/4" nominal size thread) preferably steel with plug for three phase transformer.
- (g) Thermometer pocket with cap
- (h) Oil filling holes having (1 1/4" nominal size thread) with cover (for sealed type transformers without conservator)
- (i) Lifting lugs for the complete transformer as well as for core and winding assembly
- (j) Lifting lugs for tank cover
- (k) Conservator tank shall have inter-connection pipe projection, 20 mm above bottom of the conservator so as to create a sump for collection of impurities. It shall have 30 mm dia drain valve, oil filling hole with cap on the top of the conservator.
- (l) One drain cum sampling valve.
- (m) One filter valve on the upper side of the tank
- (n) Unidirectional flat rollers
- (o) Inspection hole

3.6 **TESTS**

- (a) Measurement of winding resistance
- (b) Measurement of voltage ratio and check of phase displacement
- (c) Measurement of short circuit impedance (principal tapping, when applicable) and load loss at 50 percent & 100 percent load
- (d) Measurement of no load loss and current
- (e) Measurement of insulation resistance
- (f) Induced over voltage withstand test
- (g) Separate source voltage withstand test
- (h) Pressure test
- (i) Oil leakage test
- (j) Lightning impulse test
- (k) Temperature rise test
- (l) Short-circuit withstand test
- (m) Pressure test
- (n) Determination of sound levels
- (o) No load current at 112.5 percent voltage
- (p) Paint adhesion tests. The test is performed as per ASTM D3359 (Standard Test Methods for measuring adhesion by Tape test)
- (q) BDV and moisture content of oil in the transformer

3.7 **LOSSES**

Transformer losses and impedance values shall be as specified in Data Sheet- A.

For the purpose of evaluation of bids, the quoted load losses and iron losses shall be increased to take into consideration tolerance as permitted by applicable standard.

Should the losses as measured on the transformer after manufacture be found in excess of the values of the guaranteed losses with plus tolerance indicated in the proposal, VENDOR shall pay penalty to the PURCHASER based on the charges indicated in Data Sheet-A.

3.8 REJECTION

PURCHASER may reject any transformer if during tests or service any of the following conditions arise:

- (a) No load loss exceeds the guaranteed value by 15% or more.
- (b) Load loss exceeds the guaranteed value by 10% or more.
- (c) Total losses exceeds the guaranteed value by 10% or more.
- (d) Impedance value differs the guaranteed value by $\pm 10\%$ or more.
- (e) Oil or winding temperature rise exceeds the specified value by 5°C.
- (f) Transformer fails on impulse test.
- (g) Transformer fails on power frequency voltage withstand test.
- (h) Transformer is proved to have been manufactured not in accordance with the agreed specification.
- (i) The PURCHASER reserves the right to retain the rejected transformer and take it into service until the VENDOR replaces, at no extra cost to PURCHASER, the defective transformer by a new acceptable transformer.
- (j) Alternatively the VENDOR shall repair or replace the transformer within a reasonable period to the PURCHASER's satisfaction at no extra cost to the PURCHASER.

3.9 QUALITY ASSURANCE PLAN (QAP)

QAP shall list and define in sequential order all process control activities, inspection and tests proposed to be performed on the equipment/ material starting from component procurement and from testing stages to product dispatch. The QAP shall indicate and identify the applicable standards, detailed description with diagram the procedure, acceptance criteria, extent of check and record to be generated. Transformer Vendor has to get approval for QAP, from Purchaser / Consultant.

3.10 DOCUMENTATION

Both hard and soft copies (AutoCAD) of all Vendor drawings shall be furnished right from approval stage.

The Vendor shall plan his manufacturing schedule so as to allow at least two weeks time for approval of the drawings after their receipt by the Purchaser.

Upon completion of the installation, the Vendor shall furnish a complete set of drawings on reproducible tracing film if requested by the Purchaser and soft copies in CDs.

Drawings prepared by the Vendor and approved by the Purchaser shall be considered as a part of the Contract Specification. However, examination and approval of the drawings by the Purchaser shall not relieve the Vendor of his responsibility for engineering, design, workmanship, materials and construction under the Contract.

The Purchaser shall reserve the right to comment on drawings and documents under information category and inform the Vendor to treat these drawings and documents as approval category.

Following Documents are to be submitted along with the bid document-

- (a) Tentative GA of the transformer.
- (b) Data sheets as asked for in the Specifications.
- (c) List of makes for all components including bought out items.
- (d) Type test certificates as asked for transformer.

3.11 DATASHEET A1

SL. NO.	ITEM	UNIT	
1	<u>GENERAL</u>		
1.1	Application / Designation		
1.2	Quantity Required	No.	One (1)
1.3	Installation (Indoor / Outdoor)		Outdoor
1.4	Degree of protection as per IS:13947-1 1993		IP – 55
2.0	<u>RATINGS</u>		
2.1	Rating	kVA	125
2.2	Number of Phases & Frequency		3 Ph, 50 Hz
2.3	Type of cooling		ONAN
2.4	No Load Voltage Primary	V	11000
	Secondary	V	415
2.5	Vector Group		Dyn11
2.6	Neutral Rating (% of Phase Rating)	%	
2.6	% Impedance at principal tapping	%	4
2.7	Losses		EEL - 2 as per clause 6.8 and 7.8 of IS 1180 : 2014
2.7.1	No Load Loss	kW	As per IS 1180 standards

2.7.2	Full Load Losses at rated output, rated frequency & corrected for 75 °C winding temperature	kW	As per IS 1180 standards
3.0	<u>SYSTEM VOLTAGE</u>		
3.1	Nominal System Voltage- Primary	V	11000
	Secondary	V	433
3.2	Highest System Voltage-Primary	V	12000
	Secondary	V	433
4.0	<u>NEUTRAL EARTHING</u>		
4.1	System Neutral		
	HV		Non effectively earthed
	LV		Solidly earthed
4.2	Transformer Neutral		
	HV		Isolated
	LV		Solidly Earthed
5.0	<u>INSULATION WITHSTAND</u>		
5.1	Impulse (1.2/50 microsec/wave)		
	a) Primary	kV	75 kV (peak)
	b) Secondary	kV	-
5.2	Power Frequency		
	a) Primary	kV	28 kV
	b) Secondary	kV	3 kV
6.0	<u>TEMPERATURE RISE</u>		
	a) Reference ambient	°C	50
	b) Oil by thermometer	°C	As per IS 1180: 2014
	c) Winding by resistance	°C	As per IS 1180: 2014
	d) OTI – Alarm / Trip at ambient	°C / °C	NA
	e) WTI – Alarm/ Trip at ambient	°C / °C	NA
7.0	<u>TAP CHANGING GEAR</u>		
	a) Taps required	ON / OFF LOAD	OFF LOAD
	b) Tappings on windings	Primary/ Secondary	Primary

	c) Total tapping range	%	+5 to -10
	d) Steps	%	2.5
8.0	<u>DETAILS OF TRANSFORMER OPERATING IN PARALLEL</u>		NA
	a) Manufacturer's Name		NA
	b) Rating	kVA	NA
	c) Exact Turns Ratio		NA
	d) Tapping range		NA
	e) Full load loss corrected to 75°C		NA
	f) % impedance at principal tapplings		NA
	g) Vector group		NA
9.0	<u>BUSHINGS</u>		
9.1	Voltage class		
	a) Primary line end	kV	11
	b) Secondary line end	kV	NA
	c) Primary neutral	kV	NA
	d) Secondary neutral	kV	NA
9.2	Impulse(1.2/50 μ sec. Wave withstand)		
	a) Primary line end	kV	75
9.3	Power frequency withstand		
	a) Primary line end	kV	28
	b) Secondary line end	kV	NA
	c) Primary neutral	kV	NA
	d) Secondary neutral	kV	NA
9.4	Minimum clearance in air (in mm)		
	a) Primary phase to phase		280
	b) Secondary phase to phase		NA
	c) Primary phase to earth		NA
	d) Secondary phase to earth		NA
9.5	Minimum creepage distance (in mm)		
	a) Primary line end		220 (20 mm/kV)
	b) Secondary line end		NA
	c) Primary neutral		NA

	d) Secondary neutral		NA
9.6	Neutral CT details		
	a) CT Ratio		
	b) Class		
	c) Burden		
10.0	<u>TERMINAL CONNECTIONS</u>		
10.1	Primary line end bushing/cable box/cable box with disconnecting chamber		Bushing
10.2	Secondary line end bushing/cable box/cable box with disconnecting chamber/bus duct flange		Cable Box with disconnecting chamber
10.3	Primary neutral bushing		NA
10.4	Secondary neutral bushing		
10.5	Bushing Terminals		
	a) Required	Yes/No	No
	b) Size of Purchaser's take off conductor		-
10.6	Cable Box, Lugs and Glands		
	a) Required	Yes/No	Yes
	b) Purchaser's Cable details		3C x 120 sqmm, Al, XLPE, 11 kV (UE) 3.5C x 120 sqmm, Al, XLPE, 1.1 kV
11.0	<u>EARTHING TERMINAL</u>		
11.1	Material of conductor		GI
11.2	Size of conductor		50 x 6 mm
12.0	<u>MISCELLANEOUS</u>		
12.1	Wheels		
	a) Plain/Flanged		Plain
	b) Unidirectional/Bidirectional		Unidirectional
12.2	Vacuum withstand capability Main tank with bushing radiators, fittings & accessories		
12.3	Transformer oil		Mineral oil
13.0	<u>OPTIONAL FITTINGS REQUIRED</u>		

	a) Dehydrating breather in lieu of plain breathing device for transformer up to 200kVA	Yes/No	Yes
	b) Filter valve (1 1/4" nominal size thread) for transformers up to 200kVA	Yes/No	Yes
	c) Arcing horns or suitable rating lightning arrestors for HT side – 3 Nos. For transformers up to 200 kVA	Yes/No	Yes
	d) Bird guard	Yes/No	Yes
	e) Terminal connectors	Yes/No	Yes
	f) Oil temperature indicator and winding temperature indicators for transformers above 200kVA	Yes/No	No
	g) Jacking pads (for transformer above 1600kVA)	Yes/No	No
	h) Buchholz relay (for transformers above 200kVA)	Yes/No	No
	i) Magnetic oil level gauge (for transformer above 1600kVA) with low oil level alarm contact	Yes/No	No
	j) Non return valve (for conducting pressure test)	Yes/No	Yes
	k) Pressure relief device or explosion vent (up to 200kVA)	Yes/No	Yes
	l) Protection relay for sealed type transformers for internal parameters that is pressure, temperature, oil level and gas detection (above 1000kVA)	Yes/No	No
	m) 4 Nos anti-theft stainless steel fasteners with breakaway nut shall be provided at top cover(up to 200kVA)	Yes/No	Yes
14.0	<u>EVALUATION & PENALTY</u>		
14.1	Formula for evaluation of Bids		
14.2	Rates of penalty for exceeding the guaranteed losses		
15.0	<u>ESSENTIAL SPARES</u>		
15.1	Complete set of gaskets		Yes
15.2	Bushing of each type		1 No.
15.3	CT of each type		NA
15.4	Dial type thermometer		1 No.

15.5	Oil level gauge		1 No.
15.6	Complete set of winding temperature indicating equipment		NA
15.7	Explosion vent diaphragms / PRD		No
15.8	Silica-gel breather		Yes
15.9	Buchholz relay or fault pressure relay		NA
15.10	One valve of each type		Yes
Notes:			
1) Items tick marked to be provided.			
2) Recommended quantities and unit prices to be indicated by the Bidder in his quotation.			

3.12 DATASHEET A2

SL. NO.	BRIEF NAME		REFERENCE STANDARDS
1.0	<u>APPLICABLE STANDARDS</u>		
1.1	Power Transformer		<input type="checkbox"/> IS:2026 <input type="checkbox"/> IEC 60076
1.2	Fittings and Accessories		<input type="checkbox"/> IS:3639 <input type="checkbox"/> IEC 60076-22
1.3	Distribution transformer		<input type="checkbox"/> IS:1180 <input type="checkbox"/> IEC60076
1.4	Loading of oil immersed transformer		<input type="checkbox"/> IS:6600 <input type="checkbox"/> IEC 60076-7
1.5	Oil		<input type="checkbox"/> IS:335 <input type="checkbox"/> IS: 12463 <input type="checkbox"/> IEC:60296 <input type="checkbox"/> IEC:60076-14
1.6	Bushing for > 1000 V, AC		<input type="checkbox"/> IS:2099 <input type="checkbox"/> IEC:60137
1.7	Bushing for ≤ 1000 V, AC		<input type="checkbox"/> IS:7421
1.8	Degree of protection		<input type="checkbox"/> IS:13947 <input type="checkbox"/> IEC:60947-1 <input type="checkbox"/> IEC:61439 <input type="checkbox"/> IEC:60529
1.9	Tests & tolerances on guaranteed particulars		<input type="checkbox"/> IS:1180 <input type="checkbox"/> IEC:60076
1.10	Buchholz relay		
1.11	Electrical insulation classified by thermal stability		<input type="checkbox"/> IS:3637

SL. NO.	BRIEF NAME		REFERENCE STANDARDS
1.12	Climate proofing		<input type="checkbox"/> IS: <input type="checkbox"/> BS: <input type="checkbox"/> IEC
1.13	Transformer Losses		<input type="checkbox"/> IS:1180
2.0	<u>NOTES</u>		
2.1	Equipment, Accessories, Components /Parts Raw materials and tests shall in general conform to		<input type="checkbox"/> IS <input type="checkbox"/> IEC
2.2	Latest amendments of the standards mentioned above shall be referred.		
2.3	In case referred standard is not available other equivalent or better standard will be acceptable.		

4 **LOW VOLTAGE SWITCHBOARD**

4.1 **SCOPE**

This specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR'S/SUB-VENDOR'S works, delivery to site and performance testing at site of metal-enclosed Low Voltage Switchgear of voltage not exceeding 1000 V AC.

The switchgear would comprise Power Control Centres (PCCs), Motor Control Centres (MCCs) and Power cum Motor Control Centres (PMCCs) required for the supply of power and control of the plant medium voltage equipment.

This section along with Data Sheets A1 to A3 enclosed defines the scope of supply. The bidder shall confirm compliance to requirements of these data sheets. Deviation if any should be specifically brought out in the schedule of technical deviations.

4.2 **CODES & STANDARDS**

The switchgear and its components shall conform to the latest applicable standards as mentioned in Data Sheet A2 revisions being as on date of offer. In case of conflict between the standards and this specification, this specification shall govern.

The switchgear shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve Vendor of this responsibility.

4.3 **CONSTRUCTIONAL FEATURES**

The switchgear shall be metal enclosed, modular type suitable for indoor floor mounting and shall have following features.

- (a) Height shall not exceed 2450 mm.
- (b) Shall be easily extensible at both ends.
- (c) Shall be in single or double front execution and fixed or draw out type as indicated in data sheet A1.
- (d) Shall have designation labels both on front and rear sides.
- (e) Shall be provided with proper gasketing for removable covers, doors, between panels & base frame and all around the perimeter of panels.

Switchgear shall be divided into distinct vertical sections each comprising:

- (a) A completely enclosed busbar compartment running horizontally.
- (b) Enclosed vertical busbars serving all modules in vertical section.
- (c) A separate horizontal enclosure for all auxiliary power and control buses, if required.
- (d) Vertical cable alley of minimum 250 mm wide covering entire height.

Operating devices shall be incorporated only in the front of switchgear.

Each shipping section shall have metal sheets at both ends.

Cable alley shall be provided with suitable hinged doors.

Rear of single front switchgear shall be provided with either door or removable covers with captive screws.

All doors shall be with concealed type hinges and captive screws.

Each vertical section shall be equipped with a space heater controlled by thermostat.

For draw out modules, only handles of control and selector switches, push buttons, knobs and cutouts for lamps and meters shall be put on front door of respective compartments. All other components shall be on withdrawable chassis.

In fixed type construction, all power connections to the equipment mounted on withdrawable chassis shall be of bolted type.

4.3.1 Inter-changeability

All identical equipment and corresponding parts including chassis of drawout modules of same size shall be fully interchangeable without any modifications.

4.3.2 Module Types and Control Supply

The control wiring diagrams for various types of modules are shown in standard drawings enclosed to this specification. The list of feeders along with the module type is indicated in data sheet A3.

The control supply arrangements shall be in line with the requirement specified in datasheet A1.

4.3.3 Main and Auxiliary Buses

Switchgear busbars shall be of uniform cross section throughout the length and made of high conductivity, hard drawn copper or aluminium alloy of E91E grade.

Busbars shall be insulated by with heat shrinkable PVC sleeved with proper clearances and shall be adequately supported to withstand stresses developed due to short circuits. Material used for sleeving shall be capable of withstanding maximum temperatures specified in datasheet A1. Supports shall be of glass reinforced phynolic material or DMC. Busbar joints shall be shrouded with moulded epoxy / FRP shrouds.

Busbar joints shall be provided with contact grease at the joints and shall be complete with tensile steel bolts and belleville washers and nuts.

4.3.4 Circuit Breakers

(a) Moulded Case Circuit Breaker (MCCB)

Moulded case circuit breakers (MCCBs) shall be provided as called for in the Data Sheet and shall conform to the latest applicable standards.

MCCBs in AC circuits shall be of triple / four pole construction arranged for simultaneous three / four pole manual closing and opening. Operating mechanism shall be quick-make, quick-break and trip-free type. The ON, OFF and TRIP positions of the MCCB shall be clearly indicated and visible to the operator and one contact of each shall be brought out for Purchaser's use. Handle for operating MCCBs from door of the switchgear shall be provided.

The instantaneous short circuit release shall be so chosen by the VENDOR as to operate at a current in excess of the peak motor inrush current and a range of settings shall be provided for the Purchaser's selection.

MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.

(b) Motor Protection Circuit Breakers (MPCBs)

MPCBs in AC circuits shall be of triple / four pole construction arranged for simultaneous three / four pole manual closing and opening. Operating mechanism shall be quick-make, quick-break and trip-free type. The ON, OFF and TRIP positions of the MPCB shall be clearly indicated and visible to the operator and one contact of each shall be brought out for Purchaser's use. Handle for operating MPCBs from door of the switchgear shall be provided.

The instantaneous short circuit protection shall be so chosen by the VENDOR as to operate at a current in excess of the peak motor inrush current and a range of settings shall be provided for the Purchaser's selection.

MPCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.

(c) Miniature Circuit Breakers (MCBs)

Miniature circuit breakers for use on motor space heater control circuits shall comply with the requirements of applicable standards, unless otherwise mentioned in Data Sheet.

Protection Co-Ordination

It shall be the responsibility of the Contractor to fully coordinate the system and to provide satisfactory discrimination.

Contactors

The power contactors used in the switchgear shall be of air break, single throw, triple pole, and electromagnetic type. Contactors shall be suitable for uninterrupted duty and rated for Class AC3 duty in accordance with IEC 60947-4.

Operating coils of all contactors shall be suitable for operation on 230 V, single phase, 50 Hz supply.

Contactors shall be provided with at least two pairs of NO and NC auxiliary contacts.

Contactors shall not drop out at voltages down to 70 % of coil rated voltage.

All motor contactors and their associated apparatus must be designed to operate for a period of not less than 5 minutes at a voltage of 20% below the nominal value and at normal frequency without injurious overheating.

Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable settings for small rating motors. The hand reset button shall be flush with the front door of the control module, and shall be suitable for resetting the overload relay with the module door closed. Relays shall be either direct connected or CT operated. Overload relay and reset button shall be independent of the "Start" and "Stop" push buttons. All contactors shall all be provided with single phasing preventer (SPP).

Motor starters shall be complete with auxiliary relays, timers and necessary indications. Starters shall be of the electrically held-in type with integral "start" and "stop" push buttons mounted externally on the door, with integral interlocked isolators. Where required, auxiliary switches shall be included for the operation of "red" and "green" indicating lights in remote instrument panels.

Protective Relays

Protection relays shall be Numerical/ static type as per SLD enclosed.

All relays shall be dustproof cases and shall be suitable for flush mounting with only flanges projecting on the front with connections from the rear.

All relays shall be accessible from the front for setting and resetting. 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 shall be of the draw-out type with provision for test facilities. Relays shall be provided with operation indicators visible from the front.

Auxiliary Relays and Timers

Following auxiliary relays shall be provided on each breaker cubicle: Trip circuit supervision relay

Anti- pumping relay

Hand reset type lockout (tripping) relays and timers shall be provided. Auxiliary relays and timers shall be rated to operate satisfactorily between 80 % and 110 % of the rated voltage.

4.3.5 Form of Separation

Form 1: No internal separation between busbars & other functional units.

Form 2: Busbars are separated from other functional units but no separation between different functional units. Form 2 is divided in two parts.

(a) Form 2A: Terminals of external conductors are not separated from busbars. (b) Form 2B: Terminals of external conductors are separated from busbars.

Form 3: Busbars are separated from other functional units & each functional units are separated from other functional units. Form 3 is divided in two parts.

(a) Form 3A: Terminals of external conductors are not separated from busbars. (b) Form 3B: Terminals of external conductors are separated from busbars.

Form 4: Busbars are separated from other functional units, each functional units are separated from other functional units, each functional units are separated from any incoming & outgoing termination and incoming & outgoing terminals are separated from each other. Form 4 is divided in two parts.

(a) Form 4A: Terminals for external conductors in the same compartment as the associated functional unit.

(b) Form 4B: Terminals for external conductors not in the same compartment as the associated functional unit, but in individual, separate, enclosed protected spaces or compartments.

4.4 INTERNAL WIRING

The internal wiring shall be carried out with 1100V grade, PVC insulated, stranded conductor wires. The minimum size of conductor for power circuits shall be 4 sq.mm copper or equivalent size aluminium conductor. Control circuits shall be wired with copper conductor of at least 2.5 sq.mm for CT circuits and 1.5 sq.mm for other circuits.

4.5 **PAINTING**

Pre-treatment of all sheet steel work, including degreasing, rust/scale removal and phosphating shall be carried out as per applicable standard.

The phosphate coating shall be sealed by the application of two coats of ready mixed zinc chromate primer.

After application of the primer, two coats of finishing synthetic enamel paint shall be applied. (Second coat shall be applied after completion of tests). The colour of the finishing coat shall be as specified in Data Sheet-A1.

A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panel.

4.6 **COMPONENTS**

All components which may form part of switchgear shall be of reputed make subject to approval of PURCHASER/CONSULTANT and the makes shall be specified while furnishing the Bid.

4.7 **TESTS**

The switchgear, circuit breaker, MCCB and all associated equipment shall be tested in accordance with the latest relevant standards. All routine tests shall be carried out. Type tests shall also be carried out free of cost if not tested in the previous five years.

All meters and other reference devices used for testing shall have valid calibration certificate from reputed national laboratories/institutes. Inspection by Purchaser/Engineer will not be carried out unless the Vendor confirms that calibrated equipment is ready for proceeding with the tests.

4.8 **DATASHEET A1**

SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
1.0	<u>SWITCHGEAR & BUSBAR RATING</u>		
1.1	RATED VOLTAGE, PHASES &		415V, 3 Ph, 50 HZ

SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
	FREQUENCY		
1.2	SYSTEM NEUTRAL EARTHING :		EFFECTIVELY
1.3	MAXIMUM SYSTEM VOLTAGE		433
1.4	ONE MINUTE POWER FREQUENCY VOLTAGE : A) POWER CIRCUITS B) CONTROL CIRCUITS C) AUX. CIRCUITS CONNECTED TO SEC. OF CTS	VOLTS VOLTS VOLTS	2500 1500 2000
1.5	CONTINUOUS CURRENT RATING OF BUSBARS UNDER SITE REFERENCE AMBIENT TEMPERATURE		REFER ITEM-2 BELOW AND DATA SHEET-A3
1.6	REFERENCE AMBIENT TEMPERATURE	°C	50
1.7	MAXIMUM TEMPERATURE OF BUSBARS, DROPPERS AND CONTACTS AT CONTINUOUS CURRENT RATING UNDER SITE REFERENCE AMBIENT TEMPERATURE	°C	85°C FOR NON-SILVER PLATING JOINTS 105°C FOR SILVER PLATING JOINTS
1.8	SHORT CIRCUIT WITHSTAND FOR BUSBARS AND DROPPERS A) SHORT TIME (1 SEC.) AT 415V B) DYNAMIC RATING	KA (RMS) KA (PEAK)	50 105
1.9	BUSBAR SUPPORT MATERIAL		GLASS REINFORCED / DMC
1.10	BUSBAR INSULATING MATERIAL		HEAT SHRINKABLE PVC SLEEVES

SL. NO.	ITEM				UNIT	TECHNICAL PARTICULARS			
						(RAYCHEM)			
1.11	STANDARD APPLICABLE					AS PER DATA SHEET-A2			
2.0	<u>SWITCHGEAR PARTICULARS</u>					As per SLD, Single Front, Cable Entry - Bottom			
SL. NO.	DESIGNATION	BUSBAR DETAILS			SINGLE FRONT (SF)/ DOUBLE FRONT (DF)	FULLY DRAW OUT (FD) SEMI DRAW OUT (SD) FIXED (F)	CABLE ENTRY		
		AMPS	CU/AL	TP/TPN			TOP	BOTTOM	
							POWER	CONTROL	
2.1									
2.2									
2.3									
2.4									
2.5									
2.6									
2.7									
2.8									

SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
3.0	<u>SWITCHGEAR CONSTRUCTIONAL REQUIREMENTS</u>		
3.1	THICKNESS OF SHEET STEEL A) COLD ROLLED B) HOT ROLLED	mm mm	FRAME – 2.0 DOORS – 2.0 COVERS – 3.0 NA
3.2	DEGREE OF PROTECTION (IP CLASS)		AS PER IS:13947
3.3	COLOUR FINISH SHADE A) INTERIOR B) EXTERIOR		GLOSSY WHITE LIGHT GREY SEMI GLOSSY SHADE 631 AS PER IS:5 / RAL7032
3.4	EARTHING BUS A) MATERIAL B) SIZE	mm mm	
3.5	PURCHASER'S EARTHING CONDUCTOR A) MATERIAL B) SIZE	mm mm	GI 50 x 6
3.6	CLEARANCES IN AIR OF LIVE PARTS		PHASE TO PHASE : 25.4 MM PHASE TO EARTH : 19.4 MM
3.7	METAL ENCLOSED BUSDUCT/BUS TRUNKING ENTRY TO CUBICLES IF REQUIRED		NA
3.8	FORM OF SEPARATION AS PER IEC 61439-1		Form 2 (B)
3.9	REQUIREMENT OF ARC RESISTANCE FEATURE	YES/NO	Yes

SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
4.0	<u>STARTERS</u>		
4.1	TYPE		(a) DOL (b) REV (c) Y-Δ
4.2	CONTACTOR RATED DUTY		AS PER IS:13947
4.3	UTILISATION CATEGORY		AS PER IS:13947
4.4	CONTROL SCHEME & BILL OF MATERIAL ENCLOSED	YES/NO	No
4.5	CONTROL TRANSFORMER :	YES/NO	No
	A) SEPARATE FOR EACH MODULE B) COMMON FOR EACH SWITCHGEAR SECTION WITH 100% STANDBY	YES/NO	Yes
4.6	THERMAL OVERLOAD RELAY :	YES/NO	Yes
	A) INBUILT SINGLE PHASING PREVENTOR REQUIRED B) RELAY RESET	HAND/AUTO	Hand
4.7	STANDARD APPLICABLE		AS PER DATA SHEET-A2
5.0	CIRCUIT BREAKER		NA
5.1	CIRCUIT BREAKER TYPE		
5.2	VOLTAGE, FREQUENCY & NO. OF POLES		
5.3	RATED BREAKING DUTY		

SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
5.4	RATED BREAKING CAPACITY A) MVA B) kA(RMS) AT 415V 0.25 P.F.		
5.5	RELATIONSHIP BETWEEN ICU, ICS & ICW	%	
5.6	SHORT CIRCUIT WITHSTAND CURRENT FOR 1 SEC. DURATION	kA	
5.7	RATED MAKING CURRENT	kA(PEAK)	
5.8	RATED CURRENT AT SITE REFERENCE AMBIENT TEMPERATURE	A	
5.9	TYPE OF OPERATING MECHANISM		
5.10	KEY INTERLOCKING REQUIRED	YES/NO	
5.11	SHUNT TRIP REQUIRED	YES/NO	
5.12	TRIP FREE MECHANISM	YES/NO	
5.13	ANTI PUMPING FEATURES		
5.14	PROTECTION REQUIRED A) RELAYS / SERIES RELEASES B) RELAY TYPE & SETTINGS C) UNDER VOLTAGE RELAY REQUIRED & SETTING		

SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
5.15	MINIMUM NO OF AUXILIARY CONTACTS		
5.16	CONTROL VOLTAGE (a) FOR SPRING CHARGING MOTOR (b) FOR CLOSING/TRIPPING	V AC/DC	
5.17	EMERGENCY MANUAL OPERATION REQUIRED IN ADDITION TO ELECTRICAL OPERATING DEVICES A) FOR SPRING CHARGING & CLOSING B) FOR TRIPPING		
5.18	ANNUNCIATOR REQUIRED		
5.19	STANDARDS APPLICABLE		
6.0	MCCB's		
6.1	MOULDED CASE CIRCUIT BREAKERS TO BE PROVIDED. A) FOR MOTOR CONTROL CIRCUITS B) FOR OTHER CIRCUITS	YES/NO YES/NO	YES YES
6.2	VOLTAGE, FREQUENCY & NO OF POLES		415V , 50 Hz, TPN
6.3	RATED OPERATING DUTY		Continuous

SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
6.4	RATED BREAKING CAPACITY (AT 415V 0.25 P.F.)	kA(RMS)	50
6.5	RELATIONSHIP BETWEEN ICU & ICS	%	ICS = 100% OF ICU AT SYSTEM FAULT LEVEL
6.6	RATED MAKING CURRENT	kA (Peak)	105
6.7	RATED CURRENT AT SITE REFERENCE AMBIENT TEMPERATURE		TO SUIT MOTOR CONTROL CIRCUITS SEE DATA SHEET A3
6.8	ON/OFF OPERATION MANUAL MOTOR OPERATED	YES/NO YES/NO	YES NO
6.9	TYPE OF RELEASES THERMO MAGNETIC MICROPROCESSOR	YES/NO YES/NO	YES NO
6.10	PROTECTION REQUIRED A) TYPE & SETTINGS B) UNDER VOLTAGE RELAY REQUIRED & SETTING	YES/NO	
6.11	STANDARDS APPLICABLE		AS PER DATA SHEET-A2
7.0	<u>INSTRUMENT TRANSFORMERS</u>		

SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
7.1	METERING CT's A) RATIO B) BURDEN C) ACCURACY CLASS D) ISF	A/A VA	7.5 / 10 / 15 CL 0.5 / 1.0 ≤ 5
7.2	PROTECTION CT's A) RATIO B) BURDEN C) CLASS	A/A VA	7.5 / 10 / 15 CL 5P10 / CL5P20
7.3	CLPX CT's A) RATIO B) KNEE POINT VOLTAGE C) MAGNETISING CURRENT (Imag) D) CT COIL RESISTANCE (Rct)	A/A V mA Ω	
7.4	VT's A) RATIO B) BURDEN C) ACCURACY CLASS D) OVER VOLTAGE FACTOR	V/V VA	100 1/3P 1.2
7.4	INSULATION TYPE		RESIN CAST
7.5	INSULATION CLASS		CLASS E OR BETTER
7.6	STANDARDS APPLICABLE		AS PER DATA SHEET-A2

4.9 DATASHEET A2

1.	SWITCHGEAR GENERAL REQUIREMENTS	<input type="checkbox"/> IS:13947	<input type="checkbox"/> IEC:61439-1
2.	AC CIRCUIT BREAKERS	<input type="checkbox"/> IEC 947-2	<input type="checkbox"/> BS:3871(PI) MCCB
3.	FACTORY BUILT ASSEMBLIES OF SWITCHGEAR AND CONTROL GEAR FOR VOLTAGES UPTO AND INCLUDING 1000V A.C. & 1200 V D.C	<input type="checkbox"/> IS:8623	<input type="checkbox"/> IEC:439
4.	AIR BREAK SWITCHES	<input type="checkbox"/> IS:13947	<input type="checkbox"/> IEC-947-3
5.	MINIATURE CIRCUIT BREAKERS	<input type="checkbox"/> IS:8828	<input type="checkbox"/> IEC:
6.	HRC CARTRIDGE FUSES	<input type="checkbox"/> IS:13703(P2)	<input type="checkbox"/> IEC-769
7.	D TYPE FUSES	<input type="checkbox"/> IS:8187	<input type="checkbox"/> IEC:
8.	CONTACTORS	<input type="checkbox"/> IS:13947	<input type="checkbox"/> IEC:9474-1
9.	STARTERS	<input type="checkbox"/> IS:13947	<input type="checkbox"/> IEC:947-4-1
10.	CONTROL SWITCHES/PUSH BUTTONS	<input type="checkbox"/> IS:13947	<input type="checkbox"/> IEC:
11.	CURRENT TRANSFORMERS	<input type="checkbox"/> IS:2705	<input type="checkbox"/> IEC:60044
12.	VOLTAGE TRANSFORMERS	<input type="checkbox"/> IS:3156	<input type="checkbox"/> IEC:60044
13.	RELAYS	<input type="checkbox"/> IS:3231	<input type="checkbox"/> IEC:255

5 LOW VOLTAGE INDUCTION MOTOR

5.1 SCOPE

The specification covers the design, material, constructional features, manufacture, inspection and testing at the VENDOR's / his SUB-VENDOR'S works, delivery to site and performance testing of Low Voltage induction motors rated up to 1000V.

5.2 CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of induction motors shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the applicable standards specified in data sheet A1 latest revision as on the date of offer. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility. In case of conflict between the standards and this specification, this specification shall govern.

5.3 DRIVEN EQUIPMENT

When this specification forms part of the driven equipment specification, information not given in the Data Sheet-A will be governed by the driven equipment specification.

Motors shall be capable of satisfactory operation for the application and duty as specified in the motor Data Sheet-A and as specified for the driven equipment.

5.4 PERFORMANCE AND CHARACTERISTICS

Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously under either of the following supply conditions as specified in Data Sheet-A.

	<u>Supply Condition</u>	
	I	II
(a) Variation in supply voltage		
from rated voltage	±6%	±10%

(b)	Variation in supply frequency		
	from rated frequency	±3%	±5%
(c)	Combined voltage and		
	Frequency variation	9%	10%

Motors shall be suitable for the method of starting specified in the Data Sheet-A.

The minimum permissible voltage shall be 85% of the rated voltage during motor starting.

Motors shall be capable of starting and accelerating the load with the applicable method of starting, without winding temperatures reaching injurious levels, when the supply voltage is in the range of 85% of the rated motor voltage to maximum permissible voltage specified in Data Sheet-A.

The locked rotor current of the motor shall not exceed 600% of full load current (subject to tolerances as per the applicable standard) unless otherwise specified. The locked rotor current of VFD controlled motor shall be within the limit of IS12615 / IEC.

Motors shall be capable of developing the rated full load torque even if the supply voltage drops to 70% of the rated voltage. The pull out torque of the motor shall be atleast 205% of full load torque.

Motors when started with the driven equipment coupled shall be capable of withstanding at least two successive starts from cold conditions & one start from hot condition without injurious heating of windings. The motors shall also be suitable for three equally spread starts per hour under the above referred supply conditions.

Motors shall be of Energy Efficient type if specified in Data sheet-A1. Category of Energy efficiency shall be as mentioned in data sheet-A1.

5.5 SPECIFIC REQUIREMENTS OF VFD DRIVEN MOTORS

The Motor shall be designed to operate continuously at any speed over the range 10-100 % of rated speed.

The permitted voltage variation should take into account the steady state voltage drop across the starter and all other system components upstream of the motor.

The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.

The driven equipment manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the driven equipment.

5.6 **INSULATION**

The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid and tropical climate.

Motors which are VFD controlled shall be inverter grade and shall be suitably derated to take care of reduced cooling at lower speeds.

Insulation of VFD controlled Motors shall be designed to withstand a dv/dt of 0.1 micro sec rise from 10 % to 90 % of steady voltage and a maximum peak of 1600 volts as per NEMA standard MG1 Part 31.40.4.2 .

The insulation shall be of double coat winding wires which having superior electric strength and thermal capability for VFD controlled motors.

Winding shall be insulated as VPI (Vacuum Pressure Impregnation) of winding with suitable resin forces which eliminating voids for VFD controlled motors.

5.7 **TEMPERATURE RISE**

The temperature rises shall not exceed the values given in IS 12802. Under extremes of supply condition (clause 4.1 above), the temperature rise shall not exceed the value indicated in IS by 10oC.

For motors specified for outdoor installation heating due to direct exposure to solar radiation shall be considered.

5.8 **CONSTRUCTIONAL FEATURES**

All windings shall be of Copper. The winding insulation shall be Non-hygroscopic, oil resistant and, flame resistant.

Motors weighing more than 25 kg. shall be provided with eyebolts, lugs or other means to facilitate safe lifting.

Noise level and vibration limit should not exceed as specified in relevant IS / IEC.

5.9 **BEARINGS**

Unless otherwise specified in data sheet-A, motor bearings shall not be subjected to any external thrust load.

Unless otherwise specified, motor bearings shall have an estimated life of atleast 40,000 hrs.

The bearings shall permit running of the motor in either direction of rotation.

When forced oil lubrication or water cooling is required, prior approval from the purchaser shall be obtained.

It shall be possible to lubricate the bearings without dismantling any part of the motor.

VFD controlled Motors shall have their bearings insulated to prevent motor shaft currents from entering the bearing race.

5.10 **TERMINAL BOX**

Terminal boxes shall have a degree of protection of atleast IP 55 for out door applicable.

Unless otherwise approved, the terminal box shall be capable of being turned through 360o in steps of 90o.

Terminals shall be of stud type & the terminal box shall be complete with necessary lugs, nuts, washers.

When single core cables are to be used the gland plates shall be of non magnetic material.

Sizes of terminal boxes and lugs shall be as given in Table-I, unless specified otherwise in data sheet A or Section C.

TABLE-I

415 V MOTORS - SIZES OF CABLES, STUDS, TERMINAL LUGS & TERMINAL BOXES

(TO BE PROVIDED ON MOTORS BY VENDOR)

Sl No.	Motor Rating (kW)	1100V AI Conductor, armoured PVC/XLPE Cable Cores x mm ²
1.	Upto 3	3x4
2.	3.1 - 7.5	3x6
3.	7.6 - 15	3x16
4.	16 - 25	3x35
5.	26 - 40	3x70
6.	41 - 55	3x120
7.	56 - 70	3x185
8.	71 - 85	3x240

9.	86 - 110	3x400
10.	111 - 200	3Rx1Cx500

5.11 PAINT AND FINISH

All motor parts exposed directly to atmosphere shall be finished and painted to produce a neat and durable surface which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, all rust, sharp edges and scale removed and treated with one coat of primer and finished with two coats of grey enamel paint.

5.12 HEATING DURING IDLE PERIODS

Motors rated above 30 kW shall have space heaters suitable for 240V, single phase, 50 Hz, AC supply. Space heaters shall have adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation during idle period. The space heaters shall be placed in easily accessible positions in the lowest part of the motor frame.

5.13 ACCESSORIES

Two independent earthing points shall be provided on opposite sides of the motor, for bolted connection of the PURCHASER'S earthing conductors as specified in data sheet-A. These earthing points shall be in addition to earthing stud provided in the terminal box.

Except when otherwise specified, the motors shall be provided with a bare shaft extension having a key slot and a key at the driving end.

5.14 TESTS

Motor shall be subjected to all the routine tests as per applicable standard in the presence of the PURCHASER'S representative. Copies of test certificates of type and routine tests shall be furnished as specified in the distribution schedule, for the PURCHASER'S approval. The VENDOR shall ensure to use calibrated test equipment/instruments having valid calibration test certificates from standard laboratories traceable to national/international standards.

If type tests have not been carried out on similar Motors, or if the type test reports submitted are not found in order, then VENDOR shall carry out these tests without any extra cost to the Purchaser.

5.15 DATASHEETS A1

SL.NO.	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
1.0	GENERAL		
1.1	APPLICATION		Centrifuge pump
1.2	NUMBERS REQUIRED	No.	1
1.3	TYPE OF MOTOR		SQUIRREL CAGE
1.4	SUPPLY SYSTEM FAULT LEVEL	MVA	36
1.5	TYPE OF EARTHING OF SUPPLY SYSTEM NEUTRAL		Effectively Earthed
2.0	RATING		
2.1	RATED OUTPUT :	kW	18.5 ,
2.2	RATED VOLTAGE :	V	415
2.3	NUMBER OF PHASES & FREQUENCY		3Ph, 50 Hz
2.4	SUPPLY CONDITION (REF. CL.NO.4.1 OF TCE.M4- 203-01)		II
2.5	SYNCHRONOUS SPEED	RPM	
3.0	DUTY		
3.1	TYPE OF DUTY (CLAUSE 9.2 OF IS:325 OR EQUIVALENT)		S1
3.2	POWER REQUIRED BY LOAD	kW	
3.3	ENERGY EFFICIENCY CLASS AS PER IS-12615-2011		IE2
4.0	METHOD OF STARTING		STAR DELTA
5.0	INSULATION		
5.1	CLASS OF INSULATION		CLASS F
5.2	REF. AMBIENT TEMPERATURE	deg.C	50
5.3	TEMPERATURE RISE OF WINDINGBY WDG RESISTANCE METHOD	deg.C	Corresponding to Class B Insulation

SL.NO.	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
6.0	INSTALLATION		
6.1	LOCATION		Indoor/Outdoor
6.2	HAZARDOUS AREA DIVISION (IS:5572 OR EQUIVALENT)		
6.3	ATMOSPHERE		CHEMICAL
7.0	ENCLOSURE		
7.1	TYPE OF COOLING (IS 6362)		Air cooled
7.2	DESIGNATION FOR DEGREE OF PROTECTION (IS 4691)		IP 4X
8.0	MAIN TERMINAL BOX		
8.1	LOCATION AS SEEN FROM NON- DRIVE END:		TOP/RIGHT/LEFT
	RATINGS		
8.2	(a)	SHORT TIME	
		i. CURRENT :	kA(RMS)
		ii. DURATION :	SECS. 0.25
	(b)	DYNAMIC :	kA (PEAK)
8.3	EXTERNAL CABLE DETAILS		
8.3.1	TYPE		
8.3.2	SIZE & NO OF CORES		
8.4	EARTHING CONDUCTORS		
8.4.1	MATERIAL		
8.4.2	SIZE		
9.0	MISCELLANEOUS REQUIREMENTS		<u>TO BE FILLED IF MOTORS ARE BOUGHT SEPERATELY</u>
9.1	SHAFT ORIENTATION		HORIZONTAL/VERTICAL/HO LLOW VERTICAL
9.2	MOUNTING SYMBOL (IS:2253OR EQUIVALENT)		

SL.NO.	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
9.3	ROTATION AS SEEN FROM NON-DRIVE END		CLOCKWISE/ANTI-CLOCKWISE/ BI-DIRECTIONAL
9.4	TYPE OF BEARING		
9.4.1	DRIVE END		
9.4.2	NON DRIVE END		
9.5	WHETHER BED PLATE REQUIRED		YES/NO
9.6	MOTOR SHALL MATCH THE FOLLOWING TORQUE REQUIREMENTS OF THE DRIVEN EQUIPMENT:		
	a) STARTING TORUE		
	b) FULL LOAD (RATED) TORQUE		
	c) PULL OUT TORQUE		
	d) PULL UP TORQUE		
9.7	COUPLING BY MOTOR SUPPLIER		YES/NO
9.8	IF YES, TYPE OF COUPLING		
10.0	COLOUR SHADES OF PAINT		RAL 7032 as per IS 5
11	WHETHER VIBRATION PADS REQUIRED		YES/NO
12	TEMPERATURE DETECTORS/INDICATORS		
12.1	EMBEDDED TEMPERATURE DETECTORS FOR WINDING REQUIRED		NO
12.2	EMBEDDED TEMPERATURE DETECTORS FOR BEARINGS REQUIRED		NO
12.3	BEARING THERMOMETERS FOR DRIVING END & NON DRIVING ENDS REQUIRED		NO

SL.NO.	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
13	SPACE HEATERS FOR MOTORS REQUIRED (FOR MOTORS GREATER THAN 30KW)		NO

SL.NO.	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
1.0	GENERAL		
1.1	APPLICATION		Centrifuge FEED pump
1.2	NUMBERS REQUIRED	No.	1
1.3	TYPE OF MOTOR		SQUIRREL CAGE
1.4	SUPPLY SYSTEM FAULT LEVEL	MVA	36
1.5	TYPE OF EARTHING OF SUPPLY SYSTEM NEUTRAL		Effectively Earthed
2.0	RATING		
2.1	RATED OUTPUT :	kW	2.2
2.2	RATED VOLTAGE :	V	415
2.3	NUMBER OF PHASES & FREQUENCY		3Ph, 50 Hz
2.4	SUPPLY CONDITION (REF. CL.NO.4.1 OF TCE.M4- 203-01)		II
2.5	SYNCHRONOUS SPEED	RPM	
3.0	DUTY		
3.1	TYPE OF DUTY (CLAUSE 9.2 OF IS:325 OR EQUIVALENT)		S1
3.2	POWER REQUIRED BY LOAD	kW	
3.3	ENERGY EFFICIENCY CLASS AS PER IS-12615-2011		IE2

4.0	METHOD OF STARTING			Direct ON Line (DOL)
5.0	INSULATION			
5.1	CLASS OF INSULATION			CLASS F
5.2	REF. AMBIENT TEMPERATURE		deg.C	50
5.3	TEMPERATURE RISE OF WINDINGBY WDG RESISTANCE METHOD		deg.C	Corresponding to Class B Insulation
6.0	INSTALLATION			
6.1	LOCATION			Indoor/Outdoor
6.2	HAZARDOUS AREA DIVISION (IS:5572 OR EQUIVALENT)			
6.3	ATMOSPHERE			CHEMICAL/DUSTY/SALT LADEN
7.0	ENCLOSURE			
7.1	TYPE OF COOLING (IS 6362)			Air cooled
7.2	DESIGNATION FOR DEGREE OF PROTECTION (IS 4691)			IP 4X
8.0	MAIN TERMINAL BOX			
8.1	LOCATION AS SEEN FROM NON- DRIVE END:			TOP/RIGHT/LEFT
	RATINGS			
8.2	(a)	SHORT TIME		
		i. CURRENT :	kA(RMS)	
		ii. DURATION :	SECS.	0.25
	(b)	DYNAMIC :	kA (PEAK)	
8.3	EXTERNAL CABLE DETAILS			
8.3.1	TYPE			
8.3.2	SIZE & NO OF CORES			

8.4	EARTHING CONDUCTORS			
8.4.1	MATERIAL			
8.4.2	SIZE			
9.0	MISCELLANEOUS REQUIREMENTS			<u>TO BE FILLED IF MOTORS ARE BOUGHT SEPERATELY</u>
9.1	SHAFT ORIENTATION			HORIZONTAL/VERTICAL/HOLLOW VERTICAL
9.2	MOUNTING SYMBOL (IS:2253OR EQUIVALENT)			
9.3	ROTATION AS SEEN FROM NON-DRIVE END			CLOCKWISE/ANTI-CLOCKWISE/ BI-DIRECTIONAL
9.4	TYPE OF BEARING			
9.4.1	DRIVE END			
9.4.2	NON DRIVE END			
9.5	WHETHER BED PLATE REQUIRED			YES/NO
9.6	MOTOR SHALL MATCH THE FOLLOWING TORQUE REQUIREMENTS OF THE DRIVEN EQUIPMENT:			
	a)	STARTING TORUE		
	b)	FULL LOAD (RATED) TORQUE		
	c)	PULL OUT TORQUE		
	d)	PULL UP TORQUE		
9.7	COUPLING BY MOTOR SUPPLIER			YES/NO
9.8	IF YES, TYPE OF COUPLING			
10.0	COLOUR SHADES OF PAINT			RAL 7032 as per IS 5
11	WHETHER VIBRATION PADS REQUIRED			YES/NO
12	TEMPERATURE DETECTORS/INDICATORS			

12.1	EMBEDDED TEMPERATURE DETECTORS FOR WINDING REQUIRED		NO
12.2	EMBEDDED TEMPERATURE DETECTORS FOR BEARINGS REQUIRED		NO
12.3	BEARING THERMOMETERS FOR DRIVING END & NON DRIVING ENDS REQUIRED		NO
13	SPACE HEATERS FOR MOTORS REQUIRED (FOR MOTORS GREATER THAN 30KW)		NO

SL.NO.	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
1.0	GENERAL		
1.1	APPLICATION		Lime Dosing / PE Dosing / Effluent & Discharge Pump
1.2	NUMBERS REQUIRED	No.	1
1.3	TYPE OF MOTOR		SQUIRREL CAGE
1.4	SUPPLY SYSTEM FAULT LEVEL	MVA	36
1.5	TYPE OF EARTHING OF SUPPLY SYSTEM NEUTRAL		Effectively Earthed
2.0	RATING		
2.1	RATED OUTPUT :	kW	3.7
2.2	RATED VOLTAGE :	V	415
2.3	NUMBER OF PHASES & FREQUENCY		3Ph, 50 Hz
2.4	SUPPLY CONDITION (REF. CL.NO.4.1 OF TCE.M4- 203-01)		II

2.5	SYNCHRONOUS SPEED		RPM	
3.0	DUTY			
3.1	TYPE OF DUTY (CLAUSE 9.2 OF IS:325 OR EQUIVALENT)			S1
3.2	POWER REQUIRED BY LOAD		kW	
3.3	ENERGY EFFICIENCY CLASS AS PER IS-12615-2011			IE2
4.0	METHOD OF STARTING			Direct ON Line (DOL)
5.0	INSULATION			
5.1	CLASS OF INSULATION			CLASS F
5.2	REF. AMBIENT TEMPERATURE		deg.C	50
5.3	TEMPERATURE RISE OF WINDINGBY WDG RESISTANCE METHOD		deg.C	Corresponding to Class B Insulation
6.0	INSTALLATION			
6.1	LOCATION			Indoor/Outdoor
6.2	HAZARDOUS AREA DIVISION (IS:5572 OR EQUIVALENT)			
6.3	ATMOSPHERE			CHEMICAL/DUSTY/SALT LADEN
7.0	ENCLOSURE			
7.1	TYPE OF COOLING (IS 6362)			Air cooled
7.2	DESIGNATION FOR DEGREE OF PROTECTION (IS 4691)			IP 4X
8.0	MAIN TERMINAL BOX			
8.1	LOCATION AS SEEN FROM NON- DRIVE END:			TOP/RIGHT/LEFT
	RATINGS			
8.2	(a)	SHORT TIME		

		i. CURRENT :	kA(RMS)	
		ii. DURATION :	SECS.	0.25
	(b)	DYNAMIC :	kA (PEAK)	
8.3	EXTERNAL CABLE DETAILS			
8.3.1	TYPE			
8.3.2	SIZE & NO OF CORES			
8.4	EARTHING CONDUCTORS			
8.4.1	MATERIAL			
8.4.2	SIZE			
9.0	MISCELLANEOUS REQUIREMENTS			<u>TO BE FILLED IF MOTORS ARE BOUGHT SEPERATELY</u>
9.1	SHAFT ORIENTATION			HORIZONTAL/VERTICAL/HOLLOW VERTICAL
9.2	MOUNTING SYMBOL (IS:2253OR EQUIVALENT)			
9.3	ROTATION AS SEEN FROM NON-DRIVE END			CLOCKWISE/ANTI-CLOCKWISE/ BI-DIRECTIONAL
9.4	TYPE OF BEARING			
9.4.1	DRIVE END			
9.4.2	NON DRIVE END			
9.5	WHETHER BED PLATE REQUIRED			YES/NO
9.6	MOTOR SHALL MATCH THE FOLLOWING TORQUE REQUIREMENTS OF THE DRIVEN EQUIPMENT:			
	a)	STARTING TORUE		
	b)	FULL LOAD (RATED) TORQUE		
	c)	PULL OUT TORQUE		
	d)	PULL UP TORQUE		

9.7	COUPLING BY MOTOR SUPPLIER		YES/NO
9.8	IF YES, TYPE OF COUPLING		
10.0	COLOUR SHADES OF PAINT		RAL 7032 as per IS 5
11	WHETHER VIBRATION PADS REQUIRED		YES/NO
12	TEMPERATURE DETECTORS/INDICATORS		
12.1	EMBEDDED TEMPERATURE DETECTORS FOR WINDING REQUIRED		NO
12.2	EMBEDDED TEMPERATURE DETECTORS FOR BEARINGS REQUIRED		NO
12.3	BEARING THERMOMETERS FOR DRIVING END & NON DRIVING ENDS REQUIRED		NO
13	SPACE HEATERS FOR MOTORS REQUIRED (FOR MOTORS GREATER THAN 30KW)		NO

5.16 DATASHEET A2

SL.NO.	BRIEF TITLE	REFERENCE NUMBER OF STANDARDS
1.	THREE PHASE INDUCTION MOTORS	<input type="checkbox"/> IS-325 <input type="checkbox"/> IEC-34
2.	ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-4722 <input type="checkbox"/> IEC-34-1
3.	SINGLE PHASE INDUCTION MOTORS	<input type="checkbox"/> IS-996 <input type="checkbox"/> IEC

4.	CODE OF PRACTICE FOR CLIMATE PROOFING	<input type="checkbox"/> IS	<input type="checkbox"/> IEC
5.	DESIGNATIONS FOR TYPES OF CONSTRUCTION AND MOUNTING ARRANGEMENT OF ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-2253	<input type="checkbox"/> IEC-34-7
6.	TERMINAL MARKING & DIRECTION OF ROTATION FOR ROTATING ELECTRICAL MACHINERY	<input type="checkbox"/> IS-4728	<input type="checkbox"/> IEC-34-8
7.	DESIGNATION OF METHODS OF COOLING FOR ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-6362	<input type="checkbox"/> IEC-34-6
8.	DEGREES OF PROTECTION PROVIDED BY ENCLOSURE FOR ROTATING ELECTRICAL MACHINERY	<input type="checkbox"/> IS-4691	<input type="checkbox"/> IEC-529
9.	GUIDE FOR TESTING THREE PHASE INDUCTION MOTORS	<input type="checkbox"/> IS-4029	<input type="checkbox"/> IEC-34-2
10.	MEASUREMENT AND EVALUATION OF VIBRATION OF ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-12075	<input type="checkbox"/> IEC-34-14
11.	CLASSIFICATION OF HAZARDOUS AREAS FOR	<input type="checkbox"/> IS-5572	<input type="checkbox"/> IEC-79

ELECTRICAL INSTALLATION			
12.	DIMENSIONS OF SLIDE RAILS FOR ELECTRIC MOTORS	<input type="checkbox"/> IS-2968	<input type="checkbox"/> IEC
13.	PERMISSIBLE LIMITS OF NOISE LEVEL FOR ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-12065	<input type="checkbox"/> IEC
14.	GUIDE FOR TESTING INSULATION RESISTANCE OF ROTATING MACHINES	<input type="checkbox"/> IS-7816	<input type="checkbox"/> IEC
15.	INDUCTION MOTORS- ENERGY EFFICIENT THREE PHASE SQUIRREL CAGE- SPECIFICATION	<input type="checkbox"/> IS-12615-2011	<input type="checkbox"/> IEC-60034-3
16.	FLAME PROOF A C MOTORS FOR USE IN MINES.	<input type="checkbox"/> IS- 3682	
17.	FLAME PROOF ENCLOSURES OF ELECTRICAL APPARATUS	<input type="checkbox"/> IS-2148	
18.	STARTING PERFORMANCE OF SINGLE SPEED THREE PHASE CAGE INDUCTION MOTORS FOR VOLTAGE UP TO 600 V	<input type="checkbox"/> IS-8789	<input type="checkbox"/> IEC-34-12
19.	CAGE INDUCTION MOTORS		<input type="checkbox"/> IEC-34-17

	WHEN FED FROM CONVERTERS – APPLICATION GUIDE		
20.	ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEM- EMC REQUIREMENTS AND SPECIFIC TEST METHODS.		<input type="checkbox"/> IEC-61800
21.	DIMENSIONS AND OUTPUT SERIES FOR ROTATING ELECTRICAL MACHINES.	<input type="checkbox"/> IS-1231	<input type="checkbox"/> IEC- 72-1
22.	ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERE – CLASSIFICATION OF HAZARDOUS AREA.	<input type="checkbox"/> IS-5571	<input type="checkbox"/> IEC-79-10
23.	TEMPERATURE RISE MEASUREMENT OF ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-12802	<input type="checkbox"/> IEC
24.	TYPE OF DUTY AND CLASSES OF RATING ASSIGNED TO ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS 12824	<input type="checkbox"/> IEC
25.	CBIP RECOMMENDATION FOR MOTORS		

6 CABLES

6.1 SCOPE

This specification covers the requirements of Power Cables upto 33kV, Control, Instrumentation, Communication and Lighting Cables with general purpose insulation and sheaths. Requirement of special outer sheaths with Heat Resistant (HR), Fire Survival (FS) and Flame Retardant Low Smoke (FRLS) characteristics are also covered in this specification.

6.2 CODES AND STANDARDS

The design, construction, manufacture and testing of cables shall comply with all currently applicable statutes, regulations and safety codes in the locality where cables will be installed. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

Unless otherwise specified equipment / material shall conform to the latest applicable standards as on the date of tender submission unless otherwise indicated.

6.3 GENERAL CONSTRUCTIONAL FEATURES

The following aspects are applicable for all the types of cables covered in this specification.

6.3.1 Construction and specification

Construction and Performance specifications of the cable shall conform to the Standards indicated herein and the details furnished in Data Sheet-A.

Conductor

(a) Aluminium conductor, circular, compacted stranded, grade H4, Class 2 as per IS 8130 for power cables and as indicated in Data Sheet-A.

(b) Annealed, stranded Copper Conductor, Class 2 as per IS 8130 for control cables and designated by alphabet 'C' as indicated in Data Sheet-A. Conductor shall be tinned when indicated under notes in relevant Data Sheet-A.

Insulation

Insulation for cables shall be XLPE for power cable and PVC for control / lighting / instrumentation and communication cable as per requirement indicated herein and shall conform to the properties covered in the following applicable standard.

(a) IS 5831 - PVC insulation and sheath for electric cables

(b) IS 7098- Specification for cross linked Polyethylene insulated PVC sheathed cables

Core Identification

Colour coding shall be acceptable for all cables upto 5 cores. Cables with more than 5 cores shall have printed numerals every 50mm on each core.

Inner Sheath

Inner sheath when specified shall be extruded type and shall be compatible with the insulation provided for the cables.

Armour

Armouring for the cables shall comprise galvanised steel or hard drawn aluminium, in the form of round wires or strips. These are designated as below in Data Sheet-A.

W - Galvanised single steel wire

F - Galvanised single steel strip

AW - Hard drawn single aluminium wire

AS - Hard drawn single aluminium strip

Any other special requirement of armour shall be as per Section-C of the specification or as indicated under notes in Data Sheet-A.

Outer Sheath

The outer sheath shall be of an extruded layer of suitable synthetic material compatible with the specified ambient and operating temperature of the cables. The sheath shall be heat resistant, resistant to water, ultra violet radiation, fungus, termite and rodent attacks. The colour of the outer sheath shall be black unless otherwise specified in Section-C or under notes in Data Sheet-A. PVC sheath shall meet the requirements of standards covered above. Requirement of special sheath with Fire Survival (FS) and Flame Retardant Low Smoke (FRLS) characteristics shall be as per requirement. Requirement of Fire Protective Paint on outer sheath of the cable shall be as per Data Sheet-A.

Cable Drums

Cables shall be supplied in non-returnable wooden and steel drums as applicable. The wood used for construction of the drum shall be properly seasoned and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with a suitable rust preventive coating to avoid rusting during transit or storage. Cable drums shall conform to IS 10418 (Specification for drums of electric cables).

The BIDDER shall indicate in the offer, the maximum length for each size of cable, which can be supplied on one drum. The actual length supplied on each drum shall be within tolerance limit of 5 % with an overall ceiling of +5% on total ordered quantity of each size of cable unless otherwise indicated in Section-C/Data Sheet-A. However, before winding the cables on drums, VENDOR shall obtain PURCHASER's approval for the drum lengths so as to minimise the number of joints to the extent possible. Cable ends shall be sealed by non-hygroscopic sealing caps.

Cable drums shall carry following details in printed form :

- (a) Manufacturer's name and trade mark
- (b) Type of cable and voltage grade
- (c) Year of manufacture
- (d) Type of insulation
- (e) No. of cores and size of cables
- (f) Cable code
- (g) Length of cable on drum
- (h) Inner Diameter and Outer Diameter of Drum

Cable lengths specified in Data Sheet-A are approximate only. Actual requirements will be advised to the successful BIDDER at the time of placing the order. Incremental cable lengths in meters shall be embossed on the outer sheath of every 1 metre interval when specified in Section-C or under notes in Data Sheet-A.

6.4 **Specific Requirements**

H T POWER CABLES

System cables shall be 11kV (UE) grade suitable for use in medium resistance earthed system, stranded & compacted aluminium conductor, extruded semi conducting screen over conductor, XLPE insulated, semi-conducting followed by copper tape screened, extruded PVC Type ST – 2 inner sheathed, aluminium/GS wire armoured, overall FRLS PVC outer sheathed, conforming to IS 7098 (Part II), IEC-502 for constructional details and tests.

Power & Control Cables, 1100 V Grade XLPE Insulated

The cable shall be extruded XLPE insulated. The inner sheath over laid up cores and outer sheath over the armour shall be extruded PVC compound type ST-2. Core identification shall be by printed numerals.

Cables for low and medium voltage (from 25 sq.mm onwards size), industrial heavy application shall be of Al conductor, XLPE insulated, un-armoured, suitable for 1100 V earthed system while 16 sq.mm & below the same shall be of Cu conductor, XLPE insulated, XLPE sheathed and armoured, of voltage grade 1100 V.

The following abbreviations are applicable to these cables

A	Aluminium conductor, stranded, grade H4, class 2 as per IS
C	Copper conductor, stranded, class 2 as per IS 8130
W	Galvanised single steel wire

- F Galvanised single steel strip
- AW/AS Hard drawn aluminium single wire/strip

The construction, performance and testing of cable shall comply with relevant IS.

1100 V Grade Lighting / Misc. / Light duty armoured cables

Cables shall be insulated with extruded PVC type-A. Outer sheath shall be extruded black PVC type ST-1.

The following abbreviations are applicable to these cables.

- A Aluminium conductor, stranded, grade H2, class 2 as per IS.
- C Copper conductor, stranded, class 2 as per IS.

The construction, performance and testing of cable shall comply with relevant IS.

6.5 Tests

Cables shall be subjected to type, routine and acceptance tests as per the applicable standards. Test methods shall conform to IS 10810 (Methods of Test for Cables). Type tests and optional tests according to applicable standards shall be conducted on cables when specified in Section-C or under notes in Data Sheet-A. BIDDER shall ensure use of calibrated test equipment having valid calibration test certificates from standard laboratory traceable to National Standards.

6.6 DATASHEET A1

SL. NO.	ITEM	UNIT	
1.0	SYSTEM DATA		
1.1	System Voltage	V	415
1.2	Short circuit for 1 Sec.	KA (rms)	50
1.3	Design ambient temperature of cable	deg. C	50
1.4	Laying (underground/air/duct/trench)		Trench
2.0	CABLE DATA		
2.1	Type of Cable(HV Power/LV		LV Power

SL. NO.	ITEM	UNIT	
	Power/Control/Instrumentation/Telecommunication)		
2.2	Core(Multi/single)	No.	Multi
2.3	Conductor(Aluminium/Copper)		Aluminium / Copper
2.3.1	Conductor (stranded/solid)		Stranded
2.3.2	<u>Form-circular/segmented</u>		Segmented
2.3.3	Conductor Screen required	Yes/No	No
2.3.4	Effective cross sectional area of conductor	sq.mm.	As per SLD
2.4	Inner Sheath required	Yes/No	No
2.5	Type of Insulation(XLPE/PVC)		XLPE
2.6	Insulation Screen required	Yes/No	Yes
2.7	Design ambient temperature of cable	deg. C	50
2.8	Cable Drum Type (Wooden/Steel)		Wooden
2.10	Armour Type		F
2.11	Armour material		Steel
2.12	Rated voltage of cable (U/UE)	kV	1.1
2.13	Drum length required	m	
2.14	Tests Required		
2.14.1			
2.14.2			
2.14.3			
3.0	SPECIFIC REQUIREMENT		
3.1	Outer Sheath type(PVC/Fire Survival (FS) /Flame Retardant Low Smoke (FRLS)		FRLS
3.1.1	Fire Protective paint required	Yes/No	Yes

SL. NO.	ITEM	UNIT	
3.2	Instrumentation Cable type(Pair/Triad/Quad/ Quintuple)		
	Notes:		
	1. Quantity of spares to be indicated against each of items above		
	2. Recommended quantities other than specified above with unit prices shall also be indicated by Bidder in his quotation.		
	3. Bidder shall quote separate price for each of the test specified as per items 16.1 to 16.3		

6.7 DATASHEET A2

SL. NO.	ITEM		
1.0	<u>APPLICABLE STANDARDS</u>		
1.1	Type of conductor		<input type="checkbox"/> IS:8130,
1.2	Conductor Screening		<input type="checkbox"/> IS:7098
1.3	Insulation		<input type="checkbox"/> IS:5831 <input type="checkbox"/> IS:7098
1.4	Test and test equipment		<input type="checkbox"/> IS:10810
1.5	Cable drums		<input type="checkbox"/> IS:10418
1.6	Flammability		<input type="checkbox"/> IS:10810 <input type="checkbox"/> IEC:331 <input type="checkbox"/> IEC:332 <input type="checkbox"/> IEEE:383 <input type="checkbox"/> SS 424-1475
1.7	Test for smoke generation		<input type="checkbox"/> ASTM-D-2843
1.8	Test for acid gas generation		<input type="checkbox"/> IEC 754-1
1.9	Telecommunication cable		<input type="checkbox"/> IS:5831 <input type="checkbox"/> IEC 189-1 <input type="checkbox"/> IEC 189-2
1.10	Instrumentation cable		<input type="checkbox"/> IEC 189-1 <input type="checkbox"/> IEC 189-2
1.11	Construction, performance and testing of Power Cables 1100 V Grade PVC Insulated		<input type="checkbox"/> IS: 1554

SL. NO.	ITEM		
1.12	Construction, performance and testing of 1100 V Grade PVC Insulated Control Cables		<input type="checkbox"/> IS: 1554 <input type="checkbox"/> IS 8130
1.13	Construction, performance and testing of XLPE Insulated HV Power Cables		<input type="checkbox"/> IS:8130 <input type="checkbox"/> IS:7098
1.14	Construction, performance and testing of 1100 V Grade Lighting/Misc./Light duty unarmoured cables		<input type="checkbox"/> IS:694
2.0	<u>NOTES</u>		
2.1	Equipment, Accessories, Components /Parts Raw materials and tests shall in general conform to: <input type="checkbox"/> IS <input type="checkbox"/> IEC <input type="checkbox"/> CBIP		

7 **DIESEL GENERATOR**

7.1 **SCOPE**

This specification covers the general design, material, construction features, manufacture, inspection and testing at the VENDOR's / his SUB-VENDOR's works, delivery to site and performance testing of 125 kVA, 415 V, 50 Hz Diesel generator and accessory equipment.

7.2 **CODES AND STANDARDS**

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the VENDOR of his responsibility.

Except where specified herein otherwise, all material, equipment and construction shall conform to the Indian Electricity Act and Rules and following Standards with latest revisions

- a) Diesel Engine: BS 5514 (six (6) parts)
- b) Alternator: BS 5000, IS 4722, IS 5422, IEC - 60034

7.3 **DESIGN CRITERIA**

The emergency power system shall provide a source of power to essential loads required to permit a safe shut down of the substation in the event of failure of normal supply.

In addition, emergency power is provided for auxiliaries and services required for equipment and personnel safety and minimum plant maintenance during the blackout.

Emergency loads shall be supplied from the Emergency DG Set rated 125 KVA with interlocking with mains supply by an Auto-mains failure (AMF).

The DG shall be capable of black start. The DG shall also be capable of continuous base load operation up to 90% of the output rating at site conditions.

The DG shall be complete with common base frame for mounting on a foundation block and shall include adequate number of foundation bolts and anti-vibration pads, if required. Alignment shims, as required shall also be provided.

The DG set shall be started automatically in case of AC power loss. Manual starting facility from Control room hall shall also be provided. The starting time period shall be limited to thirty (30) sec.

7.3.1 Diesel Engine

The diesel engine shall be of stationary type and directly coupled to the generator. The engine shall be capable of driving the generator at 10% overload at the rated speed for one hour.

The engine shall be air cooled / water cooled with separately / machine mounted radiator fans.

Electrical starting arrangement complete with starting DC motor, starter, batteries and battery charger shall be provided. The electric starting system suitable for minimum six (6) starts shall be used. No external power shall be used for starting of the engine.

7.3.2 Generator

The generator shall be rated for 415 V, 3 phase, 50 Hz supply. The power factor shall be 0.8 (lag). It shall be mounted on a common base frame together with the prime mover.

The generator shall be totally enclosed air-cooled type.

In the stator winding six nos. resistor temperature detectors shall be provided.

Space heaters suitable for operation on 1 phase, 240V AC shall also be provided.

The generator shall be provided with complete excitation system with automatic voltage regulator (AVR).

The generator shall be provided with two (2) grounding terminals with clamps suitable for connection to the PURCHASER'S grounding grid

7.3.3 Auto Mains Failure (AMF) Panel

The DG set shall have its own AMF panel. This panel shall comprise of AVR, protection & metering equipment, indicating instruments and start / stop interlocking hardware. The panel shall be free standing type; CRCA sheet steel enclosed having a degree of protection of IP 55. All auxiliary devices for control, indication, measurement, protection and alarm shall be mounted on the front door of the panel.

DG set shall have automatic starting sequence from the manually initiated command from local. It shall also have auto initiation through a 'no volt relay'. DG sets are required to start-up and come into operation whenever a remote starting impulse is received in the event of failure of normal supply.

7.4 SYSTEM DESCRIPTION

DG set shall automatically start to meet the load requirement in event of power failure.

The space requirement and layout shall be furnished. Necessary approval of the installation from statutory authorities shall be taken, if required. The exhaust shall be discharged through a silencer and stack at a sufficient height complying the pollution control board requirements. DG set including stack height, acoustics, air emission and fuel oil installation shall meet the requirement given by Ministry of Environment & Forest, CPCB guidelines, all statutory requirements of Govt. of India and State Pollution Board Guidelines.

The generating set shall be installed outdoor.

Critical speed of the machine shall not be lesser than 120% of the normal speed. All couplings shall be capable of withstanding the maximum generator sudden short circuit torque.

Necessary ducting, piping, valves, drains, etc. shall be provided.

Maintenance and erection tools and tackles for all the equipment shall be provided.

7.5 TESTS AND INSPECTION

Reports of Type test already carried out on identical / similar equipment shall be furnished during detail engineering. Such type tests should have been carried out within last five years as on date of bid opening. In absence of such type test reports or in case such reports are found not to meet the design specification requirement, all type tests shall be conducted free of cost and shall be submitted to the owner for approval. Valid type test report shall be submitted in conformity with the latest international standard, IEC or equivalent.

All routine tests shall be performed as per latest amendments of IS / IEC.

8 INSULATOR AND FITTINGS

8.1 SCOPE

This specification covers post insulators and string insulators and fittings for overhead power lines suitable for nominal system voltages of 11 kV and frequency not greater than 100 Hz.

8.2 CODES AND STANDARDS

The design, material selection, constructional features and testing of insulators and fittings shall comply with all currently applicable statutes, regulations and safety codes in the locality where these are proposed to be used.

Insulators and fittings shall conform to the latest editions of standards specified in enclosed Data Sheet - A2. In case of withdrawal/revision of any of the stipulated standards by issuing authorities prior to commencement of fabrication, mutual agreement with Purchaser shall be reached for compliance with applicable standard.

8.3 PORCELAIN INSULATOR

Porcelain used in insulator shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Glazing of porcelain shall be uniform brown colour, free from blisters, burrs and other similar defects.

8.4 COMPOSITE LONG ROD INSULATOR (If specified in data sheet)

Insulators shall be interchangeable and suitable for both suspension and strain type of load. The insulators should withstand the conductor tension, the reversible wind load as well as high frequency vibrations due to wind.

The composite long rod insulators shall have proven use under foggy/ humid operational conditions in polluted industrial environment combined with smoke and dust particles.

Insulators shall have sheds of the “open aerodynamic profile without any under ribs” with good self-cleaning properties. Insulator shed profile, spacing projection etc. shall be as per IEC 60815.

Ball and socket shall be with the standard dimensions stated in IEC:60120/ IS:2486 (Part-II). Tongue & Clevis fitting if used shall be suitable for specified mechanical load. Each insulator shall have rated strength markings on each composite insulator rod unit. No negative tolerance shall be applicable to creepage distance of composite insulators.

All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/sq.m. and shall be in accordance with the latest edition of IS/IEC.

MATERIAL REQUIREMENTS

Core

The core shall be a glass-fiber reinforced (FRP rod) epoxy resin rod of high strength and hydrolysis resistant.. The rod shall be electrical grade corrosion resistant (ECR), boron free glass and shall be high resistance to acid corrosion.

Housing

Housing sheath shall be silicone rubber compound of a thickness of minimum 3mm. The housing & weathersheds shall have silicon content of minimum 30% by weight. It shall be extruded or directly moulded on the core. It shall provide protection against environmental influences, external pollution and humidity. The interface between the housing and the core shall be uniform and without voids. The strength of the bond shall be greater than the tearing strength of the polymer. Nondestructive technique (N.D.T.) shall be adopted to check the quality of jointing of the housing interface with the core.

Weathersheds

The weathersheds shall be vulcanized to the sheath (extrusion process) or moulded as part of the sheath through injection moulding process and shall be free from imperfections, any seams/ burrs protruding axially along the insulator. The track resistance of housing and shed material shall be class 1A4.5 according to IEC60587. The strength of the weathershed to sheath interface shall be greater than the tearing strength of the polymer. The composite insulator shall be capable of high pressure washing.

End fittings

End fittings shall be made of malleable cast iron/ spheroidal graphite or forged steel. It shall be connected to the rod by means of a controlled compression technique. Acoustic emission arrangement or some other arrangement shall be adopted on each insulator to ensure that there is no damage to the core during crimping. The gap between fitting and sheath shall be sealed by a flexible silicone rubber compound. The sealing shall stick to both housing and metal end fitting. The sealing shall be humidity proof and durable with time. End fittings shall have suitable provisions for fixing grading rings.

Grading rings

Grading rings shall be used at both ends of each composite insulator unit for reducing the voltage gradient on and within the insulator and to reduce radio and TV noise to acceptable levels. The size and placement of the metallic grading rings shall be designed to eliminate dry band arcing/corona cutting/exceeding of permissible electrical stress of material. Grading rings shall be capable of installation and removal with hot line tools without disassembling any other part of the insulator assembly. Vendor shall furnish design calculations using appropriate electric field software showing electric field at surface of housing, inside housing & core and at the interface of housing and metal fittings with the proposed placement and design of corona.

8.5 GUY STRAIN INSULATORS: (IS: 5300)

The porcelain insulator shall be sound, free from defects, thoroughly verified and smoothly glazed.

The design of the insulator shall be such that the stresses to expansion and contraction in any part of the insulator shall not lead to its deterioration.

The glaze, unless otherwise specified, shall be brown in color.

The glaze shall cover the entire porcelain surface parts except those areas that serve as supports during firing.

Type for Guy Insulators:

The standard guy strain insulators shall be designations 'A' and 'C' as per IS: 5300.

The recommended type of guy strain insulators for use on guy wires of overhead lines of different voltage levels are as follows:

Power Line Voltage :11KV

Designation of Insulators: C

Dry one minute Power Frequency withstand Voltage: 27 KV (rms)

Wet one minute Power Frequency withstand Voltage: 13 KV (rms)

Minimum Failing Load: 88(KN)

8.6 TESTING

Insulators and fittings shall be subjected to electrical tests as per applicable standards. All routine tests shall be carried out. All Test certificates in respect of mechanical tests and routine test shall be furnished for PURCHASER's approval. The test equipment, meters, instruments, etc. used for testing shall be within valid calibration periods. The calibrating instruments used as standard shall be traceable to national/international standards.

Evidence in the form of certification from the power utilities that the similar type of product supplied to them had been performing satisfactory shall be furnished. Certified test report for an accelerated ageing test of 5000 hours or test at multiple stresses of 5000 hrs shall be submitted.

8.7 MARKING AND PACKING

Marking on insulators and fittings and packing of fittings shall be as per guidelines covered in applicable standards.

8.8 DATASHEET A1

SL. NO.	ITEM	UNIT	
1.0	POST INSULATORS		
1.1	Nominal rated Voltage	KV (rms)	11
1.2	Highest system voltage	KV (rms)	12
1.3	System neutral earthing		
1.4	Material		Porcelain
1.5	Type		
1.6	Minimum cantilever strength	kg	
1.7	Insulation levels		
(a)	Lightning (Full wave) impulse withstand voltage (1.2/50 μ s)	kVp	75
(b)	Switching impulse withstand voltage (250/2500 μ s) – dry & wet	kVp	
(c)	One minute power frequency withstand voltage: - dry - wet	kVrms	
1.8	Min total creepage distance	mm	220 (20 mm/kV)
1.9	Minimum corona extinction voltage	kVrms	
2.0	INSULATORS FOR OVERHEAD POWER LINES (STRING INSULATORS)		
2.1	Nominal rated Voltage	KV (rms)	11
2.2	Highest system voltage	KV (rms)	12
2.3	System neutral earthing		
2.4	Material		Porcelain
2.5	Type (Porcelain)		Antifog
2.6	Minimum electro mechanical strength	kN	
2.7	Insulation levels		
(a)	Lightning (Full wave) impulse withstand voltage (1.2/50 μ s)	kVp	75
(b)	Switching impulse withstand voltage (250/2500 μ s) – dry & wet	kVp	
(c)	One minute power frequency withstand voltage of complete string with corona control rings : - dry	kVrms	

SL. NO.	ITEM	UNIT	
	- wet		
2.8	Min Creepage distance	mm	220 (20 mm/kV)
2.9	Minimum corona extinction voltage level of string with corona control rings - dry	kVrms	

8.9 DATASHEET A2

SL. NO.	ITEM	UNIT	
	8.10 <u>APPLICABLE STANDARDS</u>		
1.	Porcelain post insulators		<input type="checkbox"/> IS 9431 / <input type="checkbox"/> IS 2544 / <input type="checkbox"/> BS 3297 <input type="checkbox"/> IEC 60273
2.	Insulators for overhead power lines		<input type="checkbox"/> IS 3188 / <input type="checkbox"/> IS 731 / <input type="checkbox"/> EN 60383-1/ <input type="checkbox"/> EN 60383-2 / <input type="checkbox"/> EN 60305 / <input type="checkbox"/> EN 60433 / <input type="checkbox"/> IEC 60305 / <input type="checkbox"/> IEC 60433
3.	Composite Long Rod Insulator		<input type="checkbox"/> IEC 61109
4.	Fittings for overhead power lines		<input type="checkbox"/> IS 2486 / <input type="checkbox"/> BS 3288 / <input type="checkbox"/> IEC 60471 / <input type="checkbox"/> IEC 60120
5.	Dimensions of indoor and outdoor porcelain post insulators and post insulator units		<input type="checkbox"/> IS 5350
6.	Tests		<input type="checkbox"/> IS 8704 / <input type="checkbox"/> IS 8263 / <input type="checkbox"/> IEC 60383-1 / <input type="checkbox"/> IEC 60383-2 / <input type="checkbox"/> IEC 60437
	Unless otherwise stipulated, insulators and insulator fittings shall conform to relevant Indian Standards		

9 LIGHTING INSTALLATION

9.1 SCOPE

This specification covers the requirements of installation testing and commissioning of the following:

1.1 Lighting fixtures complete with lamps and accessories.

1.2 Lighting panels.

1.3 Lighting distribution boards.

1.4 Receptacles and lighting control switches.

1.5 Ceiling fans including regulators.

1.6 Point wiring.

1.7 Street lighting poles and flood light towers and High mast.

1.8 Junction boxes.

1.9 Multi core cables for street and boundary lighting and hazardous areas.

1.10 Taking over the material/equipment from PURCHASER's store and transporting to the erection site in case of equipments supplied by PURCHASER.

1.11 Maintaining equipment/materials during storage and being responsible for the equipment/material until they are handed over to PURCHASER.

1.12 Cleaning and clearing the debris generated by the contractor in the area of work due to CONTRACTOR's installation every day.

Installation, testing and commissioning shall be carried out in accordance with the Lighting Installation Notes, the PURCHASER's / ENGINEER's drawings and as stipulated in this specification.

9.2 CODES AND STANDARDS

The lighting system installation work shall conform to the latest applicable electricity rules, all currently applicable standards, codes of practice indicated in Data Sheet-A2, regulations and safety codes of the locality where the installation is to be carried out. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility.

All codes and standards referred to in the specification shall be understood to be the latest version on the date of offer made by the bidder unless otherwise indicated.

The CONTRACTOR shall ensure that instruments and gauges to be used for testing and inspection of critical parameters as identified in the specification have valid calibration and the accuracy can be traced to National Standards.

9.3 POINT WIRING

Wiring of lighting fixtures shall be on point wiring basis. Two types of point wiring have been envisaged viz. primary point wiring and secondary point wiring. CONTRACTOR shall quote primary point and secondary point wiring rates for each building/area specified, on the basis of lighting layout drawings enclosed with the specification.

POINT WIRING

Point wiring also covers the wiring of the associated control switches of lighting fixtures/control switches and regulators of ceiling fans/control switches of receptacle units.

Primary Point Wiring

Primary point wiring covers the wiring between a circuit of the lighting panel to the first lighting fixture/ceiling fan/receptacle unit, connected to that circuit of the lighting panel.

Secondary Point Wiring

Secondary point wiring covers the wiring of the remaining lighting fixtures/ceiling fans / receptacle units other than that covered under primary point of that circuit in the lighting panel.

Secondary point wiring also covers the wiring of the associated control switches of lighting fixtures/control switches and regulators of ceiling fans/control switches of receptacle units.

POINT WIRING FOR STREET AND BOUNDARY LIGHTING

Primary Point Wiring

Primary point wiring covers the wiring between the lighting distribution board to the junction box of the first lighting pole or flood light tower and between the junction boxes of the subsequent lighting poles or flood light towers connected to a circuit in the lighting distribution board .(ie between lighting pole/flood light tower JBs)

Secondary Point Wiring

Secondary point wiring covers the wiring between the junction box and the lighting fixture on the pole in case of street light and between junction box mounted near the base of the tower and all subsequent junction boxes mounted on that tower and also between junction box and the flood light fixture.. Secondary point also covers the wiring of the associated control fuses, switches, looping of terminals, etc. as required.

9.4 WORK REQUIREMENT

Details of work requirements are covered in lighting installation notes and details, typical drawings and specific project drawings which form part of the specification. Any changes, if necessary due to site conditions/requirements shall be carried out after obtaining approval of PURCHASER / CONSULTANT / Site Engineer. The changes carried out shall be marked clearly in the layout drawings and forwarded to PURCHASER / CONSULTANT for preparation of necessary 'AS BUILT DRAWINGS'.

WIRING

Wiring shall be carried out strictly as per project drawings/Scope of work. All conduit wiring concealed or exposed wiring shall have provision for easy inspection. Exposed wiring when run along wall shall be as near the ceiling as possible. Where cable wiring is specified, cable shall be cleated on to the wall as close to the ceiling as possible. In all types of wiring, due consideration shall be given for neatness and appearance.

Wherever DC emergency lighting is provided, emergency lighting wires shall run in a separate conduit. Colour of the wires used shall be as follows; white for positive, black for negative.

Wherever lighting system has three phase distribution, separate conduits shall be used for different phases. For easy identification of phases and neutral wires the following colour wires as per IS shall be used.

- (i) R - Phase - Red
- (ii) Y - Phase - Yellow
- (iii) B - Phase - Blue
- (iv) Neutral - Black

There shall be a circuit breaker or a linked switch on each live conductor of supply mains at the point of entry. The wiring throughout the installation shall be such that there is no break in neutral wire in the form of switch or fuse unit.

Receptacles and lighting fittings in general shall be fed from different circuits. Five amps receptacles for toilet or small rooms can be fed from the lighting circuit with proper isolating arrangement.

9.5 GENERAL PRACTICES

All receptacles and switches to be installed in offices and control rooms shall be flush mounted within the wall and those in other areas shall be wall or column mounted.

Ceiling roses shall not embody fuse terminals as an integral part. For voltages exceeding 250 volts, a ceiling rose or any similar attachment shall not be used.

A socket outlet shall not embody fuse terminals as an integral part of it. The switch controlling the socket outlet shall be on the live side of the line.

All exposed metal parts of the plug, when the plug is in complete engagement with the socket outlet, shall be in effective electrical connection with the earthing pin.

9.6 EARTHING

Conduits and fittings shall be earthed by 12 SWG GI wires (unless otherwise stated in Data Sheet - A1), run along the length of the conduit and secured by means of suitable clamps efficiently fastened to conduit. To achieve perfect electrical continuity, the conduits shall be bonded effectively on either end of a coupling and other joints.

Conduits shall be grounded at the ends adjacent to switch boards at which they originate or otherwise at the earth clip, clamp or gland, in effective electrical contact with the conduit.

In hazardous areas, and where wiring is done with multicore armoured cables, the third core of each single phase circuit shall be used as earthing conductor and connected to the fitting / junction box internal earthing terminal. The external earthing terminal of each junction box shall be earthed by 12 SWG GI wire (unless otherwise specified) to the nearest earth grid.

9.7 TESTING AND COMMISSIONING

Before a completed installation, or an extension to an existing installation is put into service, installation tests stipulated in applicable standards and Codes of Practices shall be carried out by the CONTRACTOR in the presence of the PURCHASER's / ENGINEER's representative.

9.8 CONTRACTOR's LICENSE

The CONTRACTOR shall obtain the necessary License/Authorisation from the Licensing Board of the locality/state for carrying out the installation work. The persons deputed by the CONTRACTOR's firm should also hold valid permits issued/recognised by the Licensing Board of the locality/state in which the work is to be done.

10 EARTHING AND LIGHTNING PROTECTION

10.1 SCOPE

This specification covers the requirements of installation, testing and commissioning of earthing and lightning protection systems.

10.2 CODES AND STANDARDS

The earthing and lightning protection installation work shall conform to the latest applicable electricity rules, all currently applicable standards, codes of practice indicated in Data Sheet-A, regulations and safety codes of the locality where the installation is to be carried out. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility.

All codes and standards referred to in the specification shall be understood to be the latest version on the date of offer made by the bidder unless otherwise indicated.

The CONTRACTOR shall ensure that measuring instruments and gauges to be used for testing and inspection of critical parameters as identified in the specification have valid calibration and the accuracy can be traced to National Standards.

10.3 Type of Earthing Station

Total resistance of earth grid system should not exceed one (1) ohms. Conductor directly buried in soil shall be MS rod of approved size & quality. Following earthing arrangement shall be done-

10.3.1 Plate Earthing

The station earthing arrangement shall be carried out as mentioned below:

HT panel, LT panel, Transformer body & neutral earthing shall be done by separate Plate earthing electrode.

The earth lead shall be connected to the earth plate through hot dip galvanised iron bolts.

The earthing grid and the earthing conductors shall be hot dip galvanised iron/ steel strip of size as specified.

G.I. pipe with funnel of approved quality shall be used for watering the earthing electrodes/stations.

The block masonry chamber with Cast Iron hinged cover shall be provided for housing the funnel and the pipe for watering the earthing electrodes/stations.

The hardware and other consumables for earthing installation shall be of copper/brass in case of copper Earth plate and shall be hot dip galvanised iron material in case of G.I. earth plate.

Minimum size of plate electrode shall be 1200mm x 1200mm in case of GI & 600mm x 600mm in case of copper electrode. Minimum thickness shall be as per IS.

10.3.2 Pipe Earthing

The earth electrode shall be 2.5 m long 50 mm diameter class "A", Galvanised steel pipe.

The earth lead shall be fixed to the pipe with a nut and safety set screws. The clamp shall be permanently accessible.

The earthing grid and the earthing conductor shall be hot dip galvanised iron strips of adequate size based on short circuit withstanding criteria.

G.I. pipe with funnel of approved quality shall be used for watering the earth electrode\station.

The block masonry chamber with Cast Iron hinged cover shall be provided for housing the above referred funnel and pipe.

The hardware and other consumables for earthing installation shall be hot dip galvanised iron material as shown on the drawing.

10.3.3 Installation and Connection

The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case, less than 2.5m below finished ground level.

The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 m from outer face of the respective building wall/column.

The plate electrode shall be installed vertically and shall be surrounded with 150 mm thick layers of Charcoal dust, Salt and sand mixture.

20 mm diameter G.I. pipe for watering, shall run from top edge of the plate/pipe electrode to the mid level of block masonry chamber.

Top of the pipe shall be provided with G.I. funnel and screen for watering the earth/ground through the pipe.

The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber.

The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.

Construction of the earthing station shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard (IS: 3043).

The earth conductors (Strips/Wires copper/Hot dip G.I.) inside the building shall properly be clamped/supported on the wall with galvanised clamps and Mild Steel Zinc Passivated screws / bolts. The conductors outside the building shall be laid at least 600 mm below the finished ground level.

The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly finished.

Over lapping of earth conductors during straight through joints, where required, shall be of minimum 75 mm long.

The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

10.3.4 Earth Leads and Connections

Earth lead shall be bare copper or galvanised steel as specified. Copper lead shall have a phosphor content of not over 0.15%. Galvanised steel buried in the ground shall be protected with bitumen and Hessian wrap or polythene faced Hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is at least 8 mm away from the wall surface.

The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

10.3.5 Equipment Earthing

All apparatus and equipment transmitting or utilising power shall be earthed in the following manner. Copper /G.I. earth strips/wires shall be used unless otherwise indicated.

Power Transmission Apparatus

Metallic conduit shall not be accepted as an earth continuity conductor. A separate insulated/bar earth continuity conductor of size 50% of the phase conductor subject to the minimum shall be provided.

Non metallic conduit shall have an insulated earth continuity conductor of the same size for metallic conduit. All metal junction and switch boxes shall have an inside earth stud to which the earth conductor shall be connected. The earth conductor shall be distinctly colored (Green or Green / Yellow) for easy identification.

Three phase power panel and distribution boards shall have two distinct earth connections of the size correlated to the incoming cable size. In case of single phase DB's a single earth connection is adequate.

The body of the HT panel, Transformer body & neutral, LT panels, capacitor panels, 3 phase motors etc will be provided with two distinct earthing paths.

All earthing System of LT Panel & Starter panel in same room are to be looped together in trenches.

10.3.6 Utilizing Equipment

Three phase motors and other three phase apparatus shall have two distinct earth connections of the size equal to 50% of the connecting cable subject to the following.

For single phase motors and apparatus, the single earth connection shall be provided of the above size. For all light fittings and fans a single earth connection with 1.5 sq. mm. copper or equivalent size shall be provided.

In equipment earthing grid shall be established. All earth connections to all panels, DB's and equipment shall be connected to the nearest point of the earthing grid.

10.4 SCOPE OF INSTALLATION WORK

The installation work shall include unloading at site, storing, laying, fixing, jointing/termination, testing and commissioning of equipment associated with the safety earthing system of the plant and lightning protection system for buildings and allied structures. All welding/brazing equipment, necessary tools and testing equipment shall be furnished by the CONTRACTOR.

The CONTRACTOR shall be responsible if any installation materials are lost or damaged during installation. All damage and thefts shall be repaired / replaced by the CONTRACTOR without compromising with quality till the installation is handed over to the PURCHASER.

The earthing of cable supporting structure, cable carriers, cable trays, cable trenches shall be in the scope of the CONTRACTOR.

The CONTRACTOR shall carry out the lightning protection and earthing of all equipment/panels/structures as indicated in the Project drawings. Whether specifically shown in drawings or not, building columns, hand-rails, miscellaneous items such as junction/marshalling boxes, field switches, cable boxes, etc. shall be earthed.

The CONTRACTOR shall install bare/insulated, copper/aluminium/steel conductors, braids etc. required for the system and individual equipment earthing. All work such as cutting, bending, supporting, painting/coating, drilling, brazing /soldering/welding, clamping, bolting and connecting on to structures, equipment frames, terminals, rails or other devices shall be in the CONTRACTOR's scope of work. All incidental hardware and consumables such as fixing cleats/clamps, anchor fasteners, lugs, bolts, nuts, washers, bitumastic compound, welding rods, flexible braids, anti corrosive paint as required for the complete work shall be deemed to be included by the CONTRACTOR as part of the installation work.

The approximate quantities, sizes and material of earthing conductors and electrodes to be installed are indicated in Data Sheet-A /Section-F. However, unit rates called for in the price schedule are applicable for the actual quantities installed. Routes of the conductors and locations of electrodes shall be as shown on the project drawings.

The work of embedment of earthing conductor in RCC floors/walls along with provision of earth plate inserts/pads/earth risers shall be done by the civil contractor floor casting or during construction of walls. However the CONTRACTOR shall co-ordinate with the civil contractor and shall install the earthing conductors before the commencement of the concrete work, if CONTRACTOR shall be available at site prior to civil work. In such cases, the CONTRACTOR's scope of installation shall include laying the conductors in position and making welded/brazed joints to inserts/pads/risers above the floor near the equipments. The embedded conductors shall be connected to reinforcing rods wherever necessary.

If the tap connections (earthing leads) from the floor embedded main earthing grid to the equipment are more than 500 mm long then the same shall be embedded in floor by the CONTRACTOR where required, together with associated civil work such as excavation,

concreting and surface finish, if not already done by the civil contractor. The concrete cover over the conductor shall not be less than 50 mm.

Embedment of the earthing conductor where not already done by others and for equipment earth leads in the floors slabs the Contractor shall chip the floor, place the conductors in position make welded connections and finish the floor in the original manner the cost of which shall be deemed to be included in the prices quoted for installation.

The scope of installation of earth conductors in outdoor areas, buried in ground, shall include excavation of earth upto 600 mm deep and 450 mm wide (unless otherwise stated in Section-C or Data Sheet-A), laying of conductor at 600 mm depth (unless stated otherwise) brazing/welding/cadwelding if required, of main grid conductor, joints as well as risers of length 500 mm above ground at required locations and then backfilling. Backfilling material to be placed over buried conductor shall be free from stones and other harmful mixtures. Backfill shall be placed in layers of 150 mm, uniformly spread along the ditch, and tampered utilizing pneumatic tampers or other approved means, If the excavated soil is found unsuitable for backfilling, the CONTRACTOR shall arrange for suitable soil from outside.

The scope of installation of earth connection leads to equipment and risers on steel structures/walls shall include laying the conductors, welding/cleating at specified intervals, welding/brazing to the main earth grids, risers, bolting at equipment terminals and coating welded/brazed joints by bitumastic paint. Galvanised conductors shall be touched up with zinc rich paint where holes are drilled at site for bolting to equipment/structure.

The scope of installation of electrodes shall include installation of these electrodes as indicated in Data Sheet-A such as (a) directly in earth, (b) in constructed earth pits, and connecting to main buried earth grid, as per project drawings/relevant standards. The scope of work shall include excavation, construction of the earth pits including all materials required for construction of earth pits, placing the rod and fixing test links on those pipe/rod/plate electrodes in test pits and connecting to main earth grid conductors.

The scope of installation of lightning conductors on the roofs of buildings shall include construction of upstands, laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying, fastening/cleating/welding of the downcomers on the walls/columns of the building and connection to the test links to be provided above ground level.

The scope of installation of the test links shall include mounting of the same at specified height on wall/column by suitable brackets and connections of the test link to the earth electrode.

10.5 WORK DETAILS

Work details shall be as per project drawings and Installation Notes where the sizes, number and material of earth leads for earthing various items are mentioned. In addition to that, following practices shall also be considered.

Wherever main earthing conductor crosses cable trenches, they shall be buried below the trench floor.

Suitable earth risers approved by the ENGINEER shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of the main earth conductors. The minimum length of such risers inside the building shall be 200 mm and that for outdoor shall be 500 mm above ground level. The risers to be provided will be marked in project drawings.

Earth leads between earthing riser and equipment earthing terminals shall follow as direct and as short path as possible.

Neutral connection shall never be used for the equipment earthing.

Each neutral point of a transformer shall be connected to two separate treated type earth electrodes.

Steel columns, Crane and track rails shall be bonded with the railboards and connected to the earthing system. Adjacent railway tracks shall be bonded across fish plates.

Shield wire in switchyard shall be connected to the earthing grid through test links at every alternate tower. Each Lightning mast in switchyard shall also be connected to the earth grid as per the drawings.

An earthing pad as shown in the project layout drawings shall be provided under each operating handle of the isolator and operating mechanism of HV breakers. Operating handle of the isolator and supporting structure shall be bonded together by a flexible connection and connected to the earthing grid.

Separate earth electrodes shall be provided adjacent to structures supporting lightning arrestors and coupling capacitors. Each connection shall be as short and as straight as practicable. For arrestors mounted near transformers, location of earth conductors shall have clear gap from the tank and coolers.

Wherever earthing conductor passes through walls, galvanized iron sleeves shall be provided for the passage of earthing conductor. The pipe ends shall be sealed using suitable water proof compound.

10.5.1 Earthing connections

All connections in the main earth conductors in earth/concrete and connection between main earthing conductor and earth leads shall be of welded/brazed type. Cadwelding type connections shall be done only if specifically indicated.

Connection between earth leads and earthing terminal provided on the equipment shall be bolted type unless specified otherwise in Data Sheet-A or as shown in relevant drawings.

Welding and brazing operations and fluxes/alloys shall be as per the approved standards.

All joints shall be made such that contact resistance is negligible.

All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.

Metallic conduits and pipes shall be connected to the earthing system unless specified otherwise.

Lightning protection system down conductors shall not be connected to any earthing conductors above ground level. Also no intermediate earthing connection shall be made from support structure of lightning arrester.

Earth leads of transformer neutral, lightning arrestors, CVTs, etc., will be directly connected to two separate electrodes. Lightning protection down conductor will be directly connected to separate earth electrodes. All earth electrodes in turn shall be connected to station earthing system.

10.5.2 Earth electrode

Electrodes shall as far as practicable, be embedded below permanent moisture level.

Wherever specified, test pits with concrete covers, for periodic testing of earth resistivity, shall be provided. The details of test pits shall generally be as per project drawings. Installation of rod/pipe/plate electrodes in test pits shall be suitable for watering. All the necessary materials required for test pits shall be supplied and installed by CONTRACTOR. The installation work shall also include connection to main earth grid and civil work such as excavation.

Earth pits shall be treated with salt and charcoal if average resistivity of soil is more than 20 ohm meter.

Soil, salt and charcoal placed around the electrode shall be finely graded, free from stones and other harmful mixtures. Backfill shall be placed in layers of 250 mm thick uniformly spread and compacted, if excavated soil is found unsuitable for backfilling, the CONTRACTOR shall arrange for a suitable soil from outside.

10.5.3 Lightning protection system

The lightning protection air termination rods and/or horizontal air termination conductors shall be fixed in such a way that they remain in their installed position even during severe weather conditions. The necessary accessories such as cleats, clamps, welding materials, bolts, nuts, shall be supplied by CONTRACTOR.

Air termination system shall be connected to earthing system below ground by down conductors. For this purpose separate treated earth pit to be constructed. The down conductors shall follow a direct path to earth. There shall not be any sharp bends, turns and kinks in the down conductors.

All joints in the down conductors shall be of welded/brazed type. All metallic structures within 2 meters from down conductors shall be bonded to lightning protection system.

The lightning protection system shall not be in direct contact with underground metallic service ducts, cables, cable conduits and metal enclosures of electrical equipment. However all metal projections, railings, vents, tanks etc. above the roof shall be bonded together to form a part of roof grid.

10.1 TESTING OF EARTHING SYSTEM

The CONTRACTOR shall ensure the continuity of all conductors and joints. The PURCHASER may ask for earth continuity tests, earth resistance measurements and other tests which in his opinion are necessary to prove that the system is in accordance with the design, specifications, code of practice and Electricity Rules. The CONTRACTOR shall bear the cost of all such tests.

10.2 CONTRACTOR'S LICENSE

It will be the responsibility of the CONTRACTOR to obtain necessary License/ Authorization permit for work from the Licensing Board of the locality/ state where the installation is to be carried out. The persons deputed by the CONTRACTOR's firm shall also hold valid permits issued or recognized by the Licensing Board of the locality/state where the work is to be carried out.

10.6 WORKMANSHIP

The CONTRACTOR shall ensure workmanship of good quality and shall assign qualified supervisors/engineers and competent welders/labour who are skilled and experienced in their trades. The PURCHASER/ENGINEER shall reserve the right to reject non competent persons employed by the CONTRACTOR, if the workmanship is not of good quality.

11 LIGHTNING ARRESTER

11.1 SCOPE

This specification covers the design, material, constructional features, manufacture, performance and testing at the VENDOR's Works and delivery to site of metal oxide, gapless type for alternating current systems of rated voltage upto 11 kV.

The enclosed Data Sheet A form integral part of this specification.

11.2 **CODES AND STANDARDS**

The design, material, construction, manufacture, performance, inspection and testing of lightning arresters shall comply with all **latest version of standards**, statutes, regulations and safety codes in the locality where the equipment is proposed to be installed. Nothing in this Specification shall be construed to relieve the VENDOR of this responsibility.

Lightning arresters shall conform to the latest applicable standards specified in Data Sheet A2. In case of conflict between the standards and this Specification, this Specification shall govern.

11.3 **DESIGN FEATURES**

The characteristic data of gapless metal-oxide surge arresters shall be selected based on IEC 60099-5 guidelines. The parameters such as rated voltage, continuous operating voltage, nominal discharge current, residual voltages, line discharge class, pressure relief class and pollution withstand characteristics shall be as specified in data sheet A.

The minimum criteria for requirements and testing of gapless metal oxide surge arrestors shall be as per IEC 60099- 4, 'Metal-oxide surge arresters without gaps for a.c. systems'.

Constructional Features

Lighting arresters shall be of the hermetically sealed type and of self supporting construction. They shall be suitable for mounting on the PURCHASER's concrete or steel structures. They shall be provided with pressure relief devices and shall be capable of withstanding the internal pressures developed during various discharges or should safely vent the internal pressures associated with arrester failure without violent shattering.

All metal parts shall be of non-rusting and non-corroding metal. Bolts, screws and pins shall be provided with lock washers, keys or equivalent locking facilities.

Accessories

Discharge Counter

- a) Self contained discharge counter suitably enclosed for outdoor use and requiring no auxiliary or battery supply shall be provided for each single pole unit when specified in Data Sheet A1. The discharge counter shall be visible through an inspection window. The counter terminals shall be so located that incoming and outgoing connections are easily made with minimum possible bends. Suitably sized bypass shunts of copper to facilitate bypassing the discharge counter shall be furnished. The terminal connectors shall permit the connection of these shunts.
- b) The connection between lightning arrester earth terminal and discharge counter terminal shall be PVC/XLPE insulated for a minimum of 3.6 kV and this insulated conductor shall be supplied along with the arrester.

- c) A leakage current meter as an integral part of the discharge counter shall be supplied if specified in Data Sheet A1. The counter and the meter shall be so arranged that it is possible to read the leakage current values from ground level. The value of leakage current beyond which the operation is abnormal shall be clearly marked in red color on the meter.

Grading

Grading resistors and/or grading capacitors and grading rings shall be provided for uniform voltage distribution between the units making up the arrester, as dictated by the voltage class of the arrester.

Name Plate

Each lightning arrester shall be provided with non-rusting and non-corroding name plate bearing identification as per the applicable standards.

11.4 TESTS

Certificates of type tests carried out on arresters of similar type shall be furnished with the Bid.

Routine tests and acceptance tests as per the applicable standards shall be carried out on the arrester in the presence of PURCHASER's representative.

The test equipment, meters, instruments etc. used for testing shall be calibrated at recognized test laboratories at regular intervals and valid certificates shall be made available to the PURCHASER's representatives at the time of testing. The calibrating instruments used as standards shall be traceable to national/international standards.

11.5 DRAWINGS

Drawings incorporating the following particulars shall be submitted with the Bid:

- a) Complete assembly drawing showing plan and elevation views of arrester incorporating mounting dimensions, overall dimensions, weight, electrical clearances for installation, details of terminal studs etc.
- b) Ratings and description of special features, if any.
- c) Power frequency voltage vs. time characteristic of the arrester.

11.6 DATASHEET A1

SL. NO.	ITEM	UNIT	
1.0	GENERAL		
1.1	APPLICATION	Indoor/ Outdoor	Outdoor
1.2	QUANTITY	Nos.	1
1.3	TYPE OF ARRESTER, GAPLESS METAL OXIDE	Yes / No	
1.4	SYSTEM VOLTAGE – NOMINAL – HIGHEST	kV kV	11 12
1.5	TYPE OF SYSTEM NEUTRAL EARTHING		
1.6	SHORT CIRCUIT CURRENT AT ARRESTER LOCATION	kA	26
1.7	MAXIMUM DURATION OF EARTH FAULT	Sec.	0.16
1.8	IMPULSE WITHSTAND VOLTAGE VALUE OF EQUIPMENT TO BE PROTECTED		
	- LIGHTNING IMPULSE	kV (peak)	
	- SWITCHING IMPULSE	kV (peak)	
1.9	RATED FREQUENCY	Hz	
1.10	COEFFICIENT OF EARTHING		
1.11	TEMPERATURE LIMITS		
1.12	SEISMIC REQUIREMENTS		
1.13	WIND VELOCITY		
1.14	VARIATION IN FREQUENCY		
1.15	ALTITUDE IS ALTITUDE CORRECTION FACTOR APPLICABLE		
2.0	<u>RATED VALUES</u>		

SL. NO.	ITEM	UNIT	
2.1	RATED ARRESTER VOLTAGE CONTINUOUS OPERATING VOLTAGE		
2.2	NOMINAL DISCHARGE CURRENT		
2.3	MAXIMUM RESIDUAL VOLTAGE FOR, LIGHTNING CURRENT IMPULSE AT NOMINAL DISCHARGE CURRENT SWITCHING CURRENT IMPULSE		
2.4	PRESSURE RELIEF CLASS (SHORT CIRCUIT CAPABILITY)		
2.5	LONG DURATION DISCHARGE CLASS (APPLICABLE ONLY FOR HEAVY DUTY ARRESTORS OF 10KA OR ABOVE)		
3.0	ARRESTER HOUSING		
3.1	MATERIAL OF HOUSING		
3.2	WITHSTAND TEST VOLTAGES a) ONE MINUTE POWER FREQUENCY b) LIGHTNING IMPULSE c) SWITCHING IMPULSE (FOR >245 kV)		
3.3	NOMINAL CREEPAGE DISTANCE		
3.4	SUITABILITY FOR LIVE WASHING		
3.5	LEVEL OF POLLUTION		Highly polluted .
4.0	ADDITIONAL REQUIREMENTS		
4.1	11.6.1.1 CANTILEVER STRENGTH		
4.2	MAXIMUM RADIO INTERFERENCE VOLTAGE (FOR 132 KV AND ABOVE)		
4.3	TYPE OF MOUNTING		

SL. NO.	ITEM	UNIT	
4.4	11.6.1.2 WHETHER INSULATING BASE REQUIRED		
4.5	ACCESSORIES REQUIRED		
	a) DISCHARGE COUNTER b) GRADING RING c) CLAMPS AND CONNECTORS d) LEAKAGE CURRENT METER e) EARTH LEAD DISCONNECTOR		
4.6	PURCHASER'S CONDUCTOR SIZES a) LINE SIDE b) EARTH SIDE		
4.7	VISUAL DISCHARGE VOLTAGE		
4.8	PRESSURE RELIEF VALVE		
5.0	TESTS		
5.1	LIST OF TESTS TO BE CARRIED OUT a) TYPE TESTS b) ACCEPTANCE TESTS		
5.2	NO OF UNITS TO BE SUBJECTED TO ACCEPTANCE TESTS		
6.0	LIST OF SPARES		
6.1	COMPLETE SET OF GASKETS		
6.2	DISCHARGE COUNTER		
6.3	LEAKAGE CURRENT METER		
6.4	EARTH DISCONNECTOR		
6.5	INSULATING BASE		

SL. NO.	ITEM	UNIT	
6.6	INSULATED CONNECTING LEAD BETWEEN ARRESTER AND DISCHARGE COUNTER		

11.7 DATASHEET A2

SR. NO	BRIEF TITLE	REFERENCE NO. OF STANDARD
1.0	LIGHTNING ARRESTERS	<input type="checkbox"/> IS 3070 <input type="checkbox"/> IEC 99
2.0	INSULATORS	<input type="checkbox"/> IS 2544 <input type="checkbox"/> IEC 273
3.0	LARGE HOLLOW PORCELAIN	<input type="checkbox"/> IS 5621 <input type="checkbox"/> IEC 233
4.0	CONNECTORS	<input type="checkbox"/> IS 5561
5.0	HOT DIP GALVANISING	<input type="checkbox"/> IS 2629 <input type="checkbox"/> IS 2633

NOTES :

- EQUIPMENT, ACCESSORIES, COMPONENT PARTS, RAW MATERIAL AND TESTS SHALL IN GENERAL CONFIRM TO IS BS
 IEC.
- ONLY THE MAIN APPLICABLE STANDARDS ARE GIVEN ABOVE. BIDDER SHALL, HOWEVER, NOTE THAT ALL PARTS OF THESE STANDARDS AS WELL AS OTHER STANDARDS REFERRED TO THEREIN ARE ALSO APPLICABLE.

12 DANGER PLATE

12.1 SCOPE

This specification covers the general design, material, construction features, manufacture, inspection and testing at the VENDOR's / his SUB-VENDOR's works, delivery to site and performance testing of Danger Plate.

12.2 CODES AND STANDARDS

The design, material selection, constructional features and testing of insulators and fittings shall comply with all currently applicable statutes, regulations and safety codes in the locality where these are proposed to be used.

As per provisions of IE Rules 1956, Danger Notice Plates in Hindi or English and, in addition, in the local language with the sign of skull and bones are required to be provided on power line supports and other installations.

It is further stipulated in the I.E. Rules that such Notice Plates are not required to be provided on supports like PCC, tubular, wood, steel rails, etc. which cannot be climbed easily without the aid of ladder or special appliances.

To adopt a uniform pattern and for helping easy procurement, a specification on Danger Notice Plates has been drawn up.

The Danger Notice Plates shall comply with IS:2551-1982.

12.3 DIMENSIONS OF DANGER PLATE

Two sizes of Danger Notice Plates as follows are recommended:

1. For display at 415 V installations – 200x150mm
2. For display at 11 KV (or higher voltages) installations – 250x200mm

The corners of the plate shall be rounded off.

12.4 LETTERING OF DANGER PLATE

All letterings shall be centrally spaced. The dimensions of the letters, figures and their respective position shall be as per standards.

The size of letters in the words in each language and spacing between them shall be so chosen that these are uniformly written in the space earmarked for them.

12.5 LANGUAGES OF DANGER PLATE

Under Rule No. 35 of Indian Electricity Rules, 1956, the owner of every medium, high and extra high voltage installation is required to affix permanently in a conspicuous position a danger notice in Hindi or English and, in addition, in the local language, with the sign of skull and bones.

Adequate space shall be provided in the specimen danger notice plates for having the letterings in local language for the equivalent of 'Danger', '415' '11000' and 'Volts'.

12.6 MATERIAL & FINISHING OF DANGER PLATE:

The plate shall be made from mild steel sheet of at least 1.6mm thick and vitreous enameled white, with letters, figures and the conventional skull and cross-bones in signal red color (refer IS:5-1978) on the front side. The rear side of the plate shall also be enameled.

12.7 TESTS OF DANGER PLATE:

The following tests shall be carried out :

1. Visual examination as per IS:2551-1982
2. Dimensional check as per IS:2551-1982
3. Test for weather proofness as per IS:8709-1977 (or its latest version)

PART 7

INSTRUMENTATION WORKS

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1. General Technical & Particular Requirements for Instrumentation & Control Equipments/ Systems :

1.1. List of Measurements and Control:

The plant shall be provided with required instrumentation equipment for measurement & control functions, indicated below as a minimum, but not limited to the following:

- a) Flow measurement at inlet and outlet of treatment plant
- b) Flow measurement at common header of pumps and blowers
- c) Pressure measurement at discharge of each pump/ blowers & common header
- d) Level measurement of each sump & tank
- e) Differential Level measurement across the screen
- f) pH measurement at inlet and outlet of treatment plant
- g) Dissolved oxygen measurement at Aeration tank/ Biological reactor
- h) Residual chlorine at outlet of CCT
- i) Total suspended solids (TSS), BOD & COD at inlet & outlet of treatment plant
- j) Bidder may propose additional instruments & control equipments for safe, reliable & efficient operation of treatment process proposed by him.
- k) Required quantities and application of the above instruments shall be provided as per approved P&ID to meet the requirement of the process.
- l) Necessary alarms, status signals along with the measurements of process parameters etc. shall be displayed in HMI.
- m) GPS tracking system to be installed in all the vacuum trucks for proper tracking of vehicles and traffic management. Provision for display shall be made at the office of Employer.
- n) Provision for online display and data transfer of the reading of weighbridge (at entry to SeTP) and the flowmeter readings (at inlet and outlet locations) shall be made as per Employer's requirement.

1.2. Fields Instruments / Process Analyzers required as applicable

1.2.1. Full bore Electromagnetic flow meter:

- a) Full bore type Electromagnetic flow meter shall be provided as per approved P&IDs. The flow meter shall consist of flow sensor (i.e., flow tube), flow transmitter/ flow computing unit and remote flow indicator cum integrator.

- b) The electromagnetic flow meter shall be manufactured as per BS EN ISO 6817 standard- measurement of conductive liquid flow in closed conduits, method using electromagnetic flow meters.
- c) The flow tube flanges and transmitter housing shall be properly earthed.
- d) Flow tube shall have waterproof construction (IP 68) and shall be suitable for installation on underground pipe lines buried directly in the soil and also suitable for above ground pipelines.
- e) The transmitter of the flow meter shall be SMART type microprocessor based using digital technology having facilities for configuration of engineering units, flow range and features of memory and self diagnosis.
- f) The transmitter shall be mounted separate from the flow tube, connected by a cable.
- g) The flow transmitter and flow computation/ evaluation unit shall be mounted in a field mounted metallic field enclosure / cabinet.
- h) The electromagnetic flow meter shall have bi-directional measurement feature and with accuracy better or equal to $\pm 0.5\%$ of measured value inclusive of linearity, repeatability, pressure effect etc.
- i) Flow transmitter/ flow computing unit should be microprocessor based having digital display with flow-rate indications and integrated flow values with the configuration facility from the front face.
- j) Material of construction of the wetted parts of flow meters shall be suitable for functioning on treated / raw and chlorinated water applications.
- k) Flow tube shall be rugged in construction and shall be suitable for continuous operation.
- l) Flow meters shall be suitable for the water turbidity at site during various seasons.
- m) The flow meter shall be installed in such a way that it always remains filled with water.
- n) 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 meter shall be provided, as required by the flow meter manufacturer.
- o) The flow tube shall be installed at a location free from flow turbulence. In order to achieve the same, the flow tubes shall be installed in the pipe section such that straight lengths of pipe without bends or tee connection shall be minimum 5 diameters on upstream and 2 diameters on downstream side.
- p) The Contractor shall finalize the exact location of flow transducers in consultation with Purchaser/ Engineer In-Charge.

- q) The flow meter output signals shall contain the data for flow-rate and integrated flow readings.
- r) The output signal of the flow meter will be connected to panel mounted Flow Indicator & integrator and PLC.

s) Technical Particulars- Full Bore Electromagnetic Flow Transmitter:

Sr. No.	Description	Particulars
1	General	
1.1	Make	As per approved vendor list
1.2	Item	Full Bore Electromagnetic Flow Meter
1.3	Service	Common Header of Pump Discharge
1.4	Fluid	Sewage Water
1.5	Area Classification	Non Hazardous
2	Flow Sensor	
2.1	Type	DC pulsed
2.2	Electrode / Sensor MOC	Hast alloy C
2.3	Flow Tube MOC	SS304
2.4	Coil Housing MOC	Non corrosive (SS 304) or Die cast aluminium with anti-corrosive grade paint suitable for application
2.5	Grounding Ring MOC	SS 304
2.6	Liner MOC	PTFE
2.7	Process Connection	Flanged
2.8	Flange MOC	CS
2.9	Housing Protection	IP 68
2.10	Pressure Rating	16 Kg/cm ²
2.11	Temperature	50°C Ambient
2.12	Size(mm)	To suit mains flow parameters, with pipe reducer / expander provided as necessary
3	Flow Indicator and Transmitter	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	230 VAC (UPS)
3.3	Accuracy	± 0.5 % of measured value

Sr. No.	Description	Particulars
3.4	Repeatability	± 0.1%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Dia-cast Aluminium with PU finish / Polycarbonate
3.7	Output	One Current – 4 to 20 mA (isolated) proposanal to flow rate Hart (version 6 or above) One Scalable Pulse One Status Output
3.8	Communication	Modbus RS485
3.9	Display	2 Line Backlit LCD, Programmable
3.10	Maximum Digit Display	8 Digit
3.11	Indication on Display	<ul style="list-style-type: none"> • Actual Flow Rate / Instantaneous Flow Rate • Cumulative Forward Flow • Cumulative Reverse Flow • Cumulative Flow / Sum / Totalizers • Alarm <ul style="list-style-type: none"> • Five (5) digit backlit/Normal LCD, for flow rate in m3/hr. • Eight (8) digit backlit/Normal LCD for totalized flow in ML <p>Display with 8 digits for main information. Index, menu and status symbols for dedicated information</p> <p>Key for toggling through the information and reset customer totalizers and call-up function</p> <p>Selectable default information and accessible menus:</p> <ul style="list-style-type: none"> • Operator • Meter • Service • Data Logger
3.12	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.13	Facility for on line diagnosis	Required as following: Diagnostic

Sr. No.	Description	Particulars
		<ul style="list-style-type: none"> • Continuous self test shall include <ul style="list-style-type: none"> • Coil current to drive the magnetic field • Signal input circuit • Data calculation, handling and storing <p>Features</p> <ul style="list-style-type: none"> • Alarm statistics and logging for fault analyzing • Electrode impedance to check actual media contact • Flow simulation to check pulse and communication signal chain for correct scaling • Number of sensor measurements (excitations) • Transmitter temperature • Low impedance alarm for change in media • Flow alarm when defined high flow exceeds • Verification mode for fast measure performance check • Statistic flow and consumption data
3.14	Cable Gland	Required
3.15	Cable Length (sensor to transmitter)	10 Meter minimum or suit to site
3.16	Data Protection:	<ul style="list-style-type: none"> • All data shall be stored in an EEPROM. • Totalized statistic shall be backed up every 10 min • Power consumption and temperature Measurement statistic at every 4 hour • Minimum 30 days of data shall be stored in EEPROM. • Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.17	Power Supply in case of Raw power is not available (Remote Area)	Battery power / Solar power operated
4	Flow Indicator and Totalizer (Panel Mounted)	
4.1	Type	Electronic, Microprocessor based, single unit for flow indicator and integrator.

Sr. No.	Description	Particulars
4.2	Display	Digital, LED display
4.3	Digit Height	14 mm or Higher
4.4	No. of Digits a) Flow indicator b) Flow integrator	4 Digits 8 Digits
4.4	Input	4-20 mA DC (Isolated)
4.5	Zero and span adjustment	Required
4.6	Manual Reset Facility for flow integrator	Required (shall be protected)
4.7	Engineering Units for Flow rate indicator	m ³ /hr
4.8	Battery backup for flow integrator	Required
4.9	Retransmitted output	Required

1.2.2. **Technical Particulars- Open Channel Flow Transmitter:**

Sr. No.	Description	Particulars
1	General	
1.1	Make	As per approved vendor list
1.2	Item	Open Channel Flow Meter
1.3	Service	Open Channel
1.4	Fluid	Sewage Water
1.5	Area Classification	Non Hazardous / Hazardous
2	Flow Sensor	
2.1	Type	Ultrasonic
2.2	Sensor MOC	PP / PVDF
2.3	Seal MOC	EPDM
2.4	Sensor Housing MOC	Diacast Aluminium with PU finish / Polycarbonate
2.5	Process Connection	Flanged
2.6	Flange MOC	PP / CS

Sr. No.	Description	Particulars
2.7	Housing Protection	IP 68
2.8	Temperature compensation	Required
2.9	Swirling arm arrangement for mounting of sensor	Required for access during maintenance
2.10	Size(mm)	To suit Open Channel flow parameters
2.11	Pressure Rating (Kg/cm ²)	Atmospheric
2.12	Temperature	50 °C Ambient
3	Flow Indicator and Transmitter	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	230 VAC Line Power
3.3	Accuracy	± 0.5 % of measured value
3.4	Repeatability	± 0.1%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Dia-cast Aluminium with PU finish / Polycarbonate
3.7	Output	One Current – 4 to 20 mA (isolated) proposanal to flow rate Hart (version 6 or above) One Scalable Pulse One Status Output
3.8	Communication	Modbus RS485
3.9	Display	2 Line Backlit LCD, Programmable
3.10	Maximum Digit Display	8 Digit
3.11	Indication on Display	Actual Flow Rate / Instantaneous Flow Rate Cumulative Flow / Sum / Totaliser Alarm Five (5) digit backlit/Normal LCD, for flow rate in m ³ /hr. Eight (8) digit backlit/Normal LCD for totalized flow in ML • Display with 8 digits for main information. Index, menu and status symbols for dedicated information • Key for toggling through the information

Sr. No.	Description	Particulars
		and reset customer totalizer and call-up function • Selectable default information and accessible menus: - Operator - Meter - Service - Data Logger
3.12	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.13	Facility for on line diagnosis	Required as following: Diagnostic • Continuous self test shall include - Signal input circuit - Data calculation, handling and storing • Features - Alarm statistics and logging for fault analyzing - Transmitter temperature - Flow alarm when defined high flow exceeds -Verification mode for fast measure performance check - Statistic flow and consumption data
3.14	Cable Gland	Required
3.15	Cable Length (sensor to transmitter)	10 Meter minimum or suit to site
3.16	Data Protection:	<ul style="list-style-type: none"> • All data shall be stored in an EEPROM. • Totalizers statistic shall be backed up every 10 min • Power consumption and temperature Measurement statistic at every 4 hour • Minimum 30 days of data shall be stored in EEPROM. • Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.17	Power Supply in case of Raw power is not available	External AC/DC power supply required with 8 hour battery back up
4	Flow Indicator and Integrator (Panel Mounted)	

Sr. No.	Description	Particulars
4.1	Type	Electronic, Microprocessor based, single unit for flow indicator and integrator.
4.2	Display	Digital, LED display
4.3	Digit Height	14 mm or Higher
4.4	No. of Digits a) Flow indicator b) Flow integrator	4 Digits 8 Digits
4.4	Input	4-20 mA DC (Isolated)
4.5	Zero and span adjustment	Required
4.6	Manual Reset Facility for flow integrator	Required (shall be protected)
4.7	Engineering Units for Flow rate indicator	m ³ /hr
4.8	Battery backup for flow integrator	Required
4.9	Retransmitted output	Required

1.2.3. **Pressure Gauge:**

- a) Pressure Gauges shall be bourdon tube with diaphragm seal type with dial size of minimum 150 mm in diameter and calibrated for the required range. The colour of dial shall be white. The pointer shall be adjustable & micrometer type. The indicator shall be incorporating with damper and shall have external zero setting mechanism and safety blow out mechanism. The glass shall be shatter proof. The over range protection shall be 25% above maximum pressure. All wetted parts material shall be SS 316. The pressure gauges shall have an accuracy of $\pm 1\%$ full scale and weather protection class IP 65.
- b) The gauge shall be supplied complete with sensing diaphragm unit, sealing liquid, a pressure indicator and an armored capillary connecting the diaphragm to the pressure indicator.
- c) The pressure indicator shall be supported on a rigid support and the capillary shall be well supported to prevent physical damage.
- d) Pressure gauges shall comply with IS 3624. Where the gauge is subject to pressure pulsations and/or vibration, it shall be provided with snubber or glycerine filled dial.
- e) Unless and otherwise specified the measuring range shall be from 0 to 20 kg/cm² with accuracy of $\pm 1\%$ of maximum scale conforming to the IS 3624. The vendor shall submit test calibration certificate along with the pressure indicators.

f) Pressure gauges shall be provided on discharge of each pump and common header of pump discharge.

g) **Technical Particulars- Pressure Gauge:**

Sr. No.	Description	Particulars
1	General	
1.1	Make	As per approved vendor list
1.2	Item	Pressure Gauge
1.3	Service	Pump/Blower Discharge, Pump/Blower Discharge Common Header
1.4	Fluid	Sewage Water, Air
1.5	Area Classification	Non Hazardous / Hazardous
2	Pressure Gauge	
2.1	Type	Bourdon
2.2	Sensor and other wetted parts M.O.C	SS 316
2.3	Process connection	½" NPT (M)
2.4	Dial size	150 mm
2.5	Material of dial	Aluminium with white back ground and black numerals
2.6	Glass	Shatterproof
2.7	Housing material	Die cast aluminium with epoxy coating
2.8	Accuracy	±1% of full scale or better
2.9	Over range protection	125% of maximum pressure
2.10	Gauge Protection	IP65
2.11	Temperature	50°C Ambient
2.12	Range	As per pump design (Range to be finalised during detailed engineering without any cost implication)
2.13	Accessories	<ul style="list-style-type: none"> • Snubber • 3 way isolation valve • Impulse tubing, fittings • All other installation hardware
2.14	Diaphragm Seal M.O.C	SS316
2.15	3 Way Isolation Valve M.O.C	SS316
2.16	Impulse Tube Fitting M.O.C	SS316

1.2.4. **Pressure Transmitter**

a) Pressure Transmitter shall consist of a pressure sensor/transducer/ transmitter and panel mounted digital pressure indicator and any other items required for completing the measuring system. Where the transmitter is subject to pressure pulsations and/or vibration, it shall be provided with snubber.

b) The pressure transmitters shall be designed for operation over 130 % of full range.

c) Technical Particulars- Pressure Transmitter:

Sr. No.	Description	Particulars
1	General	
1.1	Make	As per approved vendor list
1.2	Item	Pressure Transmitter
1.3	Service	Pump/ Blower Discharge Common Header
1.4	Fluid	Sewage Water
1.5	Area Classification	Non Hazardous / Hazardous
2	Pressure Sensor	
2.1	Type	Diaphragm / piezoelectric
2.2	Sensor and other wetted parts M.O.C	SS 316
2.3	Process connection	½" NPT (F)
2.4	Sensor Fill Fluid	Silicon Oil
2.5	Temperature	50°C Ambient
2.6	Range	As per pump design (Range to be finalised during detailed engineering without any cost implication)
3	Pressure Transmitter	
3.1	Type	SMART Type / Microprocessor Based, Head Mounted
3.2	Power Supply	230 VAC Line Power / 24 VDC
3.3	Accuracy	± 0.1 % of measured value
3.4	Response Time	100 ms
3.5	Transmitter Protection	IP67

Sr. No.	Description	Particulars
3.6	Transmitter MOC	SS316 /Diacast Aluminium with PU finish
3.7	Output	One Current – 4 to 20 mA (isolated) proposanal to pressure Hart (version 6 or above)
3.8	Display	Alphanumeric LCD Type, Programmable
3.9	Over range protection	125% of maximum pressure
3.10	Zero and span adjustment	Required
3.11	Cable Gland	Required
3.12	Accessories	<ul style="list-style-type: none"> • Snubber • 3 way isolation valve • Impulse tubing, fittings • Mounting Bracket • Tag Plate • All other installation hardware
3.13	Diaphragm Seal M.O.C	SS316
3.14	3 Way Isolation Valve M.O.C	SS316
3.15	Impulse Tube Fitting M.O.C	SS316
4	Digital Pressure Indicator (Panel Mounted)	
4.1	Type	Electronic, Microprocessor based
4.2	Display	Digital, LED display
4.3	Digit Height	14 mm or Higher
4.4	No. of Digits - Pressure indicator	8 Digits
4.5	Input	4-20 mA DC (Isolated)
4.6	Zero and span adjustment	Required
4.7	Engineering Units for - Pressure indicator	Kg / Cm ²
4.8	Battery backup for flow integrator	Required
4.9	Retransmitted output	Required

1.2.5. **Technical Particulars- Pressure Switches:**

Sr. No.	Description	Particulars
1	General	

Sr. No.	Description	Particulars
1.1	Make	As per approved vendor list
1.2	Item	Pressure Switch
1.3	Fluid	Sewage Water
1.4	Area Classification	Non Hazardous / Hazardous
2	Pressure Sensor	
2.1	Type	Diaphragm / piezoelectric
2.2	Sensor and other wetted parts M.O.C	SS 316
2.3	Process connection	½" NPT (F)
2.4	Temperature	50 °C Ambient
2.5	Range	As per pump design (Range to be finalised during detailed engineering without any cost implication)
2.6	Accuracy	± 1% of full scale or better
2.7	Range	As per pump design, Adjustable setting over full span and as per P&ID.
2.8	Over range Protection	125% of range
2.9	Body Material of casing	Die Cast Aluminium / non-corrosive
2.10	Set point adjusting scale	Required
2.11	Accessories	<ul style="list-style-type: none"> • Snubber • 3 way isolation valve • Impulse tubing, fittings • All other installation hardware
2.12	Diaphragm Seal M.O.C	SS316
2.13	3 Way Isolation Valve M.O.C	SS316
2.14	Impulse Tube Fitting M.O.C	SS316

1.2.6. **Ultrasonic Level Transmitter**

- a) Ultrasonic Level Transmitter shall consist of a level sensor, level transmitter cum computing unit, prefabricated cable connecting the sensor and transmitter, panel mounted digital level indicator and any other item required for completing the level measurement system.
- b) The level sensor shall be suitable for flange or bracket mounting as required and have a minimum protection conforming to IP 67. It shall have ambient temperature compensation and adjustable datum setting facilities.

- c) The level transmitter cum computing unit shall be provided in an enclosure conforming to IP 67. It shall be programmable with an integral programming keyboard, LCD display, relays for alarm, control and system fault and shall provide an isolated 4 to 20mA DC output signal proportional to the level.
- d) 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.
- e) 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.
- f) If turbulence exists, shielding, stilling tubes or other measures shall be provided to avoid effects on the measurement.

g) Technical Particulars- Ultrasonic type Level Transmitter:

Sr. No.	Description	Particulars
1	General	
1.1	Make	As per approved vendor list
1.2	Item	Level Transmitter
1.3	Service	Sump / Tank
1.4	Fluid	Sewage Water, Chemical Water
1.5	Area Classification	Non Hazardous / Hazardous
2	Level Sensor	
2.1	Type	Ultrasonic
2.2	Sensor MOC	PP / PVDF
2.3	Seal MOC	EPDM
2.4	Sensor Housing MOC	Diacast Aluminium with PU finish / Polycarbonate
2.5	Process Connection	Flanged
2.6	Flange MOC	PP / CS
2.7	Housing Protection	IP 68
2.8	Temperature compensation	Required
2.9	Swirling arm arrangement for mounting of sensor	Required for access during maintenance

Sr. No.	Description	Particulars
2.10	Size(mm)	To suit Sump / Tank Height
2.11	Pressure Rating (Kg/cm ²)	Atmospheric
2.12	Temperature	50 °C Ambient
3	Level Transmitter	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	230 VAC Line Power
3.3	Accuracy	± 0.1 % of measured value
3.4	Repeatability	± 0.1%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Diacast Aluminium with PU finish / Polycarbonate
3.7	Output	One Current – 4 to 20 mA (isolated) proposanal to Level Hart (version 6 or above)
3.8	Display	2 Line Backlit LCD, Programmable
3.9	Maximum Digit Display	8 Digit
3.10	Indication on Display	Actual Sump / Tank Level Alarm
3.11	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.
3.12	Cable Gland	Required
3.13	Cable Length (sensor to transmitter)	10 Meter minimum or suit to site
4	Digital Level indicator (Panel Mounted)	
4.1	Type	Microprocessor based
4.2	Display	Digital LED display
4.3	Digit Height	14 mm or higher
4.4	No. of Digits	3 ½
4.5	Input	4-20 mA DC with HART protocol (version 6 or above)
4.6	Zero & Span Adjustment	Required
4.7	Engineering Units for display	Meters and %.
4.8	Accuracy	±0.1 % of span

Sr. No.	Description	Particulars
4.9	Enclosure Material	Non corrosive
4.10	Retransmission output	Isolated 4-20 mA DC-2nos.
4.11	Power supply to Transmitter	24 V DC
4.12	Alarm outputs	1NO+1NC for high and Low-Low alarms (adjustable)

1.2.7. **Hydrostatic Level Measuring System**

- a) Hydrostatic level measuring system shall consist of a level sensor, level transmitter cum computing unit, prefabricated cable connecting the sensor and transmitter, panel mounted digital level indicator and any other item required for completing the level measurement system.
- b) The level sensor shall be suitable for flange or bracket mounting as required and have a minimum protection conforming to IP 67. It shall have ambient temperature compensation and adjustable datum setting facilities.
- c) The level transmitter cum computing unit shall be provided in an enclosure conforming to IP 67. It shall be programmable with an integral programming keyboard, LCD display, relays for alarm, control and system fault and shall provide an isolated 4 to 20mA DC output signal proportional to the level.
- d) 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.
- e) 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.
- f) If turbulence exists, shielding, stilling tubes or other measures shall be provided to avoid effects on the measurement.

g) Technical Particulars- Hydrostatic Type Level Transmitter:

Sr. No.	Description	Particulars
1	General	
1.1	Make	As per approved vendor list
1.2	Item	Level Transmitter
1.3	Service	Aeration Tank

Sr. No.	Description	Particulars
1.4	Fluid	Sewage Water, Chemical Water
1.5	Area Classification	Non Hazardous / Hazardous
2	Level Sensor	
2.1	Type	Hydrostatic
2.2	Sensor MOC	SS316
2.3	Process Connection	Flanged
2.4	Flange MOC	PP / CS
2.5	Housing Protection	IP 68
2.6	Temperature compensation	Required
2.7	Swirling arm arrangement for mounting of sensor	Required for access during maintenance
2.8	Size(mm)	To suit Sump / Tank Height
2.9	Pressure Rating (Kg/cm ²)	Atmospheric
2.10	Temperature	50°C Ambient
3	Level Transmitter	
3.1	Type	Microprocessor Based, Remote Mounted
3.2	Power Supply	230 VAC Line Power
3.3	Accuracy	± 0.1 % of measured value
3.4	Repeatability	± 0.1%
3.5	Transmitter Protection	IP67
3.6	Transmitter MOC	Diacast Aluminium with PU finish / Polycarbonate
3.7	Output	One Current – 4 to 20 mA (isolated) proposanal to Level Hart (version 6 or above)
3.8	Display	2 Line Backlit LCD, Programmable
3.9	Maximum Digit Display	8 Digit
3.10	Indication on Display	Actual Sump / Tank Level Alarm
3.11	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.

Sr. No.	Description	Particulars
3.12	Cable Gland	Required
3.13	Cable Length (sensor to transmitter)	10 Meter minimum or suit to site
4	Digital Level indicator (Panel Mounted)	
4.1	Type	Microprocessor based
4.2	Display	Digital LED display
4.3	Digit Height	14 mm or higher
4.4	No. of Digits	3 ½
4.5	Input	4-20 mA DC with HART protocol (version 6 or above)
4.6	Zero & Span Adjustment	Required
4.7	Engineering Units for display	Meters and %.
4.8	Accuracy	±0.1 % of span
4.9	Enclosure Material	Non corrosive
4.10	Retransmission output	Isolated 4-20 mA DC-2nos.
4.11	Power supply to Transmitter	24 V DC
4.12	Alarm outputs	1NO+1NC for high and Low-Low alarms (adjustable)

1.2.8. **Displacer Type Level Switch**

- a) Level switch shall be displacer type with flexible rope, non corrosive displacer, 2 set point micro switch, flange connection, spring housing and shall have external cage.
- b) Level switch shall be supplied complete with mounting bracket and associated accessories.
- c) Perforated still well is required for tanks with excessive turbulent liquids.
- d) The micro switch contacts being rated for 5A at 230 VAC can be directly wired to control devices through instrument cable.
- e) Level switch range shall be suitable to sump and tank height.
- f) **Technical Particulars- Level Switch:**

Sr. No.	Description	Particulars
1	General	
1.1	Make	As per approved vendor list
1.2	Item	Level Switch
1.3	Service	Tank / Sump
1.4	Fluid	Sewage Water
1.5	Area Classification	Non Hazardous
2	Level Switch	
2.1	Type	Displacer
2.2	Flexible Rope MOC	PP / SS316
2.3	Displacer MOC	PP / SS316
2.4	Spring Housing	PP / SS316
2.5	Process connection	Flanged
2.6	Process connection MOC	PP
2.7	Switching Type	Micro switch
2.8	Switching Contacts	2 SPDT, 5A
2.9	Housing material	Die cast aluminium with epoxy coating
2.10	Protection Class	IP65
2.11	Perforated Still well	PP
2.12	Temperature	50 °C Ambient
2.13	Range	As per Sump / Tank design (Range to be finalised during detailed engineering without any cost implication)

1.2.9. **Technical Particulars- Float & Board Type Level Indicator:**

Sr. No.	Description	Particulars
1	General	
1.1	Make	As per approved vendor list
1.2	Item	Level Indicator
1.3	Service	Sump / Tank

Sr. No.	Description	Particulars
1.4	Fluid	Sewage Water, Chemical Water
1.5	Area Classification	Non Hazardous / Hazardous
2	Level Indicator	
2.1	Type	Float and Board
2.2	Construction	Guided
2.3	Measuring Range	To Suit Sump / Tank Height
2.4	Travel	Full Range
2.5	Float	SS316
2.6	Float / Guide wire Rope	SS316
2.7	Calibrated Gauge Board	6" wide x aluminium powder coating with black graduations and numerical
2.8	Pointer	Red, powder coated steel with measuring rope holder
2.9	Protection Conduit	Vertical and Horizontal limb in galvanized steel
2.10	Elbow pulley	Cadmium plated steel or PP pulley with PTFE bush and SS shaft housed in weather proof aluminium or PP enclosure
2.11	Tensioner	Cadmium plated steel spring housed in CS or PP enclosure
2.12	Anchor	SS316 plate (25mm x 6mm thick plate to be welded at bottom of sump / tank at site)
2.13	Rope Fastener	SS316
2.14	Gauge Brackets	Powder Coated Steel
2.15	Counter weight for rope type probe to keep it straight	Required
2.16	Spacers between the probes to avoid entangling with each other	Required

1.3. **Laboratory Instruments:**

The treatment plant shall be provided an administrative building that will house the laboratory.

The laboratory shall be equipped with instruments, equipment, chemicals and other infrastructure that is necessary to perform the routine analysis for the parameters as detailed in table below.

Contractor shall submit the complete list of lab equipments required for full analysis of parameters to the employer's representative for approval.

Contractor shall include in his offer supply of chemicals required for analysis along with proposed lab instruments and associated equipment, including for the O&M period as specified elsewhere in the bid document.

Typical Laboratory equipments to be provided are detailed as below:

Sr. No.	Description	Unit	Quantity
1	Comparator test set for residual chlorine or chloroscope	No.	1
2	Multi parameter (pH & Conductivity Meter)	No.	1
3	Mains operated pH meter completed with one calomel electrode and glass electrode	No.	1
4	Photoelectric calorimeter / Spectrophotometer	No.	1
5	Water bath with 6 to 8 concentric holes and discs, electrically heated	No.	1
6	Hot plates	No.	25
7	Distilled water plant	No.	1
8	Demineraliser	No.	1
9	Refrigerator (280 litres capacity) double door	No.	1
10	Muffle furnace	No.	1
11	Electric oven	No.	1
12	Magnetic stirrer	No.	1
13	Analytical balance with weight box	No.	1
14	Jar-Test apparatus (Phipps & Bird)	No.	1
15	Centrifuge	No.	1
16	Gas cylinder if gas supply is not available	No.	1
17	Fume cupboard	No.	2
18	Depth Sampler	No.	2
19	Total Organic Analyser	No.	1
20	Sieve shaker with standard sieves and two pan balance weighing up to 200gm samples	No.	1
21	Equipment Needed For Bacteriological Examination		

Sr. No.	Description	Unit	Quantity
22	Hot Air Oven	No.	1
23	Autoclave	No.	1
24	Incubator 37°C or 44°C (Water/Air-Jacketed)	No.	1
25	Binocular microscope	No.	1
26	pH Meter	No.	1
27	Pipette Box (Stainless Steel)	No.	10
28	Wooden Racks/Aluminium Racks	No.	5
29	Wire Baskets	No.	10
30	Cotton/ Aluminium Foils	No.	10
31	Burners (Bunsen) With Pilot Lamp	No.	3
32	Suction Flask (1 Litre Cap)	No.	2
33	Suction Pump	No.	1
34	Sampling Bottles	No.	10
35	Measuring Cylinders (1000 MI, 500 MI, 200 MI, 100 MI, 50 MI, 25 MI)	Set	3
36	Vacuum pump	No.	1
37	Soxhlet extraction unit	No.	1
38	Kjeldhal digestion unit	No.	1
39	Weighing Balance (max 10kg)	No.	1
40	Laminar Air Flow chamber	No.	1
41	Bacteriological Media	No.	1
42	M. Endo Broth (dehydrated)	No.	1
43	Lactose or Lauryl Tryptose broth	No.	1
44	Mac Conkey broth	No.	1
45	Brilliant Green Bile Lactose Broth	No.	1
46	Total Plate Count Agar	No.	1
47	Peptone/Tryptone Water	No.	1

The equipment shall be supplied with all the accessories that are necessary to make the equipment functional for analyzing parameters.

Contractor shall provide additional Equipment if necessary for the performance of the plant without extra cost to the Employer.

1.4. **Work Tables and Benches**

- a) Minimum of 1set of work table and chair per staff shall be provided for the laboratory and office staff.
- b) The furniture and chairs shall be of ergonomic design so that staff can work most efficiently and safely.
- c) The work tables shall be along the wall and shall be provided with adequate storage capacity and open glass shelves on the top to provide additional space for storage of chemicals and stock solutions.
- d) A fume cupboard with ventilation hood shall be provided to prevent spreading of toxic and irritant fumes and odours into other parts of the laboratory.
- e) Forced ventilation with exhaust fans shall be provided. The wall space and offsets shall be convenient to locate cabinet, benches, hoods, incubators alongside without any loss of floor space.

Part 8

Process Requirements

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11. Design/Sizing Criteria and Other Requirements

Process Requirements

1. Septage Collection System

Vacuum Trucks:

Vacuum Trucks shall collect the septage at the household level and transport it to Septage treatment plant. The vacuum trucks are available in different capacities of from 2,000 up to 12,000 litres.

A series of dedicated Vacuum Trucks (4 cum capacity, typical) are proposed for septage collection from each household – 16 nos. for year 2017 to 25 nos. for year 2032. However, as per actual requirement and availability, even smaller capacity trucks may be deployed in areas where access roads are narrow. A household size of 5.5 persons may be considered. Septic Tank cleaning frequency has been considered as 2 years. The entire town has been divided into 15 Service areas (Table 6-8-1) formed by clubbing nearby wards (Refer drawing no. **TCE.7690A-176-LM-6551 to 6565**). Each service area will be catered by dedicated vacuum truck. Apart from this, 2 nos. trucks will be available as standby to attend emergency calls. All these trucks will be parked inside the SeTP during non-operation period. A covered parking lot has been considered and indicated in the Layout Plan for the same (Refer drawing no. **TCE.7690A-163-GA-6199**).

Each of these vehicles should be equipped with GPS tracking devices for proper monitoring. All necessary safety equipments should be provided in each of these vehicles in sufficient quantity and in workable condition.

Table 6-8-1 Service Areas for Chas town

S. No.	Service Areas	Ward no.
1	SA-1	1, 2 and Partial 3.
2	SA-2	13
3	SA-3	12 and 15
4	SA-4	14 and 16
5	SA-5	17 and 18
6	SA-6	21 and 22
7	SA-7	19 and 23
8	SA-8	20 and 24
9	SA-9	25 and 26
10	SA-10	27 and 28
11	SA-11	8 and 9
12	SA-12	7 and 10
13	SA-13	4 and Partial 3

14	SA-14	6 and 5
15	SA-15	29 and 30

A septage treatment Plant lay out plan vide Drg No. **TCE.7690A-163-GA-6199** is enclosed for reference.

2. Septage Treatment Plant

Process requirements for the following SeTP is included in this contract and is described herein Part 8 – “Process Requirements”

No.	SeTP Name	Design Capacity	Treatment Process
1	Chas, Jharkhand	89 kLD	Pretreatment followed by Mechanical Dewatering of Septage ; Package treatment plant* for centrate to meet desired effluent characteristics for proper reuse / disposal; Stabilization of dewatered sludge for proper disposal / sale.

*The design of this package treatment plant is left open for Bidders to meet the specified plant effluent quality. For the purpose of DPR, a package treatment plant with MBBR (2-stage) followed by ACF, PSF and UF was considered.

Bidders wishing to offer technical alternatives to the requirements of the Bid documents must provide all information necessary for a complete evaluation of the alternatives by the Employer, including drawings, design calculations technical specifications, proposed installation methodology and other relevant details.

Alternative Bids must satisfy the Employer’s performance requirements as set out in the Bid documents. Bidder shall include with their Bid evidence acceptable to the Employer of satisfactory past performance of alternative designs and the associated equipment and processes offered and full details of similar plant capacities called for to enable proper evaluation of such alternative designs.

Bidders should note that they must submit a Bid based on the Employer’s Requirements for their alternative Bid to be considered. Bidder may propose alternate dewatering equipment with all technical documents for approval of Employer.

3. Influent Characteristics

The typical influent septage characteristics used as the basis of design are listed in Table 6-8-2. However, bidder should carry out sampling on his own to establish the actual characteristics. After award of work, it is mandatory for contractor to conduct tests on atleast 3 samples to establish the raw septage characteristics, before proceeding for design stage.

Table 6-8-2 Typical characteristics of Influent Septage for SeTP

No.	Source	Septage
	Characteristics	Faecal Sludge of low concentration, usually stored for several years, more stabilized than Type- "A"
1	COD (mg/L)	<15000
2	COD / BOD	5:1 to 10:1
3	NH ₄ N (mg/L)	< 1000
4	TS (%)	< 3%
5	SS (mg/L)	7,000 (approx.)
6	Helminth Eggs	4,000 (approx.)

Source: CPHEEO, 2013

4. Effluent Quality Requirements

The effluent quality requirements to be met are listed in Table 6-8-3.

Table 6-8-3: Treated Effluent Characteristics

Sl. No.	Parameters	Tolerance Limits (Inland Surface Water)
1	BOD (3 days at 27°C) (mg/l)	≤10
2	COD (mg/l)	≤50
3	TSS (mg/l)	≤10
4	Total Kjeldahl Nitrogen, TKN (mg/l)	≤10
5	Dissolved Phosphorus (mg/l)	≤2
6	pH	6.5-7.5
7	Residual Chlorine, mg/L	≤1.0
8	Oil and grease, mg/L	≤10
9	Faecal Coliform	230 MPN/100 ml

5. Dewatered Sludge Quality Requirements

The dewatered sludge quality requirement to be met is listed below:

Minimum sludge TSS (dry solids)	% w/w	20%
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6. Treatment Process

The septage brought by Vacuum Trucks shall be emptied into the Inlet Chamber of the SeTP. In this facility, the septage shall be treated and the parameters shall be brought down to permissible levels. Inlet BOD and SS to the SeTP has been considered as 1500 mg/l and 7000 mg/l respectively. With the pre-treatment (screening, grit removal), there will be some reduction in SS and BOD. However, the major reduction will take place in dewatering stage. Considering 90% solids recovery in centrifuge, the SS concentration in centrate can be expected as approx. 700 mg/l. Incidental BOD reduction can be assumed as 50%; accordingly BOD level in centrate shall be approx. 750 mg/l. This centrate will now be treated further in package MBBR to achieve final treated water with BOD and SS as 10:10. In case the parameters of centrate are higher than the design inlet parameters of MBBR plant, a part of treated water shall be recirculated to dilute it.

Basic steps involved in Septage Treatment are:

Septage → Pre Treatment → Septage Dewatering → Composting of Dried Sludge → Used as fertilizer

For Liquid portion (filtrate resulting from dewatering of septage):

Filtrate → Package MBBR / WSP → Disinfection → Reuse / Disposal to river

A peak factor of 3 has been considered for pretreatment units (upto Equalisation tank). This is based on the fact that the total septage estimated for a day will be received at the SeTP in the working shift of 8 hours only. Hence the factor of $24/8 = 3$.

Average Daily flow (Cum/day): 89

Hourly flow (Cum/Hr) : 3.71

Assumed Characteristics:

BOD (5 days at 20 degree C) (mg/l) :600

TSS (mg/l): 700

Total Septage/day: 89,000 Ltrs

Treated water Characteristics

BOD Less than equal to: 10 mg/l

Suspended solids Less than equal to:10 mg/l

A representative flow diagram of the treatment scheme and layout for SeTP is included in this bid document. The flow diagram is attached as Appendix 6-2.

This drawing shall be considered representative only. In the event of any conflicts between information in the drawings then Part 8 – “Process Requirements”, shall govern.

The Contractor shall ensure that the layout submitted as part of the Contractor’s bid comply with the following specific constraints and all other requirements described in the Bid Documents:

- For all structures containing water or process liquid, the minimum freeboard (distance by which top of wall is higher than the maximum water surface level at peak plant flow with one unit of each unit process out of service) shall be 0.5 m unless specified otherwise.
- Contractor shall provide at SeTP all necessary facilities for manual bypass of the process liquid at various locations in the flow path as indicated below. These facilities are included in this contract and shall be provided regardless of whether or not they are shown in any drawings included in the contract document, shall be fully functional in all respects, and shall include any and all components necessary to safely and efficiently accomplish the intended bypass. Each bypass facility shall include, but not be limited to:
 - (i) downward opening overflow weir gates installed in the appropriate channel or structure from which the bypass is to be effected, (ii) an RCC channel or structure to receive the bypass flow over the weir gate, (iii) an appropriately sized buried (above ground piping will not be acceptable) cement mortar lined and coal tar epoxy coated ductile iron pipe or RCC pipe (NP3 class) to carry the bypass flow from the channel or structure in (ii) above to a manhole or junction box in the SeTP’s main outfall pipe through chlorine contact tank.
- Bypass facilities as described above shall be provided at the following location:
 - Outlet of Grit Chamber to nearest drain

PRETREATMENT OF SEPTAGE

- **Receiving Chamber:** To receive the collected septage.
- **Pumps:** To pump the septage from storage tank to the screens (if required).

- **Mechanical/manual screens:** To remove large size particles, such plastic, rag from the septage and protect downstream treatment facilities.
- **Grit channels or aerated grit chambers:** To remove coarse sand and cinder from the septage to prevent abrasion of downstream mechanical equipments, such as pumps, etc. Aerated grit chambers can also help in reducing odor emissions from the septage.
- **Equalisation Tank –** To store and homogenize the collected septage. Lime dosing shall be provided here.
- **Pumps:** To pump the septage from equalisation tank to the dewatering unit.

In addition, lime stabilization is also practiced to stabilize, control odour, vector and pathogen destruction. Lime stabilization involves adding and thoroughly mixing lime (alkali) with each load of septage to ensure that the pH is raised to at least 12. Lime addition could be done at any of these three points:

1. In the hauler truck (vacuum truck) before or while the septage is pumped.
2. In septage storage tank (Receiving Chamber) where septage is discharged from the hauler truck as shown in Figure 6.
3. In the Equalization Tank.

In this case, it is proposed to add lime through suitable lime dosing pumps into the Equalisation Tank.

7. Plant Layout

The SeTP components shall be laid out and fully contained within the respective designated site boundaries so as to logically interface with any and all existing infrastructure at the site and that must remain in service. Contractor's proposed site layout shall clearly show the space allocated for all plant components, including those components and/or unit processes that may be designated for future construction or installation. Setbacks and clearances from the site boundary shall be provided as appropriate and as required by law. All existing utilities (including water, sewer, power, or others, underground tanks located on the site) if requiring to be relocated to accommodate the Contractor's proposed and approved site layout shall be relocated by the Contractor at no additional cost and without interrupting provision of such utility services to users and customers. Such relocations shall be fully coordinated with Employer's Representative.

The plant layout shall adhere to the following general rules:

- Minimum clear distance provided to permit safe and convenient access for operation and maintenance shall be 5 m between adjacent treatment units or fixed structures and 1.5 m between pieces of equipment
- An area adjacent to all mechanical equipment shall be provided as a maintenance lay down area

- All electrical equipment (except for motors) shall be located above the plinth level at the site or for the effluent receiving water body, whichever is higher.

8. General Design Requirements

The following general design requirements shall be met for SeTP. These requirements shall be fully met regardless of whether or not such requirements or any related components are shown in any drawings included in the contract documents.

- The Contractor shall perform a complete Hazardous Area Classification analysis per IS 5572 for SeTP in this contract and shall submit a complete report of such analysis as well as Hazardous Area Classification Drawings that delineate boundaries of all classified areas and indicate the classification of each area. All electrical or other powered equipment, instrumentation, or components shall fully comply with all requirements of IS 5571.
- All components (including but not limited to equipment such as pumps, blowers, screens, diffusers, inline devices; instruments such as flow meters; and distribution and collection channels or pipes) shall be provided with appropriate isolation devices such as valves, gates, or other devices in order to allow isolation, drainage, cleaning, calibration, servicing, and maintenance of such components. In-line instrumentation can be isolated and removed for calibration and maintenance without interrupting the flow.
- Where necessary, equipment shall be provided with acoustic, sound-dampening enclosures to limit ambient noise during normal operation to the limits detailed in the General Requirements.
- All equipment shall be arranged and buildings and structures designed to permit safe and easy access to and removal of all equipment.
- Fixed runways, lifting eyes, cranes, hoists, or other appropriate devices and means shall be provided to permit safe and easy removal of all equipment for maintenance or any other purpose
- All liquid or sludge flow distribution shall be accomplished using atleast one of the following options only:
 - non-submerged (i.e. with a positive free fall limited to 50mm from weir invert to the water surface on the downstream side) overflow weirs,
 - non-submerged downward opening overflow weir gates, or
 - automatic feedback flow control using inline flow measurement and modulated flow control valves with electrical actuators.
- All structures, whether liquid-holding or not, shall be designed such that they can be fully and completely drained and will not float or move when empty, because of groundwater buoyancy or any other reason. The structures shall be designed to counteract any possible floatation without the use of any type of groundwater pressure relief valves.
- All channels carrying process liquid shall be fully covered with solid non-skid FRC/GRP cover plates (not grating) designed for human traffic live loads at a minimum and heavy vehicle live loads wherever the channel crosses traffic paths.
- Inlets into tanks, reactors, or other structures via pipes, channels, valves, or gates shall be designed such that the incoming flow does not cause any damage or excessive wear

whatsoever to the structure or any equipment in the vicinity under any hydraulic condition, including but not limited to the condition when the structure is empty.

- All piping shall be of corrosion-resistant material appropriate for the service and shall be provided with interior lining, exterior coating, and other corrosion protection as appropriate. All piping shall be fully and adequately supported and braced to comply with all applicable codes and standards. All supporting hardware shall also be of corrosion-resistant material. The design of pipe supports and anchors shall fully account for static and dynamic vertical, lateral, longitudinal, and seismic loads, fluid flow, and thermal expansion. Seismic bracing, thrust restraints and/or thrust blocks, and appropriate expansion joints or loops shall be provided as needed. Pipe lengths and joints shall be assembled and arranged for ease of removal in such a way that individual runs can be changed without dismantling adjacent pipes, by providing dismantling joints at regular intervals.
- For liquids and sludge, the minimum pipe flow velocity shall be no less than 0.5 m/s and the maximum pipe flow velocity shall be no more than 1.5 m/s for pumped suction and no more than 2.0 m/s for pumped discharge or gravity flow. All mixed liquor and sludge lines shall be minimum 150 mm diameter and shall be provided with appropriate cleanouts and flushing arrangements for safe and easy flushing using high-pressure water.
- All liquid service pipes shall be provided with appropriate means for safe and easy drainage of the pipes when not in service.
- All pipes shall be colour banded and suitably labelled with the stream designation and direction of flow to enable individual lines to be identified throughout their run.
- Particular attention shall be paid to the layout of the chemical piping, which shall be arranged without clutter and shall be functional and neat in appearance. Generally, where piping is installed in ducts, it shall be supported not less than 150 mm clear of the floor.
- All piping routed under any type of structure or equipment shall be fully and completely encased in reinforced cement concrete, with the encasement thickness beyond the outer diameter of the pipe being at least 200 mm on all sides or $d/4$ whichever is higher. The encasement shall extend along the pipe length for a minimum horizontal distance of 1500 mm in each direction beyond the footprint of the overlying structure or equipment.
- All piping connecting to, entering, or exiting any and all structures shall be provided with appropriate restrained flexible connections and/or joints at all such interfaces with structures to allow for differential movement between pipe and structure in all directions without stressing or breaking the pipes.
- Appropriate restrained flexible connections and/or joints shall be provided for all pipes where they connect to any and all of the following:
 - Equipment such as pumps, blowers, or inline devices
 - Valves
 - Wall, floor, or roof penetrations
- Where piping or other materials susceptible to damage from ultraviolet radiation are employed, they shall be protected from such radiation through the use of appropriate additives and/or coatings and shall be physically shielded from direct sunlight at all times in their normal service location using enclosures, covers, canopies, roofs, and/or other similar means.

- Platforms, handrails/guardrails, ladders, and stairs shall be provided where necessary for proper, safe, and easy access to and/or operation of valves, gates, instruments, control panels, and other devices, equipment, or structures.
- Appropriate sampling ports and/or sampling valves shall be provided to allow easy, safe sampling of all process streams without spillage or contamination and without the need to interrupt normal operation.
- The influent flow meter and influent sampling location shall be selected such that the true influent flow and characteristics will be measured without inclusion of in-plant recycles or other extraneous streams. Separate flow measurement and sampling shall be provided for the recycle streams.
- Foam, scum, fats, oil, grease, or any other floating material from any location in the SeTP shall be completely removed from the process flow path along with waste, dewatered solids leaving the SeTP and shall under no circumstances be recycled or returned to any location in the plant.

9. Process and Facilities Description

This Process and Facilities description is intended to provide a general indication of the processes and types of facilities that the Contractor shall be required to design, construct, operate & maintain and applies to SeTP in this contract unless specifically indicated otherwise. The Contractor shall use this description together with other specific information for SeTP provided elsewhere in bid document, including but not limited to Paragraph 11 – “Design/Sizing Criteria and Other Requirements”, Part 1- “Project Requirements”, and Volume III – “Drawings”, all of which are integral to this Process and Facilities Description and are incorporated herein by reference. The Contractor may propose alternate treatment process and implementation details such as detailed site layouts and elevations of specific components. However, the Contractor shall strictly comply with the performance requirements (such as effluent and sludge quality and equipment efficiencies).

Contractor should note that this particular contract may or may not include all of the components described in this “Process and Facilities Description”. Components included in this specific contract are listed in Paragraph 11 – “Design/Sizing Criteria and Other Requirements”.

i. Receiving (Inlet) Chamber

This is designed to receive the septage from Vacuum Trucks. The arrangement shall be such that the vacuum truck can be conveniently emptied into this. The level of this chamber should be designed in a way that the septage should be able to flow through gravity through the following units – screen channel, grit chamber and equalization tank. Size of the tank should be such that it is able to empty two trucks at a time (e.g. for 4 cum capacity vacuum truck, the volume of this chamber should be 8 cum minimum).

ii. Coarse Screens

The raw septage received in the inlet chamber shall be screened using Coarse Screens placed in deep concrete channels. An electronically controlled automatic jam removal system shall be provided in addition to the safety devices specified elsewhere in the document. The screenings removed by the screens shall be discharged at the appropriate elevation above ground on to a conveyor. A screw or belt conveyor positioned above ground level shall convey the screenings through a galvanized steel chute to a truck/tractor-trolley positioned at ground level. The screenings compacting is part of scope of tender. The dry solids content equal or superior to 30 % shall be guaranteed.

iii. Fine Screens

The Fine Screens shall receive coarse-screened septage. An electronically controlled automatic jam removal system shall be provided in addition to the safety devices specified elsewhere in the document. The screenings removed by the screens shall be discharged at the appropriate elevation above ground on to a conveyor. A screw or belt conveyor positioned above ground level shall convey the screenings through a galvanized steel chute to a truck/tractor-trolley positioned at ground level. The screenings compacting is part of scope of tender. The dry solids content equal or superior to 30 % shall be guaranteed.

iv. Grit Chamber

A complete grit removal facility shall be provided, with integrated Fats, Oil, and Grease (FOG) removal where specified. The grit removing mechanism shall be of moving rake type to collect and removal settled grit effectively, with proper circumferential speed, and it shall be installed grit chambers. All equipment and components (including but not limited to conveyors, pumps, and blowers) necessary for a fully functional system shall be provided regardless of whether or not such items are specifically listed or described in the bid document. Each of the grit removal equipment shall be provided the Vertical propeller pump with suitable motor, starter, etc. shall be provided. The design of the pump and the piping on the inlet and outlet side has to be such that there are minimum numbers of bends as they are liable to be choked with organic matter.

Dewatered grit shall be collected in a truck/tractor-trolley positioned at ground level below the Grit Classifier discharge. Classifier Mechanism shall consist of the followings:

- (i) Chain and sprocket with guard.
- (ii) Reciprocating rake with hangers.
- (iii) A.C. motor.
- (iv) Local push button shall be provided.

De-gritted sewage shall exit the Grit chambers over the outlet weir. Liquid streams from grit washers and classifiers shall be returned to the de-gritted sewage stream. Any FOG skimmings

removed shall be routed to the sludge holding tanks and removed with an outlet at required and disposed off safely.

v. Equalization Tank

An equalization tank shall be provided to store and homogenize the collected septage. Lime dosing shall be provided here.

Design Considerations:

- Holding time: 5 hours
- Mixing arrangement: Submersible mixers
- Dosing arrangement: Lime dosing system

vi. Sludge sump and pump house

The homogenized septage shall be pumped through screw pumps to the centrifuge for further treatment. There shall be a sludge sump for this. The sump may be equipped with Agitator assembly to facilitate mixing of sludge content.

vii. Dewatering Machine (Centrifuge)

The pre-treated septage is dewatered mechanically using the sludge dewatering system. The Decanting Centrifuge considered, for sludge dewatering system, comprises of the rotating bowl, consisting of a feed pipe, a cylindrical section where the separation of the suspension takes place and a conical section where the scroll removes the dewatered sludge, the housing enclosing the rotor, the base frame bearing rotor and housing, and the bowl and scroll drive systems. The sludge is dewatered by the continuous separation of a solid-liquid suspension in which the specific gravity of the liquid is less than the specific gravity of the solid. This is accomplished using bowl speeds and scroll differential speeds.

Design Parameters for Centrifuge:

Capacity :	8 m ³ /hr
Inlet Solid Concentration :	1-3%w/w (TSS Only)
Solids in cake :	upto 20%w/w depending on inlet solid concentration
Recovery :	90-95%w/w with poly dosing
Poly dosing :	1.5-2.5kg/ ton of dry solids at concentration of 0.1%w/w

viii. Centrate Collection Tank

The centrate produced from sludge dewatering shall be collected in this tank. The holding time should be sufficient enough to handle the intermittent flow being released from the centrifuge. From this tank, the centrate would be supplied for 20 hours (say) to the package treatment plant for further treatment.

ix. Package Treatment Plant for Centrate

The filtrate from the septage treatment will be malodorous, containing sizable portion of dissolved organic content and pathogenic organisms and hence, shall be treated before its final, safe disposal. It shall be done through packaged treatment plants using suitable technology like MBBR (owing to lesser land requirement).

The design of this package treatment plant is left open for Bidders to meet the specified plant effluent quality (BOD: SS as 10:10 mg/l). For the purpose of DPR, a package treatment plant with MBBR (2-stage) followed by ACF, PSF and UF was considered.

In order to ensure safe reuse / disposal, chlorination of treated effluent is mandatory. Simple chlorination equipment like Electro Chlorinators can be used for this purpose.

x. Lime Dosing System

Lime dosing arrangement shall be considered for the Equalization Tank.

xi. Polyelectrolyte Dosing System

To enhance the dewatering process, poly electrolyte will be dosed online at the centrifuge inlet. The strength of the dosing solution shall be 0.1%. There shall be minimum 2 no. of P.E. solution dosing tank, each designed for minimum 8 hrs/day operations.

Each P.E. solution dosing tank shall be equipped with slow speed mixer (100 RPM) to prepare Poly electrolyte solution. The solution will be fed using 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.

xii. Effluent Reuse / Disposal

The post chlorinated effluent shall be collected in the treated water tank. Thereafter, it should be reused within the premises for horticulture and other washing purposes; used for recirculation to the inlet units, if required; excess should be conveyed to the disposal point through disposal pipe of 200mm dia pipe. The ultimate disposal point shall be into river Garga.

The details of the pipe considered for disposal of treated water is as below:

Specification	Length	Unit
Length of pipe	100	meter
Dia of pipe	200	Mm
Sand Bedding	150	Mm
Depth	1000	Mm

Disposal / Reuse of treated effluent and sludge:

The selected treatment technology shall be able to produce the high-quality effluent, suitable for reuse applications and for surface water discharge applications. The purpose of these processes is water conservation and sustainability, rather than discharging the treated water to surface waters such as rivers. Reusing water for beneficial use involves using treated wastewater effluent in place of or to supplement non-drinking water requirements. Since the quantity of this high quality treated filtrate from the MBBR plant is not significant in this case, it can be reused for various purposes within the SeTP premises such as:

- toilet flushing,
- fish culture,
- gardening,
- sustainable landscape irrigation,
- washing of vehicles
- road washing,
- horticulture

Table below gives the recommended norms of treated sewage quality for using it for the specified activities. In this case, the treated water can be safely used for all the above listed applications.

Recommended norms of treated sewage quality for specified activities at point of use

	Parameter	Toilet flushing	Fire protection	Vehicle Exterior washing	Non-contact impoundments	Landscaping, Horticulture & Agriculture			
						Horticulture, Golf course	Non edible crops	crops	
								Crops which are eaten	
							raw	cooked	
1	Turbidity (NTU)	<2	<2	<2	<2	< 2	AA	< 2	AA
2	SS	nil	nil	nil	nil	nil	30	nil	30
3	TDS	2100							
4	pH	6.5 to 8.3							
5	Temperature °C	Ambient							
6	Oil & Grease	10	nil	nil	nil	10	10	nil	Nil
7	Minimum Residual Chlorine	1	1	1	0.5	1	nil	nil	nil
8	Total Kjeldahl Nitrogen as N	10	10	10	10	10	10	10	10
9	BOD	10	10	10	10	10	20	10	20
10	COD	AA	AA	AA	AA	AA	30	AA	30
11	Dissolved Phosphorous as P	1	1	1	1	2	5	2	5
12	Nitrate Nitrogen as N	10	10	10	5	10	10	10	10
13	Faecal Coliform in 100 ml	Nil	Nil	Nil	Nil	Nil	230	Nil	230
14	Helminthic Eggs / litre	AA	AA	AA	AA	AA	<1	<1	<1
15	Colour	Colourless	Colourless	Colourless	Colourless	Colourless	AA	Colourless	Colourless
16	Odour	Aseptic which means not septic and no foul odour							

All units in mg/l unless specified; AA-as arising when other parameters are satisfied;
A tolerance of plus 5% is allowable when yearly average values are considered.

Source: CPHEEO, 2013

xiii. Sludge Disposal

Dewatered septage/sludge can be used as fertilizer in agriculture application

Composting is the stabilization of organic waste through aerobic biological decomposition. The humus is produced after composting that can be used as a soil conditioner. The process can be accomplished in various configurations. The different types of composting include two open-area methods: windrow and static pile composting and in-vessel mechanical composting. Compost products can be sold or given away. Operational parameters for septage composting are presented in **Table** below.

Operational parameters for dewatered septage composting

Parameter	Optimum range	Control mechanisms
Moisture content of compost mixture	40-60%	Dewatering of septage to 10 to 20% solids followed by addition of bulking material (amendments such as sawdust and woodchips), 3:1 by volume amendment: dewatered septage.
Oxygen	5-15%	Periodic turning (windrow), forced aeration (static pile), mechanical agitation with compressed air (mechanical).
Temperature (compost must reach)	55-65°C	Natural result of biological activity in piles. Too much aeration will reduce temperature.
pH	5-8	Septage is generally within this pH range, adjustments not normally necessary.
Carbon/nitrogen ratio	20:1 to 30:1	Addition of bulking material.

Excess Sludge shall be disposed off by the Contractor by transporting to designated landfill site.

10. Other infrastructure facilities

i. Internal Roads, Drainage, Parking Lot, etc.

Internal roads, pathways, culverts as required, storm water drainage, sewerage, water supply and wastewater disposal shall be provided as per civil works specification. Two days of storage of the total water requirement for the plant and service water shall be provided along with pumping and all allied facilities.

An underground RCC tank and service water pump house shall be provided. All necessary electrical, mechanical equipment along with piping, fittings and valves etc., shall be installed. An overhead tank shall be provided along with necessary piping to individual units.

The storm water drain shall finally discharge into the river through existing nallah.

Two lane roads of carriage way of minimum 3.5 m shall be provided to facilitate the transportation and approach to the process units and buildings.

ii. Administrative Building, Laboratory, Staff Quarters, etc.

An administration building, a laboratory, a maintenance workshop, a storage facility and other miscellaneous buildings and related equipment and furnishings shall be provided as needed for a fully functional facility and as described elsewhere in the bid documents.

Administration building shall be two- storeyed and shall house the Laboratory.

Staff Quarters of single storey type shall be constructed within the premises as per standard practice.

11. Design/Sizing Criteria and Other Requirements

Item/ Parameter/ Description	Units	SeTP at Chas, Jharkhand
Avg design Capacity	kLD	89
Influent Septage Flow		
Maximum daily peaking factor (PF)		3.00 upto Equalization Tank (Based on 8 working hours of septage collection per day)
Inlet Chamber		
Min No of Units		1
Type		Rectangular or tapered
MOC		RCC
Sizing Criteria		Should be able to empty two trucks at a time (e.g. for 4 cum capacity vacuum truck, the volume of this chamber should be 8 cum minimum)
Min Freeboard	m	0.50
Coarse Screen Channels		
Screen type		Coarse bar screen with mechanical cleaning
Min No of Units – Working (Peak flow)		1
Min No of Units – Standby (Peak flow)		1
MOC – Channel		RCC
MOC – Screens		SS 316 L
Fine Screen Channels		
Screen type		Bar screen with mechanical cleaning
Min No of Units – Working (Peak flow)		1
Min No of Units – Standby (Peak flow)		1
MOC – Channel		RCC

Item/ Parameter/ Description	Units	SeTP at Chas, Jharkhand
MOC – Screens (all screen components)		SS 316 L
Grit Chambers		
Type		Detritor with center drive, full diameter scraper
Min No of Units – Working (Peak flow)		1
Min No of Units – Standby (Peak flow)		1
MOC – Structure		RCC
MOC – Equipment/Mechanism		MS – Epoxy coated
Grit Washer and Classifier		
Type		Integral inclined trough with chain-and-flight rake/ Screw classifiers
Centrate Collection Tank		
Min No of Units		1
MOC		RCC
Max SWD	m	1.5
Min freeboard	m	0.50
Equalization Tank		
Holding Time	hrs	5
Min. no. of mixers per basin – Working		1
Mixer type		Submersible/ (Open to Bidder)
Lime Dosing Arrangement		Required
Process Air Blowers (As per requirement)		
Blower type		Rotary lobe Positive Displacement with VFD control
No of blowers – Working		Working plus 50% standby.
Process Air Diffusers (As per requirement)		
Diffuser type		Disc / Fine bubble tubular retrievable
Diffuser material		EPDM or silicone elastomer with anti-microbial coating
Max air flow per diffuser	Nm ³ /hr	6
Dewatering Feed Pumps		
Centrifuge operation schedule	hrs/day	8
Min no of pumps – Working		1
Min no of Pumps – Standby		1
Type of Pump		Progressing Cavity
Min. pump efficiency within flow-head operating envelope (η)	%	35.0
Min. motor Efficiency (V_e)	%	95.0
Sludge Sump and Pump House (Dewatering Feed Pumping Station)		

Item/ Parameter/ Description	Units	SeTP at Chas, Jharkhand
Min no of units		1
MOC – Roof, columns, beams		RCC
MOC – Side walls		230 mm thick brick masonry
Dewatering units		
Min no of units – Working		1
Min no of units – Standby		1
Type of Centrifuge		Solid Bowl
Max input TSS	% w/w	1.0-3.0%
Min dewatered sludge (DWSL) TSS required	% w/w	20%
Min solids capture required	%	90%
Maximum dewatering duration per unit	Hrs/week	50
Polymer System		
Type		Dry polymer with batch tanks
Minimum polymer dose	kg/ton dry solids	1.5 – 2.5
<u>Dry Polymer Storage</u>		
Type		Covered bin
MOC		GRP
Minimum storage period	days	30
Storage safety factor		1.50
Min no of storage bins		1
<u>Dry Polymer Feeder</u>		
Type		Gravimetric or volumetric "atomizing" eductor
Min no of units		1
Batching period	days/batch	1
Operating time	min/batch	30
Min capacity per feeder	kg/min	2.47
<u>Polymer Batch Tanks</u>		
MOC		GRP/RCC
Poly solution strength	% w/w	0.1%
Solution storage volume safety factor		1.50
Min no of tanks - Working	tanks/batch	1
Min no of tanks - Standby	tanks/batch	1
Minimum capacity per tank	cum	2
<u>Polymer Batch Tank Mixers</u>		
Min no of mixers per tank		1
MOC - Impeller and shaft		SS316
Type		Turbine
<u>Polymer Metering Pumps</u>		

Item/ Parameter/ Description	Units	SeTP at Chas, Jharkhand
Type of Pump		Hydraulic double diaphragm
Min no of pumps - Working		1
Min no of pumps - Standby		1

PART 9

TESTING, ERECTION, COMMISSIONING AND ACCEPTANCE

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General:

This part deals with specifications for - Erection, testing, re-commissioning, commissioning and acceptance.

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, otherwise have them calibrated at his own expense by an independent authority.

1.2 Test Certificate:

Copies of certificates of all works hydraulic 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 times, certifying that they have been satisfactorily tested and giving full particulars of such tests.

1.3 Hydraulic Test:

All equipment subject to water/wastewater pressure including casting, pressure vessels, pumps, pipes, fittings, and valves, shall be hydraulically tested to the pressure specified or in accordance with the applicable standard or to at least 1.5 times the maximum working pressure, whichever shall be the greater. Hydraulic test shall be given at the manufacturer's works. Any of the hydraulically tested items shall be subject to the Engineer's / inspector's random item proof re-test and notice of testing dates shall be submitted to the engineer. Unless otherwise specified, hydraulic tests to 1.5 times the maximum working pressure shall also be applied at site to all pipework installed by the contractor.

1.4 Manufacturer's works inspection tests and guarantees:

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 30 days' notice when such equipment or material is ready for inspection of works test.

Full witness testing to the relevant standards and to prove guarantees given will be required for the following items:

- a) All pumps
- b) Electric motors

- c) All control panels
- d) iv. All circuit breakers
- e) All transformers;
- f) All lifting equipment
- g) Cables
- h) All process control and indicating instruments
- i) All electrical measuring instruments and meters
- j) Flow measuring equipment and gauges.

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, manufacturers 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 test.

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 test shall proceed in his absence. These test 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 sizes and duty it may be required, at the Engineer's discretion, that a reduced number of the items be subjected to witness test; 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 performance requirements, 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.

1.5 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 test
- d) All loading weights for the load testing of all lifting equipment All test shall be carried out by the contractor to the approval of the Engineer.

The Contractor shall be responsible for coordinating the programme of site testing of all items and to ensure that all parties concerned are present during any tests to obligate their responsibilities.

Manufacturer's Works Tests

1.6 Pumping Plant:

Pumping plant shall be tested as follows:

- a) Each pump shall be tested individually in accordance with part I of BS 5316. Site conditions shall be simulated as near as possible particularly the minimum site NPSH condition.
- b) Each pump shall be tested complete with all shaft bearings, thrust bearings and directly driven auxiliaries or, where this is impracticable, the contractor shall state what allowances shall be made for losses incurred by these items, and shall demonstrate the accuracy of these allowances to the satisfaction of the Engineer.
- c) Each pump shall be tested with its own motor wherever feasible. It shall be tested particularly at the guarantee performance duty point and over its full working range where possible from its closed value condition to 30% in excess of the guaranteed quantity or minimum head. Head/quantity curves and overall efficiency/quantity curves shall be plotted to demonstrate that the plant will be capable of meeting the full range of operating conditions at site.
- d) Pump casings shall be subject to pressure test at 1.5 times the maximum pressure obtained with the delivery valve closed. The positive suction head shall be taken into account in determining this pressure.

1.7 Cranes:

All cranes lings and lifting beams shall be tested at the manufacturer's works with a load 25% in excess of the rated load. Tests shall include measurement of deflection and speed of lifting etc. The test shall be repeated at site when erection is complete using test weights to be provided under the contract. Certificates shall be provided for both tests.

1.8 Valves:

All valve bodies shall be hydraulically tested closed ended to 1.5 times the rated pressure. Isolating value sate shall be tested to the maximum working pressure, at which pressure they shall be drop tight.

The contractor shall include for all necessary tests as laid down in the specification and those required in order to comply with the relevant Indian standards as follows; a.

Power Transformers

Measurement of winding resistance

Ratio polarity and phase relationship iii. Impedance voltage

Load losses

No-Load losses and no-load current

Insulation resistance

Induced over voltage withstand

Separate source voltage withstands.

a) Type test

- 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.

b) Circuit breakers and control gear

- i. Routine tests including H.V. pressure test, mill-volt drop (Doctor) test;
- ii. To ensure operation of the closing child 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 the 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. The test figures for heat-run tests performed on identical panel types shall be made available.

c) Protection and control circuits Based 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 in injection test to ensure correct operation of the current operated protection relays and direct acting coils over their full range of setting.
- 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.

- iii. With differential 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.
 - iv. Tests on auxiliary relays e.g. Buchholz auxiliary, at normal operating voltage by operation of associated remote relays.
 - v. 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.
- d) **Motors:** Motors over 22 KW site rating shall be subject to full performance test which may be witnessed by the engineer at the motor manufacturer's works. Motors of 5.5 KW to 22KW 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 BIS/IS.
 - ii. Class of insulation
 - iii. Type of cable fittings.
 - iv. Type of bearing size and lubricant.
 - v. Type of and rating of motor heaters. Motor testing shall be carried out in accordance with the requirements of BIS.
- e) **Instruments and Meters:** Tests to ensure operation of all ammeters, voltmeters and transducers and checks for correct calibration. Kwh meter shall be changed for correct rotation and creep test shall be carried out to ensure that the meter is inoperative with voltage along, of the secondary of the current transformer is left connected with the primary Corinthian erupted.

1.9 Test 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 amour as applicable
- b. Insulation resistance test
- c. Core continuity and identification

d. Conductor resistance test.

1.10 Process Control and Indicating Instruments:

All flow, level process measurement controllers, transmitters, recorders, indicators, vacuum and pressure gauges shall be subject to routine in accordance with BIS. Test certificate shall be provided against each item of equipment.

1.11 Electrical measuring Instruments and Meters:

Test to ensure accurate operation of all meters, voltmeters and kwh. Meter shall be undertaken in accordance with IS:9319.

1.12 Alarm systems:

The contractor shall be responsible for testing all items of equipment comprising the works alarm system for correct operation and sequence action.

14 Site Tests: Leakages tests at the test pressure shall be carried out on all enacted 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.

1.13 Tests on Cables 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 event 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, labor 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 personal 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. The contractor to the satisfaction of the Engineer shall carry out all tests.

1.14 Pump 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 works test and at site trials in accordance with the procedure given in Indian standards specification etc. The 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 labor and instrumentation to conduct the tests. The discharge from the pumps shall be measured using a portable ultrasonic flow meter.

1.15 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:

- a. Power transformers: i. Dielectric tests on insulating oil to IS: 566.
- b. Circuit breakers and control gear: i. Routine tests, including H.V. pressure tests
- c. Protection and control circuits: Tests at 8.9(a), (b) (c) with the addition of satisfactory operation of all inter- tripping circuits in connection with other items of plant.

1.16 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 value: - 1. PLYSWS 11,000 volt grade cable Between cores 30,000 volts Between any cores and armour 17,500 volts 2. XLPE SWAPVC Between cores 10,000 v Between any core and armour 3,300 v 3. XLPE SWAPVC or PVC SWAPVC 1,100 volt grade mains cable Between cores 3,000 v Between any core and armour 3,000 v

Witnessed high voltage pressure tests shall not be carried out on PVC SWAPVC control cables, but it shall remain the responsibility of the contractor to test the insulation of these cables both between core and between cores and earth during installation with a 'Megger' 500-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.

1.17 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. The tests shall be made on completion of the installation. The test shall be performed for each major item of plant, by using an Earth Meager and auxiliary return conductor.

1.18 Testing pipelines:

General: Pipelines shall be tested in lengths between manholes or valve pits or such shorter lengths as the Engineer may direct or permit.

Pipelines shall be tested in the presence of the Engineer. Fittings required for temporarily closing openings in pipelines to be tested shall be properly designed for this purpose and shall be adequately strutted to withstand the test pressure specified. The arrangements for testing a pipeline shall include provision for the surging of air from the pipeline prior to a water test. The contractor shall keep a record of all tests in a book which shall be available for inspection and handed over to the Engineer on demand.

1.19 Testing pressure pipelines:

Each pressure pipeline shall be tested after completion with the exception of any backfilling not necessary for the stability and safety of the work.

Prior to the testing of a pressure pipeline valves shall be checked and sealed. The pipeline shall then be filled with water and the air released. After having been filled the pipeline shall be left under operating pressure for at least 24 hours so as to achieve conditions as stable as possible for testing.

The pressure in the pipeline shall then be raised steadily until the test pressure of 50% excess of the maximum working pressure is reached in the lower part of the pipeline and the pressure shall be maintained at this level by pumping if necessary for a period of one hour.

The pump shall then be disconnected and no further water shall be allowed to enter the pipeline for a period of one hour. At the end of this period the original test pressure shall be restored by pumping and the loss measured by drawing off water from the pipeline until the pressure as at the end of the one-hour test period is again reached.

The permissible loss for pressure pipelines under test shall not exceed 20 liters per meter nominal bore per kilometer length per bar of pressure (Calculated as the average pressure applied to the pipeline) per 24 hours.

Gauges used for testing pressure pipelines shall have a dial diameter of not less than 150 mm and a full-scale reading not greater than twice the specified test pressure. Before any gage is used the contractor shall arrange for it to be checked independently and a data certificate of its accuracy shall be provided for the Engineer.

The contractor shall make his own arrangements for the supply and disposal of water used for testing which shall be obtained from a source approved by the engineer.

1.20 Test on Instruments:

The contractor shall carry out on-site pre calibration test to demonstrate the accuracy of all level, pressure at rate of flow instruments, the transducers, buffers, displays amplifiers, recorders, integrator and transmitters incorporated in the works over a range of flow from the minimum to the maximum anticipated design range in the plant as required by the specification and that the accuracy obtained at the manufacturer's works tests can be obtained on site. The contractor shall supply sets of calibration curves of weirs, flow meters, metering pumps and the like.

1.21 Other tests:

The contractor shall carry out all other tests required either by himself and or the engineer to prove the plant, and to comply with the requirements specified.

These tests shall embrace all instrumentation, alarms, control systems and processes, all pumps, chemical metering devices, feeders, robes, gages and other components of the plant over the full range of operating conditions.

If, in the opinion of the engineer, any item of plant is irreparable or insufficient for its purpose or function the contractor shall, without delay, replace the item with another satisfactory item or better unit all at this own cost, paying if necessary, air freight charges to expedite prompt delivery.

1.22 Erections – General:

- a. The contractor's staff shall include at least one competent erection engineer with previous, suitable, privacies experience on similar contracts to supervise the erection of the works and sufficient skilled, semiskilled and unskilled labor to ensure completion of the works in time. The contractor shall not remove any representative, erector or skilled labor from the site without the prior approval of the Engineer's Representative.
- b. One erection engineer who shall be deemed to be the contractor's representative shall be conversant with the erection and commissioning of the complete works. Should there be more than one erector, one shall be in charge and contractor shall inform the Engineer's Representative in writing which erector is designated as his representative and he is in charge. Erection engineer is to report to Project manager.
- c. The contractor's erection staff shall arrive on the site on date to be agreed by the engineer's Representative before the proceed to the site, however, the contractor shall first satisfy himself, as necessary, that sufficient plant of his (or his subcontractor's) supply has arrived on site so that there will be no delay on this account.
- d. The contractor shall be responsible for setting up and erecting the plant to the line and Levels of reference given by the engineer in writing, and for the correctness (subject as above mentioned) of the positions, levels dimensions and alignment of all parts of the works and for provision of all necessary instruments, appliances and labor in connection therewith. The checking of setting out of any line or level by the engineer or engineer's representative shall not in any way relive the contractor of his responsibility for the correctness thereof.
- e. Erection of plant shall be phased in such a manner to as not to obstruct the work being done by other contractors or operating staff who may be present at the time. Before commencing any erection works the contractor shall check the dimension of structures where the various items of plant are to be installed and shall bring any deviations from the required positions, lines or dimensions to the notice of the Engineer. Plant shall be erected in a neat and workmanlike manner on the foundations and at the locations shown on the approved drawings. Unless otherwise directed by the Engineer, the contractor shall adhere strictly to the aforesaid approved drawings. If any damage is caused by the contractor during the course of erection to new or existing plant or buildings or any part thereof, the contractor shall, at no additional cost to the employer, make good, repair or replace the damage, promptly and effectively as directed by the Engineer and to the engineer's satisfaction.

- f. During erection of the Plant the Engineer will inspect the installation from time to time in the presence of the contractor's site representative to establish conformity with the requirements of the Specification. Any deviation and deficiencies found or evidence or unsatisfactory workmanship shall be corrected as instructed by the Engineer.

1.23 Leveling and grouting of Machinery:

- a) Contractor shall check the civil works, where the plant is to be installed sufficiently in advance. For their conformity to the approved drawings for installing the plant with respect to lines, levels and accuracies of position embedment, anchorage pockets, cutouts etc. and he shall record all measurements and deviation in prescribed control formats. He shall proceed with the works, with the Engineer's approval of civil works for undertaking of installation of the plant consequent to such preparatory inspection or work.
- b) Contractor shall mark precisely the centerline and datum reference on the civil works. Where the plant is to be installed with reference to bench marks, using indelible means of marking.
- c) He shall undertake sufficiently in advance chipping of any unevenness of concrete on foundations, anchor bolt pockets, cutouts etc. to achieve uniform level of reference for erection.
- d) All concrete surfaces receiving grout shall be hacked at 35 required to ensure better bonding with grouting.
- e) Contractor shall undertake the inspection of all components to be erected sufficiently in advance to check their soundness and conformity to drawings and the inspection records shall be signed by the engineer as approval for undertaking the installation of the components. Any damage, shortfalls etc shall be made good to the satisfaction of the engineer.
- f) All grout for equipment shall be carried out using non-shrinkable continuous grout materials with suitable formwork of at least 12 mm thickness. Surfaces to receive the grout are hacked and roughened and laitance shall be removed by wire brushing or blast of air. Concrete surface shall be blown off by compressed air before commencing grouting. Grouting shall be done in one continuous operation from one side such that grout flows in a single way until grout reaches all confined spaces with no air pockets and air from all confined spaces is expelled. A hydrostatic head of 150 mm shall be maintained during grouting operations. All grouting shall be carried out in the presence of the Engineer's Representative. All manufacturers' recommendations. All lines levels shall be checked up after grout is set, block outs shall be closed using cement concrete of the same grade as that of the parent structure.

1.24 Completion of Erection:

- a) The completion of plant under erection by the contractor shall be deemed to occur, if all the units of the plant are structurally and electro-mechanically complete and will include amount other such responsibilities the following:
 - i. Plant in the scope of the contractor has been erected, installed and grouped as per specification.
 - ii. Installation checks are completed and approved by the engineer.
 - iii. The erected plants are totally ready for commissioning checks.

- b) At the stage of completion of reaction, the contractor shall ensure that all the physical, aesthetic and workmanship aspects are totally complete and the plant is fit and sound to underage commissioning check/test on completion.

PART 10

TRIAL RUN OF SEPTAGE FACILITY

Contents

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GENERAL

On completion of the construction of SeTP, trial operation and commissioning of all the components of the project, the same shall be taken over by the employer and the same shall be handed over back to the Contractor, for Trial Operation for a period of one month. The cost of operation during the trial run shall be borne by the client.

The following measures are to be taken essentially by the contractor Necessary maintenance crew with supervisory staff shall be deployed as specified. The entire strength of maintenance crew with the supervisory personnel should be available from the first day of the Trial run period. The staff to be deployed shall be adequately qualified for the performance of the job and trained in operation of electrical equipment, pumps, etc. and also capable of identifying and managing trouble shooting of faults and attend minor repairs.

The contractor should keep all spares required for replacements at the pumping stations, pumping main, Septage treatment plant, etc. as recommended by the respective manufactures readily available to ensure proper functioning of the Septage system.

All the equipment that go out of order during the course of the Trial run period shall be rectified/ replaced within a week's time or such longer time as approved by the employer, to ensure uninterrupted operation of me plant. The contractor is responsible for the incidence of any theft; malpractice etc. within the project area during the Trial run period and the contractor shall keep the Employer indemnified.

On completion of Trial run period of 3 months, the contractor shall hand over to the employer in good working condition all the components of the project taken over by him as mentioned in para 1 above.

One set of as laid plans of all the components of the project - Architectural, mechanical, instrumentation, piping drawings, sections details charts etc., with modifications as carried out (with the approval of employer) shall be supplied. Operating and maintenance manuals supplied by manufacturer and Step by step procedures for all operation requirements and adjustments required shall be given.

The contractor shall carry out the works observing all safety precautions. The owner shall be indemnified for any accidents that may occur at the site. The contractor shall follow all the rules and regulations of statutory authorities Government agencies etc. The owner shall be indemnified against any failure. The contractor shall take necessary insurances for the properly and labour etc., The owner shall be indemnified against any failure. The contractor shall pay all the fines, penalties etc., imposed by various agencies for non-performance / non adherence to rules in connection with his work. The owner shall be indemnified.

1.1 ENERGY CONSUMPTION:

The electrical energy consumed for the operation of the building, street lights, pump sets and other pumping station accessories shall be borne by the contractor direct to the local electricity board.

The Contractor shall ensure strict economy in electricity usage for lighting and as well as for pumping sewage by using high duty pumps only when the rate of flow to the pumping station cannot be handled satisfactorily by low duty pumps. All level controls shall be maintained in operating condition always.

Any diversion of electricity from the Septage project installations for unauthorized purpose will invite penal action as directed by the Engineer.

In the pumping stations where the HT supply has been availed, maximum demand in KVA is to be controlled. The operator should ensure that the maximum demand in KVA does not shoot up in any case than the contractual maximum. Demand, since any excess over the contractual maximum demand invites double the cost per KVA to be paid to **Local Electricity Board**. The maximum demand shall be fixed with reasonable margin by the Employer. The contractor shall train persons in all aspects and post suitable persons. In case of any excess over the fixed KVA as in the electric consumption statement for the maximum point of full designed capacity appended the excess amount to be paid to Local Electricity Board has to be borne by the contractor.

The power factor should be maintained at 0.95 and pump sets shall operate at the efficiency specified by the manufacturer. Any excess consumption of electricity for not adhering to be above, the contractor has to bear the cost. The low power factor compensation charges levied by the **Local Electricity Board** has to be borne by the contractor. Diesel oil required for operation of pumping plants shall be paid for by the Client.

1.1.1 Energy Consumption

The electrical energy consumed for the operation of the pump sets and other pumping station accessories shall be borne by the Client direct to the **Local Electricity Board**.

Though the cost of electricity to be borne by the Contractor, he shall ensure strict economy in electricity usage for lighting and as well as for pumping sewage by using high duty pumps only when the rate of flow to the pumping station cannot be handled satisfactorily by low duty pumps. All level controls shall be maintained in operating condition always.

Any diversion of electricity from the Septage project installations for unauthorized purpose will invite penal action as directed by the Engineer and Local Electricity Board as support from client shall be provided specially for SeTP purpose.

In the pumping stations where the HT supply has been availed, maximum demand in KVA is to be controlled. The operator should ensure that the maximum demand in KVA does not shoot up in any case than the contractual maximum demand, since any excess over the contractual maximum demand invites double the cost per KVA to be paid to local electricity board. The maximum demand shall be fixed with reasonable margin by the contractor in discussion with Employer. The contractor shall train persons in all aspects and post suitable persons. In case of any excess over the fixed KVA as in the electric consumption statement for the maximum point of full designed capacity appended the excess amount to be paid to **Local Electricity Board** has to be borne by the contractor.

The power factor should be maintained at 0.95 and pump sets shall operate at the efficiency specified by the manufacturer. Any excess consumption of electricity for not adhering to be above, the contractor has to bear the cost. The low power factor compensation charge levied by

the local electricity has to be borne by the contractor. Diesel oil required for operation of pumping plants shall be borne by contractor.

1.1.2 SAFETY PRECAUTIONS

Traffic Control

- a. Place easily readable and clear warning signs well ahead of work area.
- b. Barricade the space around the manhole / ditches for placing equipment and deposition of silt removed.
- c. Place barricades or signs to channelize the traffic, if possible.
- d. Use a flagman at the two ends for controlling flow of traffic from each, direction and to avoid a traffic jam, if the road is narrow and only one lane of traffic is possible.

Safety Equipment

The various safety equipment that are normally required in sewer maintenance work are gas masks, oxygen breathing apparatus, portable lighting equipment, non-sparking tools, portable air blowers, safety belts, inhalators and diver's suit.

The use of the particular safety equipment is governed by the detection of various gases and oxygen deficiency. Acknowledge of the type of gases, in the atmosphere and of the working location becomes essential for the selection of the right type of safety equipment. Simple tests for detection of various gases and oxygen deficiency should be furnished to the workmen.

(a) Gas Masks

General purpose gas masks are used for respiratory protection from low and moderately high concentrations of all types of toxic gases and vapors present in the atmosphere, in which there is sufficient oxygen to support life.

Persons using gas masks should practice regularly with them in order to become proficient in putting them on quickly and breathing through them.

Gas masks cannot be used in Oxygen deficient atmosphere, in unventilated locations or areas where large concentrations of poisonous gases exist.

(b) Breathing Apparatus

This is designed for respiratory protection from atmosphere that contains very high concentrations of toxic gases and vapors or **oxygen** deficient in oxygen.

(c) Air Hose Respirator

This is used where a source of fresh air is available within a distance of 50 m from working location. It is essential that the supply of air is obtained from an uncontaminated source. purified air is used where a source of fresh air is not available within 50 m to permit the use of an air hose respirator or in situations where an air hose would encumber the worker.

(d) Portable Lighting Equipment

The equipment normally used are portable electric hand lamps of either 24 V or 110 V grade or

permissible types, electrical cap lamps and explosion proof flash lights.

(e) No sparking Lighting Equipment

These are made of an alloy (containing at least 80 percent of copper) that will not spark when struck against other objects and metals and yet retains the necessary strength and resistance to wear.

(f) Portable Air Blowers

Forced ventilation of manholes, pits and tanks can be provided by portable air blowers. Special precautions should be taken to ensure that the blowers do not serve as a source of ignition for inflammable gases.

(g) Safety Belt

This consists of a body belt with a bucket and a shoulder harness. The life line is of high grade spliced manila rope, nylon rope or a steel cable anchored with rings on each side of the belt and provided with safety straps for anchoring or securing to a stable support. The life line should be about 15 m in length and the overall assembly should be capable of withstanding a tensile load of 2000 kg. The safety belt and the life line should be tested by lifting the wearer clear of ground before each day's use.

(h) Inhalators

Approved inhalators employing a mixture of oxygen and carbon dioxide are used for resuscitating victims of gas collapse, drowning or electric shock.

(i) Diver's Suit

A good quality diver suit should be provided to the diver whose services are very necessary while plugging the sewer line/chamber of treatment facility or removal of some hard blockage at the mouth of the pipe in the manholes/units of SeTP. Depending upon the site condition, suit should have provision to connect an air line with compressor or oxygen cylinder.

Precautions against Electrical Shocks

- a. Only qualified and specially trained personnel should be allowed to operate and maintain electrical equipment.
- b. All electrical controls should be kept dry and in good condition.
- c. No metal ladders or metal tapes should be used around electrical equipment.
- d. Insulated rubber mats should be provided before all electrical control panels and they should be kept dry.
- e. Always test wires for current before working on any electrical item. Use tools with insulated handles and rubber gloves.
- f. All precautions to be taken as per statutory regulations are to be adhered to.

II. Septage Treatment Plant

- a. Where chemicals are used, the required precautions as prescribed during storage and handling of chemicals are to be taken.

- b. Safety measure like using of safety helmets, safety belts, gum boots safety slices, goggles, gloves, etc. are to be ensured depending on the operations performed.
- c. All safety precautions connected with work on electrical and mechanical installations to be followed.

1.1.3 RECORDS TO BE MAINTAINED BY CONTRACTOR:

The following records are to be maintained by the Contractor during trial run. The formats for the records are to be approved by the Engineer/employer.

1. Pumping Main

- Details of Installation
- Record of Inspection - leaks noticed, bursts and action taken

1.2 INSURANCE:

The contractor shall without limiting his or the employer obligation and responsibilities insure the works together with materials and plant for incorporation therein to the full replacement cost (term cost in this context shall include profit).

The contractor's Equipment and other things brought on to the site by the contractor for a sum sufficient to provide for their replacement at the site.

The firm/contractor shall provide risk insurance at their/his cost against loss or damages to the construction and to their workmen to cover from the start date to the end of the Defects liability period, for the following events.

- Personal injury or death
- Loss of or damage to the works, plant, material
- Loss of or damage to Equipment
- Loss of or damage of property (except the works, plant, materials, and equipment) in Connection with the contract policies and certificates for insurance shall be delivered by the contractor to the Engineer for the Engineer's approval before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

The contractor will not be eligible for any payment on this account. If the contractor does not provide any of the policies and certificates required, the Employer shall effect the insurance which the contractor should have provided and recover the premiums the Employer has paid from payments otherwise due to the contractor or, if no payment is due, the payments of premiums shall be a debt due.

Alterations to the terms of insurance shall not be made without the approval of the Engineer.

PART 11

OPERATION AND MAINTENANCE REQUIREMENTS

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General

Septage Management System i.e. Collection of septage from household to its treatment at Septage Treatment Plant (SeTP) and further to disposal of treated effluents shall be operated & maintained by contractor for a period of 10 years (120 months) post defect liability period. While activities involved in the operation & maintenance of works are given in subsequent paragraphs, it would be the duty of the Contractor to maintain the Plant to keep the grassy lawns & flower beds in the plant area in tip top condition & general upkeep of the balance area. Contractor has to ensure proper functioning and management of the overall system. The broad level task shall be as mentioned below but not limited to:

1. Collection of septage from household at planned interval of once in 2 years.
2. Collection of user charges as per prevailing rates. Refer detailed description of the same in clause 1.32 of this section.
3. While Collecting septage from household, contractor has to ensure that septic tanks shall not be physically damaged and no littering on roads while travelling to SeTP. If damaged, Septic Tanks shall be restored to its original positions by contractor.
4. Check the functioning of vacuum emptier and equipment
5. Check personal protective equipment – All employees should be responsible for maintaining their own personal protective equipment (such as gloves, boots, hat, face mask, Davy's lamp) in good condition
6. Check disinfecting and spill control equipment – Operators should be trained on identifying spills and proper methods of disinfecting. Sprinkle lime over spilled area, wait 15 minutes, then wash with water
7. Check Hoses – inspect hoses for cracks and wear– discard or repair worn and broken hoses. Connecting the Hose in the correct manner using the clamp style fitting ensures a tight and leak proof connection. Use of twine and plastic for making connections causes leaks and require cleanup.
8. Treatment of collected septage to the dedicated SeTP.
9. Final disposal of treated septage sludge and reuse/ disposal of treated effluent as per the tender requirements.
10. Depositing of collected user charges into Escrow Account.
11. During Operation & Maintenance, the Contractor is to ensure that the effluent to SeTP, shall not exceed the estimated quantity of Septage per day.
12. Operating the Plant at the design capacity maintaining the output quality in accordance with CPCB norms.
13. Keeping the down time of any equipment as low as possible and should be in compliance with Clause no. 1.2 (c) of this section of tender document.
14. Operating and Maintaining all the Plant, Equipment and Tools and making necessary repairs to civil structure and electro-mechanical part during the period of 10 years.
15. Technical and administrative monitoring of the Plant. Also, all necessary documents/records shall be maintained and properly stored.

16. The Laboratory for maintaining the overall performance of the Plant & those of any individual Units shall also be maintained & staffed by the Contractor. He will be responsible for daily monitoring of the Plant. Contractor shall maintain necessary records regarding quality at various stages of treatment.
17. General Tests such as BOD, COD, Suspended Solids etc. both for influent & effluent will have to be monitored on daily basis while any other test such as VSS, TSS, MLSS, MLVSS etc. may also be required to be done routinely. Contractor will be responsible for Manpower, Chemical Consumption & replacement of any broken Glassware.
18. Bonafide Electricity/ Diesel charges as per the meter reading of the Plant, Street Lighting, Plant Lighting and Laboratory Consumption will be paid by the contractor. Use of electricity by the Contractor for any purpose other than that elaborated above is prohibited and detection of any such case will attract action from client. The SeTP shall be maintained by following the specifications and directions given in Manual for Sewerage and Sewage Treatment published by CPHEEO, New Delhi.
19. Minimum staff which the Contractor will have to deploy for proper operation and maintenance & upkeep of the collection system and plant shall be as per this tender document.

1.1 Introduction

Maintenance comprises those operations which are well planned systematic programme of maintaining the Machinery and equipments by taking appropriate steps to prevent breakdown well in advance before it causes major damage. This prevents wastage of time, production loss and prolongs the life of Machine. This maintains better efficiency in the system and economizes the running cost of the Plant. It can be classified as:

- (a) Preventive Maintenance which constitutes works and precautions to be taken to prevent breakdown and
- (b) Corrective Maintenance which involves carrying out repairs after breakdown.

Preventive maintenance is more economical than corrective maintenance and provides uninterrupted service which is essential to achieve the basic objectives of collection and treatment viz. protection of health of the community and prevention of nuisance.

The primary aim is the running and maintenance of the collection system and Plant efficiently and economically so that the effluent from the Plant meets the prescribed standards in terms of pH/BOD/COD/TSS etc. laid down while discharging the treated septage safely in public sewer, on land, in the water body or for recycling.

The basic requirements of successful operation and maintenance of collection system and SeTP are:

- Collection of Septage from households without damaging Septic tank using vacuum suction machine and carrying it to SeTP.
- Cleansing of septic tanks as plan and transport septage to the SeTP for treatment.

- A thorough knowledge of Vacuum Suction Machine, Treatment Plant, Machinery and Equipments provided in the Septage Treatment Plant and their functions.
- Maintain proper fencing with entry gate to the facility. All incoming and outgoing details shall be maintained.
- A thorough knowledge of the processes.
- Proper and adequate tools.
- Adequate stock of Spares and Chemicals.
- Assignment of specific maintenance responsibilities to operating staff.
- Systematic and periodic inspection and strict adherence to servicing schedules.
- Training of all operating Staff in proper Operating Procedures and Maintenance Practices.
- Overall supervision of Operation & Maintenance Schedules for vehicles and units of SeTP.
- Good housekeeping.
- Proper logging of all Operation & Maintenance activities for technical and financial aspects i.e. maintain a ledger for revenue generation and expenditure receipt.
- Observation of safety precautions & procedures.
- Provision for water supply for drinking and other uses.

The various Units of the Plant are designed for maximum efficiency within a certain flow range and input effluent quality. Close control and co-ordination of operation of different Units are therefore, required within the limits of design so as to achieve maximum efficiency. Hence, accurate measurements of flow of raw septage, treated effluent and sludge are required. For this purpose, Flow Measuring Devices and Meters are provided to guide the Operator in his supervision and obtain data for progressive improvement. For quality control, analysis of raw effluent, sludge, digested sludge etc. as they pass through different Units of the Treatment Plant and of the treated effluent should be carried out on a regular basis. Proper recording of data is essential for an accurate assessment of deficiency of operation. On the chemical side, dosages must be closely and accurately proportioned to the varying rates of flow of influent and sludge based on analysis.

Better operation is possible only when the Septage Collection, Operating, Maintenance and Laboratory Staff is fully conversant with the characteristics and composition of raw effluent handled and the results achieved during each State or Unit of the treatment process.

Operation and Preventive Maintenance of collection vehicle and several treatment units and the frequency of cleaning, lubrication of mechanical equipments etc. are to be strictly adhered to if optimum results are to be expected.

1.2 Operation & Maintenance Services

The Operation and Maintenance Services shall be made according to the following specifications.

a) Collection of Septage from Households

Contractor shall deploy trained staffs for collection of Septage and clean the septic tanks as per Cleansing/collection plan of Septic tank for households based on Frequency and Routing. Households shall be informed well in advance to household owners regarding septage collection to avoid/hurdles in the collection.

Proper receipts for work done and collection of user charges shall be provided to household owner and properly documented in the records.

b) Resolution of complaints

Contractor shall act upon the complaints received at the earliest and resolve. There should be proper record of consumer complaint and its corrective action taken by the Contractor. After resolution of complaint, the counter signed copy by complainant should be duly preserved. The consumer complaint redressal system has been detailed in Clause 1.30 of this section.

c) Maximum Downtime

The Plant shall never be operated at less than 50% of its design capacity due to maintenance and repair reasons. The period of 50% operation shall not exceed more than two consecutive days and not more than three days in a week. The maximum downtime to the whole Plant shall not exceed more than 8 continuous hours. The periods for repairs and maintenance have to be communicated to ULB at least one month in advance.

d) Operation of the Plant

The Plant shall be operated according to the rules and procedures laid down in the Operation & Maintenance Manual as required according to the required raw septage characteristics of the SeTP. The Plant must be in a position to work at the design and overload capacity at any time and to produce the design / overload output.

e) Carefulness and Cleaning

The Contractor and his staff have to ensure a maximum of carefulness in the operation and maintenance of the Plant. At any time, the Plant and its equipment and surroundings have to be kept clean and proper.

f) Preventive maintenance frequency

The preventive maintenance will be made according to the Preventive Maintenance Schedule of the Plant. Short term specialists of the Contractor for special Maintenance tasks may reinforce the regular staff. The operation, maintenance and repair shall be made with the help of the equipment and tools available at the Plant, backed-up and completed with

the facilities of the Contractor at his HQs or brought to the Plant by him temporarily for a special maintenance

e) Repairs

Repairs shall be made as and when needed on the spot or at the Contractor's Workshop has to be defined in co-ordination with the ULB and according to the status of the spare parts availability.

f) Spare Parts

The Contractor has to keep reasonable stock of Spare Parts so that the downtime of equipment can be kept in the limits. The content of the stock has to be approved by ULB.

g) Transportation

All necessary transports shall be arranged and made by the Contractor at his own costs.

1.3 Buildings

Building should be well ventilated and illuminated. They should be maintained and kept in good repair, white or colour washed metallic parts being painted annually. The effect of corrosive gases could be minimized by proper ventilation, proper collection and disposal of corrosive gases and painting the structures which are prone to be attacked by the gas, with anticorrosive paints. Dampness inside buildings could be reduced by proper ventilation. Wherever necessary, exhaust fans and forced ventilation should be adopted.

1.4 Equipments

- The Operator should maintain a book of Catalogues supplied by the Manufacturers containing instruction sheets of all equipments. In addition, printed or written Operating and Maintenance Schedules should be displayed near each equipment in the language understood by all operating staff.
- Lubrication Schedules, Cleaning and Painting Schedules, Checks for efficiency, leaks and wear and tear and testing of Safety Devices should be followed strictly according to manufacturer's instructions.
- All Metering Devices should be maintained in proper working condition including calibration. Charts should be changed at the same hour every day. Records maintained should show total maximum and minimum rates of flow.

Operating, lubricating and maintenance instructions for all Pumps and other mechanical equipments should be strictly followed. Special attention should be given to maintaining Pumps in an efficient operating condition, free from clogging, excessive friction or entrance losses and abnormal power consumption due to wear and tear. Sludge level in the Wet Well should not be lower than the minimum designed level and all accumulation of grease and other deposits

removed promptly. Floats and sequence switches controlling the pumping cycles should be examined at the beginning of each shift. All Pumps including standby pumps should be operated in rotation so that the wear and tear is distributed evenly. All bearings, motors and electrical control equipment should be inspected daily for any over-heating. The manufactures directions for operation and lubrication should be strictly followed. Packing glands should be checked for over-tightening. When pumps may have to be operated automatically time interval between start & stop, should not be less than 5 minutes. A reversing switch shall be installed for dislodging the clogging materials. This can also be achieved by taking the backflow from the header main. Valves and piping should be regularly checked for leaks. Leaks should be attended to as per the instruction in the manufacturers catalogues. Gas masks must be used while attending to chlorine leaks. Operation records should show the volume of sewage chlorinated, rate of application of chlorine, residual chlorine in the plant effluent and the amount of chlorine consumed each day.

1.5 **Safety in the Plant**

- The work of an Operator in a SeTP presents many hazards that must be guarded against. Common type of accident is injuries from falls, deaths from drowning and asphyxiation. Narrow walks or steps over tanks (particularly in darkness, rains and wind) ladder and spiral staircases are potential danger spots where the operator should be alert; overexertion during operation of valves, moving weights and performing other arduous tasks should be avoided. All open tanks should be provided with guard rails to prevent accidental falls. Glass parts as well as moving parts should be protected by screen or guards. Adequate lighting within the plant and around the plant should be provided which gives better working facility reducing accidents on account of slipping etc. Honeycomb grating be provided on open channels to avoid accidents on account of falling down or drowning. The staff should be trained and compelled to use helmets, gumboots, hand gloves etc. Wherever necessary, precautionary boards/danger boards/sign boards should be displayed in the plant (wherever necessary), drawing attention to the potential danger spots. Gas poisoning, asphyxiation and gas explosion are other hazards. Hence smoking or carrying open flames in and around digesters should be prohibited. Covered tanks, wet wells or pits should be well ventilated. Before entering, they should be kept open for sufficient time or preferably forced ventilated as the present problems of asphyxiation. Entry into them should be permitted only after ensuring the safety by testing for the presence of hazardous gases. Gas masks should be stored in location where no possibility of contamination by gas exists and should be easily accessible. A first aid kit should be available readily at hand. Fire extinguishers of the proper type should be located at strategic points and maintained in good operating condition at all times by testing them.
- All staff should be trained in rendering first aid and operating fire extinguishing equipment. Adequate number of toilets and bathing facilities, drinking water facilities and locker should be provided for the convenience of operating staff and protection from risk of infection. canteen should be maintained hygienically.

- All workers should be compelled to observe personal, hygiene such as washing with soap after work as well as washing before taking food. The use of antiseptics along with washing should be emphasized. The employees should be medically checked after every six months especially for eye sight, hearing, indigestion, mental capability, T.B. Diabetes, heart troubles etc.

1.6 Training of Personnel

All operating staff engaged in technical and skilled work should be trained. This plant is to be headed by a plant manager who should have the necessary training with considerable experience in effluent treatment. All junior operation staff should receive in service training. It is desirable that all components of SeTP are run and maintained by operators who hold certificates of competency. The person who would be looking after the maintenance and operation of the plant should be preferably involved in the activities at the time of design, procurement and installation including inspection of equipment at manufacturer's place and their test and trials on completion of system. The operation and maintenance staff should undergo training from time to time as to keep them conversant with the operations, health, safety and environment. The staff should also be encouraged by sending them to other similar plants. They should also be provided with well-equipped library for references and also be sent for higher studies. The contractor would impart necessary training to the designated ULB staff for taking over and carrying out proper maintenance after the expiry of his contract. The training shall be imparted in a training institute as well as at the field. The total training shall not be less than 6 months.

1.6.1 Recording and Reporting

All operating records of the septage management system comprising collection of septage through vacuum suckers to various treatment units in a plant should be properly compiled on a day-to-day basis and daily, monthly and yearly reports prepared, maintained and periodically reviewed. These reports will form a valuable guide to optimise the septage collection system and better operation and serve as an important document in the event of a legal suit resulting from nuisance or danger attributed to the plant or for meeting the statutory requirements about the satisfactory performance of the plant, computers should be used for storing and compiling such voluminous information and to have easy access for prompt information when called for. This would also help in reviewing the performance of the various equipments and plant as whole.

1.7 Operations

1.7.1 Operating the Septage Collection Vehicles - Vacuum Suckers

Operators should become familiar with the proper operation of the equipment in use for each operation. This includes the physical operation of the truck, and all valves, piping, power take-

offs and ancillary equipment for the vacuum emptier (including the tank, valves, hoses, and fittings). The following steps can be followed for operating the vacuum emptier:

1. Reach the first site and meet the building owner.
2. Before pumping, check the tank to look for obvious damage to the structure and to verify proper piping is in place.
3. Check the water level to get clues as to tank condition: high levels (above outlet level) indicate a clogged outlet; low levels (below outlet level) indicate a leaking tank (or tank not in use).
4. Check for back flow into tank during pumping and when pumping is complete. Flow back may indicate a problem with plumbing in the house or clogged disposal.
5. Open the access covers, inspect the interior and exterior of the tank. If more than one, locate and remove lids from all compartments.
6. Each compartment will require pumping after ventilating. Probe the tank with the last length of hose. This will provide an indication on the volume of sludge to pump.
7. Start the pump or vacuum equipment. The operator will make sure there is suction and that the pump is operating.
8. Volume in the tank should start decreasing rapidly. Use hose to break up sludge and scum to the extent possible.
9. After pumping is complete, check the tank for remaining sludge. If there are accumulated solids remaining, initiate the pump-back procedure, which is to send the pumped faecal sludge under pressure back into the tank and direct this flow toward the sludge mass. This will break up the mass, making it possible to pump out. When pump-back is complete, pump out the tank again (suction). When pumping is complete, wash the hoses and replace the tank lids. Leave back small amount of sludge of around 1 to 2 inches in the tank so that it microorganisms can act upon the new incoming faecal waste. Clean up any spills and disinfect with lime or bleach solution. Chemicals such as lime can also be added into the suction trucks to neutralize the septage, to render the septage more treatable and to reduce odours

1.7.2 Daily Operations of Septage Treatment Plant

The Contractor shall carry out all facility operation and waste water disposal operations indicated below; in accordance with Good Operating Practices, as set out in this Contract. The Facility operation and waste water disposal operations shall include, but not be limited to the following:

- Operating Septage Treatment Plant to maintain the quality of treated effluent within the standards prescribed in the Tender/CPCB's norms, operate electrical equipment during power failures by operating generators, operate the Centrifuge for sludge drying and treat incoming effluent at prescribed standards through optimal dosing.

- Carrying out daily cleaning of grit channels and removal of screenings and disposal of floating matter in grit dewatered sludge out of premises. Carrying out continuous flow measurements of treated & raw effluent and recording the same as per tender requirements. Collecting samples of influent and effluent and analyzing them daily to determine the quality of effluent and performance of the treatment plant and providing security for facilities and system at all times.

1.7.3 Contingency Plan

Developing and implementing contingency plans in respect of responses to natural disasters, periods of power failure, storm water inflow into Septic tanks during monsoon, de-silting of units of treatment plants, constraint operations or other similar emergencies to maintain the quality of treated effluent.

1.7.4 Energy Audit

The Operator shall take all necessary measures to minimize the power consumption in carrying out its operations. The energy audit operations shall include, but not be limited to the following. Reducing electricity consumption by regulating equipment operation through suitable modifications to the operating schedules. Maintaining power factor and demand to avoid penalty installing more efficient pumping equipment and following better maintenance practices for electrical installation.

1.7.5 Repairs and Maintenance (Collection vehicles and SeTP premises)

The Contractor shall carry out preventive, routing maintenance and break down maintenance Operations for proper upkeep of collection system and plant in accordance with good operating practices. The following items shall be included in such maintenances.

i) Machinery and Treatment Plant Equipment

- Vacuum Suction Machine and its vehicle
- Dewatering and de-silting of sludge Sump, chemical dosing tanks at least twice a year as per approved programs and disposal of silt.
- Cleaning and maintaining all rising mains/sewers in the plant area at least four times a year.
- Repairing and replacing damaged pipes, fittings and valves for suction and delivery pipe.
- Repairing and replacing pump impellers, body, bearings shafts column pipes.
- Repairing and replacing motors
- Repairing and replacing starters, circuit breakers, capacitors
- Repairing and replacing vanes and/or gears of agitators
- Repairing and replacing transformer.
- Repairing of blowers, decanter, diffusers, chlorinator, chemical dosing equipments & Centrifuge.

ii) Building and Civil Structures

- Water proofing leaking roofs of the Buildings.
- The preventive and routine maintenance shall include all repairs and provision of spares material and tools required for these repairs. The Contractors shall also carry out breakdown maintenance and repairs. The labour, tools and plant, spares shall be arranged by the Contractor. The following spares shall be the respective responsibility of the Contractor and the Employer during preventive routing and breakdown maintenance.

1.8 Advice Early Warning:

The Contractor is to warn the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the operations or the condition of the facilities and / or system. The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstances can be avoided or reduced and in carrying out any resulting instruction of the Engineer.

The Contractor shall also advise the Employer from time to time, on improving the quality of operations, reduction in water / energy losses and betterment practices.

1.9 Replacing

The Contractor shall utilize the office space, provided by the Employer to establish its monitoring and reporting office along with computer and peripherals. It shall also obtain a telephone connection and maintain the same through the Contract period. All data transfers and updates made to the Employer shall be affected through the said telecommunications medium. The Contractor shall carry out all reporting indicated below and as set out in this Contract. The reporting shall include, but not be limited to the following

- Daily summary of Operations at Septage Treatment Plant – A daily report of operation of the diffuses, agitators, decanter and other equipment at the Septage treatment plants providing information on the quantity of Septage treated, hours of operation of equipment, energy consumed and use of chemicals.
- Effluent Quality Monitoring – A daily report monitoring the quality of raw and treated effluent through the analysis of samples.
- Sewer / Storm Water Drains / wet well & other units etc. - Monthly cleaning report of sewer / storm water drain de-silted and record of silt disposed at disposal sites.

1.10 Employer's Responsibilities

The Employer shall be responsible for procuring obtaining and maintaining Employer Clearances required, however that the Contractor shall be responsible for maintaining the conditionality of any such clearance, if such maintenance falls within the purview of the Contractor. The Employer shall supervise the Contractor's Operations at all times and notify the Contractor of any defects that are found. Such checking shall not affect the Contractors responsibilities. The Engineer-in-charge may instruct the Contractor to search for a defect and to uncover and test any work that the Employer considers may have a defect.

The Employer shall be responsible for:

- Treated effluent testing charges from State PCB if required.
- Maintaining administrative control over the personnel, facilities and system.

1.11 Contractors Responsibilities

The Contractor shall maintain properly and keep intact all assets /vacuum suckers/works/facilities/ system of the Employer throughout the Contract period and shall hand over the same in good working condition at the end of the Contract. The Contractor shall not modify or alter any operations regarding the facilities and / or system without prior written permission of the Employer or its representative. The Contractor shall procure all spare parts required for the maintenance of equipment excluding those to be supplied by the Employer. The Contractor shall warrant to the effect that all the spares shall be procured from the authorized sources and be of the better quality or quality mentioned in this Bid Document and fit for the purpose for which it is being used.

1.11.1 The Contractor is expected to carry out the work in such a manner as not because any damage to public property on account of negligence or otherwise. The Contractor shall be fully responsible for making good the damages so caused by him entirely at his own cost.

The assets / works / facilities / systems of the Employer shall be at the risk and in the sole charge of the Contractor and it shall be responsible for making good any loss or damage there to arising from any cause whatever including that due to a theft or robbery.

The Contractor shall provide adequate engineering equipment, maintenance staff, inventories plant and machinery and all other things, whether of a temporary or permanent nature required for carrying out operations under the Contract.

The Contractor shall carry out its Operations, so far as compliance with the requirement of the Contract permits, so as not to interfere unnecessarily or improperly with:

- The convenience of the public
- The access to use and occupation of public or private roads and footpaths to or of properties.

Permissions: The Contractor shall obtain all required permissions, sanctions clearances and permits for carrying out its Operations, including Contractors clearances and shall be fully responsible for carrying out the operations in a safe and secure manner, consistent with the law of the land, laws and regulations regarding such facilities and / or System and directives of any Authority and planning permissions.

Safety: The Contractor shall be responsible for the safety of all activities on the site and shall be absolutely and solely responsible for any and all kinds of injuries or damages to persons and property of any description whatever may be caused by or result from the operations carried

out, whether these may have been carried out skilfully and carefully and strictly in conformity with the provision of the specifications or not.

Discoveries: All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall as between the Employer and the Contractor, be deemed to be the absolute property of the Employer. The Contractor shall take reasonable precautions to prevent its workmen or any other persons from removing or damaging any such article or thing and shall, immediately upon discovery thereof and before removal, acquaint the Engineer of such discovery and carry out the Employer instructions for dealing with the same.

The Contractor shall be responsible for payment of reinstatement charges for roads, footpaths and land as per the Employer's rates. The Contractor shall take full responsibility for the adequacy stability and safety of all Site operations.

1.12 Staff & Labour:

1.12.1 Engagement of Staff & Labour

The Contractor shall employ skilled, semi-skilled and unskilled labour in sufficient numbers to carry out its operations at the required rate of progress and of quality to ensure workmanship of the degree specified in the Contract for timely fulfilling of the Contractor's obligations under the Contract and to the satisfaction of the Employer.

The Contractor shall not employ in connection with the operations any child who has not completed his/her fifteenth year of age. It shall also not employ an adolescent who has not completed his / her eighteenth year unless he/she is certified fit for carrying out operations as an adult as prescribed under clause b) of such section (2) (of Section 69 of the factories Act 1948).

The Contractor shall provide its staff, a minimum of two sets of uniforms with the titles the Employer inscribed on the back and subject to approval of the Employer. Each worker on duty shall wear a clean uniform whenever on duty.

The Contractor shall be required by the Engineer deliver to it, to such forms and at such intervals as the Engineer may prescribed a return showing the numbers of the several classes of staff employed by the Contractor on the site and such other information as the Engineer may require.

If the Employer asked the Contractor to remove a person who is a member of the Contractor's staff stating the reasons, the Contractor shall ensure that the person leave the site within seven (7) days and has no further connection with operations under the Contract.

At all times during continuance of the Contract, the Contractor and its subcontractors shall abide by all existing and future labour enactment and rules made there under, regulations, notifications and bye-laws of the Central, State or Local Government. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by any Authority on

account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments.

If the Employer is caused to pay or reimburse such amounts as may be necessary to carry or observe, or for non-observance of the provisions stipulated in the notifications/bye-laws/acts/rules/regulations including amendments if any, on the part of the Contractor and in connection with labour enactment, the Engineer shall have the right to deduct any money due to the Contractor including its amount of security deposit. The Engineer shall also have the right to recover from the Contractor, any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

1.12.2 Contractor's Superintendence

The Contractor shall provide all necessary superintendence while carrying out its operations and as long thereafter as the Employer may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor shall nominate a competent and authorized representative (Contractor Representative) approved by the Engineer-in-Charge and that may be withdrawn any time. The Contractor's Representative shall give its whole time to the superintendence of the operations. The Contractor's Representative shall receive, on behalf of the Contractor, instructions from the Engineer which shall be deemed received by the Contractor.

1.12.3 Contract Performance Review and Progress

(a) Management Meetings:

Either the Employer or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining Operations and to deal with matters raised in accordance with any advice. The Employer shall record the business of management meetings and is to provide copies of its record to those attending the meeting and to the Employer either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

The Employer may instruct the Contractor to rectify defects and deficiency in its Operations. Alternatively, the Employer shall carry out the operations on its own and deduct the amount incurred in attending to such defaults from the next payment due to the operation. The deduction of such damages shall not relieve the Contractor from its obligations to carry out the operations, or from any other of its obligations and liabilities under the Contract.

(b) Notwithstanding anything stated above:

If the Employer is of the opinion that the actions of the Contractor is deemed as an event of default of services and the event persists beyond even after 3 written reminders, the Employer

shall be entitled to invoke the Security deposit and carry out the operations through another Contractor or departmentally. The Employer shall then proceed as per Tender conditions.

1.13 Intellectual Property & Confidential Information

The Parties agree that all details, plans, manuals documentation, specifications, schedules, programs, reports, calculations and other work relating to the Facilities and / or Systems and the provision of operations pursuant to this Contract (hereafter referred to as "Proprietary Material") which have been or are hereafter written, originated or made by any of them or any of their respective employees, sub-contractors or agents and by the persons related to the Contractor in connection with this Contract shall be owned by and be the property of the Employer. The determination of information as Proprietary Materials shall be made at the sole discretion of the Employer.

The Contractor shall have an irrevocable royalty-free, non-exclusive license to use the Proprietary Material during the term of this Contract for all purposes connected with fulfilling its obligations hereunder. However, this license shall not be transferable to any party other than to a permitted assignee under this Contract. Such license shall not continue after the suspension or termination of this Contract or the discharge by the Contractor of its duties hereunder.

1.14 Confidentiality

The Contractor shall cause the persons related to the Operator not to, without the prior written consent of the Employer, at any time, divulge or disclose to any person or use for any purpose unconnected with the operations, proprietary material under this contract. This shall not apply to information.

- Already in the public domain otherwise than by breach of this Contract.
- Already to the possession of the receiving party before it was received from the office party in connection with this Contract and which was not obtained under any obligation of confidentiality; or
- Obtained from a third person who is free to develop the same and which was not obtained under any obligation of confidentiality.

The Contract shall, whenever required take necessary steps to ensure that all persons employed by it, under this Contract comply with the Indian Official Secrets Act 1923 (XIX of 1923) and agree that it applies to them and shall continue to apply even after completion of this Contract.

No photographs of the Facilities or System or any part thereof or equipment employed thereon shall be taken or permitted by the Contractor to be taken by any of its employees or any employees of its sub-Contractor without the prior approval of the Engineer in writing and no such photographs shall be published or otherwise circulated without the approval of the Engineer in writing. The Employer shall use its best efforts to ensure that the confidential

proprietary information relating to the Contractor is not made public. However, the Employer shall not be liable in any manner whatsoever in case such information becomes public.

1.15 Assignment

The Contractor shall not subcontract the whole of the operations or a substantial part thereof. Except where otherwise provided by the Contractual conditions, the Contractor shall not subcontract any part of the operations without the prior consent of the Engineer. Any such consent shall not relieve the Contractor from any liability or obligations under the Contract and it shall be responsible for the acts, defaults and neglects of any subcontractor, its agents, servants or workmen as fully as if they were the acts, defaults or neglects of the Contractor, its agents, servants or workmen.

The Contractor shall not be required to obtain such consent for:

- The provision of labour or
- The purchase of materials specified in the Contract.

In the event of a Subcontractor having undertaken towards the Contractor in respect of the work executed or the goods, materials, plant or operation supplied by such Subcontractor, any continuing obligation extending for a period exceeding that of the Contract period under the Contract, the Contractor shall at any time, after the expiration of such period assign to the Employer, at the Employer's request and cost, the benefit of such obligation for the unexpired duration thereof.

1.16 Default of Contractor

1.16.1 Event of Default

At any time after the Commencement Date, the Engineer may investigate each case where the Contractor has failed to properly perform the operations in accordance with this Contract. The Engineer shall issue a notice to the Contractor, instructing him to rectify the failure within a reasonable time.

a) In event of default on the part of the Contractor being unable to fulfil its services obligations under the Contract shall be deemed as a serious default and is said to have occurred due to any of the following causes.

b) The Engineer certifies to the Employer with a copy to the Contractor that in its opinion the Contractor

- Has repudiated the Contract **or**
- Without reasonable excuse has failed to commence Operations in accordance with the Contract and pursuant to the Commencement date; or failed to complete the Operations within the time stipulated for completion.

- c) Gross misconduct of the Contractor.
- d) Despite previous warning from the Engineer, in writing, is otherwise persistently or flagrantly neglecting to comply with any of its obligations under the Contract.
- e) Contractor persistently fails to follow good operating practices in execution of the Contract.
- f) If the Contractor changes the use to which any part or whole of the Site is put or initiates a variation without the required approval of the Engineer.
- g) The Contractor stops providing the operation for one day and the stoppage has not been authorized by the Engineer.
- h) The Engineer gives notice that failure to correct a particular defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer.
- i) If the Contractor is in breach of any law or statute governing the operations.
- j) The Contractor does not maintain a security which is required.
- k) The Contractor, in the judgement of the Employer has engaged in Corrupt Practices fraudulent Practices in competing for or in carrying out the Operations under the Contract.
- l) If the Contractor fails to obtain or keep in force the insurance requirements under this Contract.
- m) The Contractor (in case of a consortium) has modified the composition of the consortium and/or the responsibility of each member of the consortium without prior approval of the Employer.
- n) The Contractor is unable to maintain the composition and structure of its organization due to any of the following causes:
- The Contractor enters into voluntary or involuntary bankruptcy, or liquidation.
 - The Contractor becomes insolvent.
 - A receiver, administrator, trustee or liquidator is appointed over any substantial part of its assets and
 - Any act is done or event occurs with respect to the Contractor or its assets which under any applicable law has substantially similar effect to any of the foregoing acts or events.'

1.16.2 Consequences of Default

- a) If a default by the Contractor is said to have occurred pursuant to the Employer may after giving three days notice to the Contractor enter upon the Site, the facilities and / or system and terminate the Contract without thereby releasing the Contractor from any of its obligations under the Contract, or affecting the rights and authorities conferred on the Employer by the Contract. The Employer may use so much of the Contractor's equipment, temporary works and materials as it may think proper.
- b) If the Contract is terminated because of an Contractor's event of default, the Employer shall be entitled to invoke the Security Deposit and carry out the Operations through a successor Contractor or departmentally and at the risk and cost of the Contractor. If the total amount due to the Employer exceeds any payment due to the Contractor the difference shall be a debt payable to the Employer.

- c) If the Contract is terminated because of a Contractor's event of default, all materials on the site, plant, equipment and temporary works shall be deemed to be the property of the Employer.
- d) Unless prohibited by law, the Contractor shall, if so instructed by the Engineer within 3 days of such entry and terminated referred to, assigns to the Employer the benefit of any Contract for the supply of any goods or materials or operations which the Contractor may have entered into for the purposes of the Contract.

1.17 Default of Employer

1.17.1 Events of Default

- a) An event of default on the part of the Employer, affecting the performance of the Contractor's operations shall be deemed to have occurred due to any of the following causes.
- b) The Employer does not give access to part of the Site by the commencement date.
- c) The Employer does not make a payment certified by the Engineer within 90 days from the day of receipt of the Engineer's Certificate.
- d) The Engineer instructs the Contractor to stop providing the operations and the instruction is not withdrawn within 3 days and
- e) The Employer is in breach of any law or statute governing this Contract.

1.17.2 Consequences of Default

1. Pursuant to the Contractor may terminate its employment under the Contract by giving notice to the Engineer – in – Charge. Such termination shall take effect 14 days after giving the said notice.
2. If the Employer, before the expiry of the above notice period, or immediately thereafter removes the cause of its default, the Contractor's entitlement shall lapse in respect of such defaults, and the Contractor shall continue with / resume normal working as soon as is reasonably possible.

1.18 Risks, Indemnification's & Insurance

1.18.1 Risks

All risks of loss of or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract other than the risks stated, is the responsibility of the Contractor.

1.18.2 Indemnification

1.The Contractor shall indemnify and keep indemnified the Employer against all losses and claims for injuries or damage to any property whatsoever which may arise out of or in consequence of the operations and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto.

2. The Contractor shall at all times indemnify the Employer against all claims, damages or compensation under the provision of:

- Payment of wages Act 1936
- Minimum Wages Act 1948
- The Employers Liability Act 1938
- The Workmen's Compensation Act 1923
- Industrial Dispute Act 1947.
- Indian Factories Act 1948 and
- Maternity Benefit Act 1961.

Or any modifications thereof and rules made there under from time to time or as a consequence or any accident or injury to any workman or other persons in or about the Operations, whether in the employment of the Contractor or not save and except where such accident or injury have resulted from any act of the Employer, their agents or servants and also against all cost, charges and expenses of any suit, action of proceedings arising out of such accident or injury and against all sum and sums which may with the consent of the Contractor be paid to comprise or compound any such claim without limiting its obligations and liabilities as above provided. The Contractor shall insure against all claims damages or compensation payable under the various acts mentioned above or any modifications thereof or any other law relating thereto.

1.18.3 Insurance

The Contractor shall provide in the joint names of the Employer and the Contractor insurance cover from the Commencement date to one year beyond the end of the

Contract Period for the Contractor's risks covering:

- Loss of or damage of property (except the Facilities, System and Equipment) in connection with the Contract.
- Personal injury or death; and
- The Contractor's All risk (CAR) Insurance Policy.
- The covers shall be obtained from the Directorate of Insurance, Maharashtra State only.
- The Contractor may at its own discretion provide for the following insurance covers
- Loss or damage to the Facilities and / or System and
- Loss of or damage to equipment.
- Such cover may be taken either from the Directorate of Insurance, State or from any other Insurance company with the approval of the Employer.

The Contractor shall deliver policies and certificates to the Engineer for an approval before the Commencement Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

If the Contractor or any of its Subcontractors does not provide any of the policies and certificates required, the Employer may affect the insurance, which the Contractor should have provided and recover the premiums the Contractor has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due to the Employer.

Alterations to the terms of insurance shall not be made without the approval of the Engineer and both parties shall at all times comply with any conditions of the insurance policies.

1.19 Force Majeure

1.19.1 Force Majeure Events

A Force Majeure Event as defined is said to have occurred if any such event arises after the issue of the Letter of Award of Contract and extends for a period greater than thirty days, outside the control of both parties, thereby rendering it impossible or unlawful for either party to fulfil its Contract obligations under the law governing the Contract. The Force Majeure Events are:

- War, invasion, mobilization, requisition or embargo;
- Rebellion, revolution, insurrection or military or usurped power or civil war.
- Contamination by radio-activity from any nuclear fuel or from any nuclear waste from the combustion of nuclear fuel radioactive toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component of such assembly.
- Riot commotion or disorder, unless solely restricted to employees of the Contractor or of its Subcontractors;
- Floods and any other calamity resulting from climatic imbalances and
- Provided always that such events are beyond the control of the parties and have a materially adverse effect on the operations.

The Contractor shall be under no liability whatsoever in consequence of any of the Force Majeure events referred to in this clause whether by way of indemnity or otherwise.

Both parties shall be released from further performance pursuant to any Force Majeure events occurring outside the control of both parties and extending for a period greater than 180 days.

If the Contract is frustrated by a Force Majeure event, the Employer shall certify that the Contract has been frustrated. The Contractor shall make the site safe and stop operations as quickly as possible after receiving this certificate.

1.20 Consultation and Duty to Mitigate

For so long as the period of Force Majeure is continuing the affected party shall consult with the other parties on the period and effect of the Force Majeure event, and the affected party shall use all reasonable endeavours to alleviate its effects on the performances of its obligations

under this Contract. The other party shall afford reasonable assistance to the affected party to alleviate the effect of the Force Majeure event on the performance by the affected party of its obligations under this Contract. The affected Party shall use its best efforts to continue to perform its obligations hereunder and to correct or cure the same during the subsistence of such Force Majeure Event.

1.21 Consequences of Force Majeure

If and to the extent that any of the Force Majeure events listed above results in loss or damage to the Facility and / or System the Contractor shall promptly give notice to the Employer. The Employer may direct the Contractor to rectify this loss or damage to the extent required by the Employer at costs to be mutually agreed between the parties. The Contractor shall expeditiously rectify the loss or damage and shall be entitled to payment of such costs. In the event that the parties are not able to reach an agreement on the cost of rectification, the Employer may carry out the rectification works by itself or through any agency nominated by it. The Contractor shall provide all cooperation required to complete such rectification expeditiously.

1.22 Resumption of Performance

When the affected party is able to resume performance of its obligations under this Contract, it shall give to the other party a written notice to that effect and shall promptly, and in any event within 3 days resume performance of its obligation hereunder:

The obligations and liabilities of the parties under this Contract would continue as long as Force Majeure event does not impede the performance.

There shall be no penalty / liquidated damages applicable in the period of subsistence of a Force Majeure.

1.23 Taking over Process

At the end of the Contract period and subject to the provisions or its earlier terminations except on account of default of the Contractor, the Contractor shall request the Engineer to take over the Facilities and / or System. The Employer shall take over the facilities and / or System within 7 days of such a request being made. The Contractor shall:

- Cease all further operations except for such operations as may be necessary and instructed by the Engineers' Representative for the purpose of making safe or protecting those parts of the Facilities and / or System and any operations required to leave the Site in a clean and safe condition.
- Hand over all documents and supplies for which the Contractor has received payment and
- Remove Contractor's equipment which is on the Site and repatriate its entire staff and labour from the site.

- Provide adequate training to ensure complete transfer of technology of entire Operation & maintenance of systems/automation etc. to the successor Contractor to the satisfaction of the Engineer.

The Contractor shall supply to the Engineer a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Contract Period. The Engineer within 28 days of receiving the Contractor's account shall certify any final payment that is due to the Contractor, or indicate to the Contractor the corrections or additions that are necessary. If the final account is still unsatisfactory, after the Contractor resubmits it, the Engineer shall decide on the amount payable to the Contractor and issue a payment certificate. The Employer shall any time, within a period of 90 days from the Completion Date or Termination Date as applicable, carry out an independent assessment of the facilities and / or system departmentally or through a Successor Contractor. Any deficiencies in the facilities and/ or System shall be made good by or at the cost of the Contractor so as to bring the facilities and or /system into Good Repair and proper working condition as handed over at the Commencement Date and subsequent works done pursuant and normal wear and tear excepting.

1.24 Repairs and Maintenance Schedules

In order to ensure smooth and uninterrupted operations, routine maintenance of the project facilities shall be carryout as per following schedule but not limited to these to ensure the proper functioning of the system.

1.24.1 Vacuum Sucker Vehicles for Septage Collections:

Septage collection vehicles shall be periodically carryout checkups of all vehicles and equipments for septage collections. In addition to regular maintenance of the vehicle, contractor to ensure to carryout out repair and maintenance work as per schedule to:

Monthly

- Clean of Air filters
 - Flush the vacuum pump.
 - Clean and lubricate the shafts of all valves
 - Grease all points of unit, vacuum pump, vacuum pump drive line and other units
 - Check all bolts on unit and tighten as required, especially the bolts mounting the vacuum pump and
 - Clean the vacuum tank (outer body).
 - Check the fittings on the loading hoses.
- (Above list can be modified for the proper functioning of the system)

Yearly

- Use only recommended oil as per pump manual. Keep container clean.
- On older pumps where oil tank is attached to the pump, it can collect condensation. It needs to be drained on a regular basis, especially in cold weather climate.
- Change the air filter.

1.24.2 Treatment Plant Complex:

As per indicated period checking the operation, correcting defects, attending to calibration and setting is required attending to minor repairs and proper up keeping) such as cleaning and painting) required for the following :

i. Monthly

- Roof and surroundings and
- Lightning arrestors.

ii. Annual

- Leakages in structures
- Ladders
- Railings
- Structural damages to the wet and dry well and
- Overflow drain.

(Note: Above Schedule of Maintenance and components to be included can be modified for the proper functioning of the system)

1.24.3 Pumping Machinery and Treatment Plant Equipment:

As per indicated period checking the operation, correcting defects attending to calibration and setting is required attending to minor repairs and proper up keeping(such as cleaning and painting) required for the following:

Daily

- Screens/ Grit Channels
- Moving parts of screens and grit removal equipment, Blowers /Agitators / Pumps/ Agitators /Return Sludge pumps/ Chemical mixer/Centrifuge/Decanter
- Bearing and
- Vibration, balancing on Decanter, chemical dosing and mixing, Motors
- Contact tightness
- Cable insulation near the lugs.
- Panels Breaker and Starter
- Contacts of relay and circuit breaker and
- Setting of over-current relay, no-volt coil and tripping mechanism and off in the dash pot relay.
- Transformer Sub-station

- Ground Operated Dis-connectors (GOD)
- Contacts of GOD and of Over Current (OC) relays
- Radiators and Earth pit

Monthly

- Screens and Grit channels
- Chains in mechanically operated components
- Screens performance
- Transformer
- Oil in transformer
- Relay alarm circuit
- Load (Amperes) and
- Voltage

Quarterly

- Transformer
- Bushing and
- Dehydrating breathers

Half -Yearly

- Pumps / Blowers /Agitators / Compressor /Decanters/Centrifuge
- Gland of stuffing box
- Gland bolts
- Gland packing
- Alignment of pump aerator and drive and
- Oil lubricated bearings
- Motors
- Tripping elements for motor protection
- Contact points and
- Fuse ratings

Annual

- Paint screens, grit removal mechanism, scrapers, scrapers , motors, pipes,
- Valves, fittings agitators and inlet/outlet weirs with two coats of anticorrosive paints.
- Replace worn out parts of mechanical equipment in effluent treatment plant.

(Note : Above Schedule of Maintenance and components to be included can be modified for the proper functioning of the system)

Contractor to follow the maintenance schedule of manufactures for package treatment plants and other parts. Manufacturers schedule may be clubbed with above mentioned repair and maintenance schedule in order to keep plant in operational stage.

1.24.4 Buildings and Civil Structures:

Carry out routine maintenance and minor repairs including cleaning, repairs to

plaster, doors, windows and painting.

Daily

- Sweep the premises
- Clean the floors and parts inside the Building
- Clear the cobwebs and other biological growth
- Maintenance of horticulture
- Disposal and transportation of dewatered sludge

Half - Yearly

- Repair damaged floor, plaster, roof, leakages and
- Repair damaged doors, windows and other fixtures.

1.25 SCHEDULE OF PREVENTIVE MAINTENANCE:

1.25.1 Pumps

S.No.	Name of section or part to be attended	Maintenance to be carried out	Frequency/time interval at which inspection and maintenance can be done	Remarks
1.	Bearings	Checking of temperature with thermometer	Two months	Hot ball or roller bearing point to too much oil or grease; hot sleeve bearings need more oil or heavier lubricant. If does not correct, disassemble and inspect the bearing alignment of pump and driver.
2.	Glands	Changing of gland packing	Two months	
3.	Bearing	Lubricants (greasing)	Two months	Check for specification resulting in whitish colour; washout with kerosene.
4.	Gauges	Checking of pressure and vacuum gauge	Three months	

5.	Valves	Changing of gland packing in delivery sluice valve, suction valve, bye pass valve, reflux valve	Six months	
6.	Exhaust pump and its auxiliaries	Checking of gland packing & its auxiliaries etc.	Six months	
7.	Impeller	Checking of impeller blades, sleeves, efficiency rings, bearings, neck ring impeller nut etc.	year	

1.25.2 Electrical Motors

S.No.	Name of section or part to be attended	Maintenance to be carried out	Frequency/time interval at which inspection and maintenance can be done	Remarks
1.	Induction motor stator and rotor	Opening of end covers dust blowing and checking of air gap	One month	Depending on the working conditions & maintenance staff available.
2.	Slip ring device	Cleaning of slip	One month	

		rings and adjustment of carbon brushes short circuiting jaws, oiling of clutch etc.		
3.	Bearings	Proper lubrication	Two months	
4.	Windings	Checking of motor after taking out its rotor. Dust blowing. Checking of end connections of stator. Rotor and taking insulation test, no load test before putting the motor on load	Two years	

1.25.3 Power Transformer

S.No.	Name of section or part to be attended	Maintenance to be carried out	Frequency/time interval at which inspection and maintenance can be done	Remarks
1.	Checking of silica gel. Topping of transformer oil. Temperature gauge vent pipe, voltage tap changing switch	Six months	Check and if required silica gel must be changed before the outbreak of monsoon.	
2.	Filtration of oil, checking of dielectric. Strength, checking of viscosity of oil, terminal boxes (HT < both)	Year	If the transformer oil with stands insulation test upto 40KV for one minutes it is not necessary to dry and fill the transformer oil.	

	insulators, neutral earthing, lightening of nuts bolts, cable sockets stopping of leakages if any through points.			
3.	Checking of its functioning	Year		
4.	Checking of condition of core of the transformer and its windings insulation conditions.	5 Years		

1.25.4 Switchgears

S.No.	Name of section or part to be attended	Maintenance to be carried out	Frequency/time interval at which inspection and maintenance can be done	Remarks
1.	Oil circuit breaker or air circuit breaker	Checking, cleaning and tightening of nuts, bolts of fixed auxiliary contacts, moving auxiliary Contacts, main fixed contacts. No volt coil, overload coil, interlock system, condition of transformer oil, knife switches & insulators etc.	Six months	
2.	Oil tank	Cleaning & topping of oil & checking dielectric strength of transformer oil.		
3.	Contacts	Changing of old & wearing out contacts (fixed moving auxiliaries	Three months	Depending on the source of

		etc.)		power supply & its tripping
4.	Oil circuit breaker or air circuit breaker	Checking, cleaning and tightening of nuts, bolts of fixed auxiliary contacts, moving auxiliary contacts, main fixed contacts. No volt coil, overload coil, interlock system, condition of transformer oil, knife switches & insulators etc.	Six months	

1.26 **Maintenance Staff**

O & M Personal shall dedicate their 100% time and the Contractor will ensure that adequate number of his staff shall be available on duty 24 hours, 7 days per week including all holidays. Minimum O&M Personnel to be provided by the Contractor is mentioned in the Annexure II of ITB. However, if required, contractor may increase the staff deployment at STP and on collection system for the proper functioning of the system.

The Contractor shall maintain & submit statements to client for consumption of power, chemicals, quantity & quality of treated effluent on the prescribed Performa to be laid down by client and shall get the treated effluent samples duly tested for submission to State pollution Control Board for NOC/ Consent and shall submit consolidated monthly statement at the time of claiming payment.

In case, the Contractor fails to operate & maintain the septage collection system and Treatment Plant to the rated capacity and quality, client shall be at liberty to terminate the Operation & Maintenance Contract without assigning any reason and take penal action as per the Contract and prevailing Law as this is covered under Essential Services Act. The Contractor shall adopt all necessary safety measures for all his Staff, Plant, Building and Machinery.

1.27 **Scope of Work**

- Collection of septage from household using vacuum sucker mounted vehicles
- Collection of user charges from user and depositing to escrow account

- Operate the plant i.e. SeTP as per the instructions in the operation manual.
- Carryout Routine, Annual & Breakdown Maintenance of the equipment in the system.
- Maintain record book/log book with the help of computer.
- ESI & PF Registration & Record keeping.
- Providing Safety Gear to O & M Staff.
- Maintain the log sheet for various equipments and systems and revenue collections..
- Draw samples and get analyzed for the parameters required and make the necessary process correction.
- Vendor will give enough lead-time to department to arrange and provide power and diesel free of cost to vendor for running of the plant.
- Maintain a record of stock levels and assist client on reordering levels.
- Maintain history card for the equipments.
- Submit report in the form and frequency required by the client.
- Housekeeping of the entire plant allocated area.
- Maintain clear record of attendance for his workmen and staff.
- Vender shall be responsible for preventive maintenance necessitated by normal usage of the equipment.

1.27.1 Maintenance

Contractor shall get the routine preventive, Annual & Breakdown maintenance done with the help of their own staff. All spare parts, consumable for maintenance will also be supplied by Vendor. The painting of Mechanical & Civil structures as and when necessary shall be carried out by contractor.

1.27.2 Consumables and spares

Various chemicals such as Coagulants, Chlorine, Polyelectrolyte, cleaning chemicals, lubricants, spares, cartridges etc. are either consumed continuously or replaced periodically to maintain the performance of the plant, will be procured by contractor. Sufficient stock level of these items shall be maintained by contractor. The contractor shall allocate adequate covered space for storage of consumables, chemicals and spares.

In addition to above any other test required by Pollution Control Board for grant of NOC shall be carried out by the contractor. This scope of work includes painting, white washing, distempering of plant, building & equipments at the time of handing over of the plant and after every 2 years of operation & maintenance period.

1.27.3 Laboratory and stores

The minimum lab equipment needed & tests recommended to be carried out at the SeTP are in accordance with the CPHEEO manual.

1.28 Waste Disposal

The disposal of the effluent/waste water/beyond battery limits site shall be the responsibility of the contractor. Disposal of hazardous sludge to a common hazardous waste management facility will be under the scope of contractor.

1.29 Extra Work

No extra work charges of any kind shall be entertained by the ULB during O & M contract period.

SPECIAL REQUIREMENTS OF THE CONTRACT DURING O&M

1.30 Consumer Relation Management Centre

The Contractor shall design, develop and set up consumer relation management centers (CRMC) 1 nos each of not less than 60 sqm including Central Control Center (CCC) to facilitate receiving and resolving consumer requests in the project areas of new septage collection point, service deficiencies, resolution of billing disputes, payment of bills etc. The consumers shall file their complaints through e-mail, text message from mobile phones, telephone, Fax and other electronic media. Contractor will maintain 1 (One) toll free numbers each for septage collection services at CCC.

The Centers shall function between 8am to 8pm during all working days and between 8am to 1pm during public holidays including Sundays. The CRMC including CCC shall be air conditioned and have reasonable space and furniture for the Consumers to wait, interact and represent their requirements. During the other off peak times of 8pm to 8am, the Contractor shall have a facility to receive Consumer complaints through telephone, fax, text message, email and any other electronic means. The complaints once received should be acknowledged automatically and a registration number shall be given to the complainant immediately.

The CRMC and CCC shall be equipped with sufficient human resources, hardware and software to facilitate continuous record of consumer requests, monitoring the resolution, and reporting completion of necessary actions and tasks. There shall be an exclusive desk for servicing the urban poor consumers preferably serviced by an efficient local executive who can interact in local language.

1.31 Management Information System

Contractor shall develop, establish, operate and manage during the entire contract period a comprehensive Integrated Management Information System (MIS) in respect of all matters including but not limited to:

- i. Design Built activities

- ii. All the Operation and maintenance activities
- iii. billings and collection systems;
- iv. Consumer services, including data bases relating to complaints and questions, response times and resolution;
- v. Financial management, including accounting systems;
- vi. Performance information systems; and
- vii. Others as identified during SIP preparation and implementation.

1.32 Establishing Billing and Revenue Collection Systems

The Contractor shall:

- i. Prepare and monitor the profile of Septage Connection or Consumers in the Service Area describing consumer categories and other attributes collected through consumer survey in a **GIS platform geocoded to the property footprints**. The database and software shall be in a position to analyse the number of Consumers under each category, estimated average volume of septage to be collected per month, and estimated average revenue per month;
- ii. Develop and implement basic Standard Operating Procedures for (i) Septage connections, (ii) preparing, issuing, and collecting a bill for Septage, (iii) dealing with underpayment or non-payment; these SOPs shall be prepared in close coordination with Employer or Engineer.
- iv. Set up and implement in detail the revenue collection procedures, and the facilities for achieving the high level of revenue collection efficiency.

1. Billing and Revenue Collection responsibility

- i) The contractor shall establish and operationalise billing and revenue collection system before commissioning of System. Contractor shall generate the septage collection bills with the tariff decided by GoJ. All bills will be processed, printed, collated, distributed and handled by the Contractor on behalf of and as an agent of Department UD & HD. All revenues shall be invoiced in the name of Department UD & HD. All revenues will be collected by the Contractor on behalf of Department UD & HD and deposited into the designated Escrow revenue account set up for the entire operation period.
- ii) The Department UD & HD shall have full and unrestricted access to the billing and revenue system comprising software, all current and historical billing data and the consumer service centers operated and managed by the Contractor upon request. All reasonable requests for data and analysis from the billing data system shall not be unreasonably refused by the Contractor.

iii) The Contractor shall:

a) Collect all revenue amounts related to the septage collection:

- o through CRM centers,
- o through banks, electronic transfer, mobile banking and
- o by other means as may be agreed to by JUIDCo, Jharkhand;

All the charges initial or annual required to be paid to the bank, payment gateways etc. will be paid by the contractor.

b) Identify and record all outstanding accounts and take all necessary measures to collect outstanding accounts with the knowledge of the Employer;

c) Submit to Employer a summary and analysis of unpaid accounts on monthly basis; and

d) Manage all aspects of consumer services with the Consumers.

iv) The Contractor shall directly deposit all of the collected consumer payments, whether in the form of cash, cheques or any other form, into the designated revenue account by the next working day.

2. Training to Employer (JUIDCo/ULB/PHED)

Contractor will provide on the job training during operation services to the staff of JUIDCo/ULB/PHED. Such trainings will be commenced 30 days prior to commissioning the SeTP. Also that in the last year of O&M period and before 30 days from the date of handing over the assets back to the Employer, the Contractor shall organize detailed training to the identified staff in technical, commercial and financial aspects of septage collection to enable the Employer to build sufficient capacity and skills to manage the water services after the Contract Completion Date. Commencing from 30 days before the Contract Completion Date, the staff either from Employer or from a future Contractor will overlap and co-manage the operations to ensure continuity in service delivery.

Appendix 6-1

Guidelines and Format for Technical Proposal

The Bidder shall submit a Technical Proposal setting out the approach to the Project. The Technical Proposal shall comply with the Construction Requirements and O&M Requirements as set out in this bid document.

The Technical Proposal shall set out the following components:

- a) Methodology Statement
- b) Process Flow Chart and Material Balance Statement
- c) Resource Utilization Statement
- d) Area Allocation Statement
- e) Operations & Maintenance Scheme
- f) Project Schedule
- g) Environment, Health & Safety Policy and Practice

a) Methodology Statement

The Bidder shall provide a methodology statement, which broadly sets out the approach to the Project. The methodology statement shall include the Bidder's appreciation of the Project, the sequencing of activities to be performed, the facilities to be provided, design standards and basis for calculations of the treatment plant units. The methodology statement should address aspects relating to all the activities of collection, transportation and treatment including receipt, weighment and treatment of septage, reuse / disposal / sale of treated effluent and sludge.

The methodology statement should clearly demonstrate the compliance of the approach to be adopted by the Bidder for the implementation of the Project to the minimum specifications set out in the bid document.

b) Process Flow Chart and Material Balance Statement

The Bidder shall provide a process flow chart and a material balance statement setting out the activities and the outputs at each stage. The components, which shall be addressed, include liquid and solid stream of the SeTP. The Bidder should indicate supporting calculations and assumptions, if any.

c) Resource Utilisation Statement

A statement indicating the procurement, deployment and utilisation of the resources shall be provided. The statement shall include proposed organizational structure, employee deployment, equipment procurement and utilisation, contracting activities, utilisation of office and other facilities.

d) Area Allocation Statement

The Bidder shall set out the area utilisation plan for the Project Facilities including the treatment Facility, other facilities and common areas etc.

e) Operations and Maintenance Scheme

The Bidder shall separately set out the operations and maintenance scheme for Door to door collection, transportation and treatment indicating the operational practices during O&M period. The maintenance (regular and emergency) schedules and mechanism should also be indicated over the contract period.

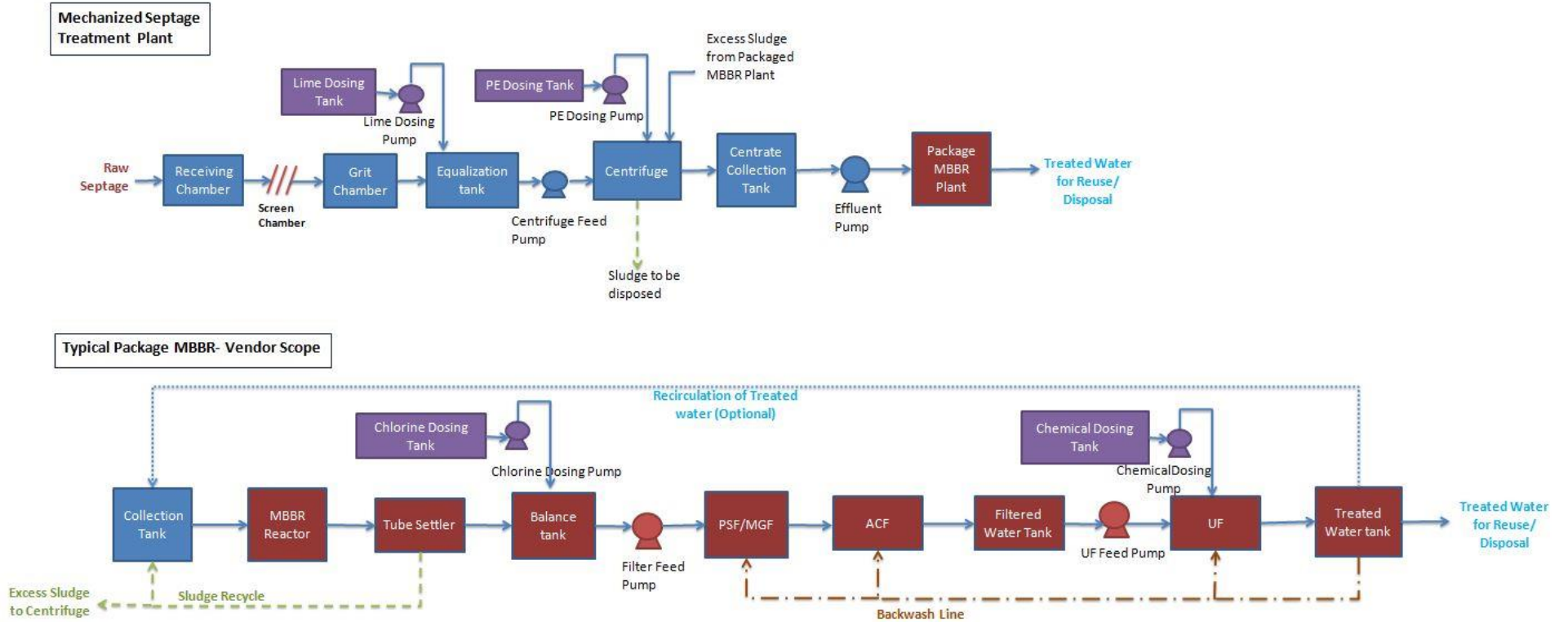
f) Time Schedule

The Bidder shall indicate an activity schedule over the Contract Period including the Construction Activities and O&M Activities.

g) Environment, Health & Safety Policy and Practice

The Bidder shall indicate the environment, health and safety policy and practices, which are proposed to be adopted during the Contract Period. The aspects relating to employee and worker safety, control mechanisms of litter, pest, odour, fire, surface runoffs etc needs to be elaborated.

Appendix 6-2: Typical Process Flow Diagram for the SeTP



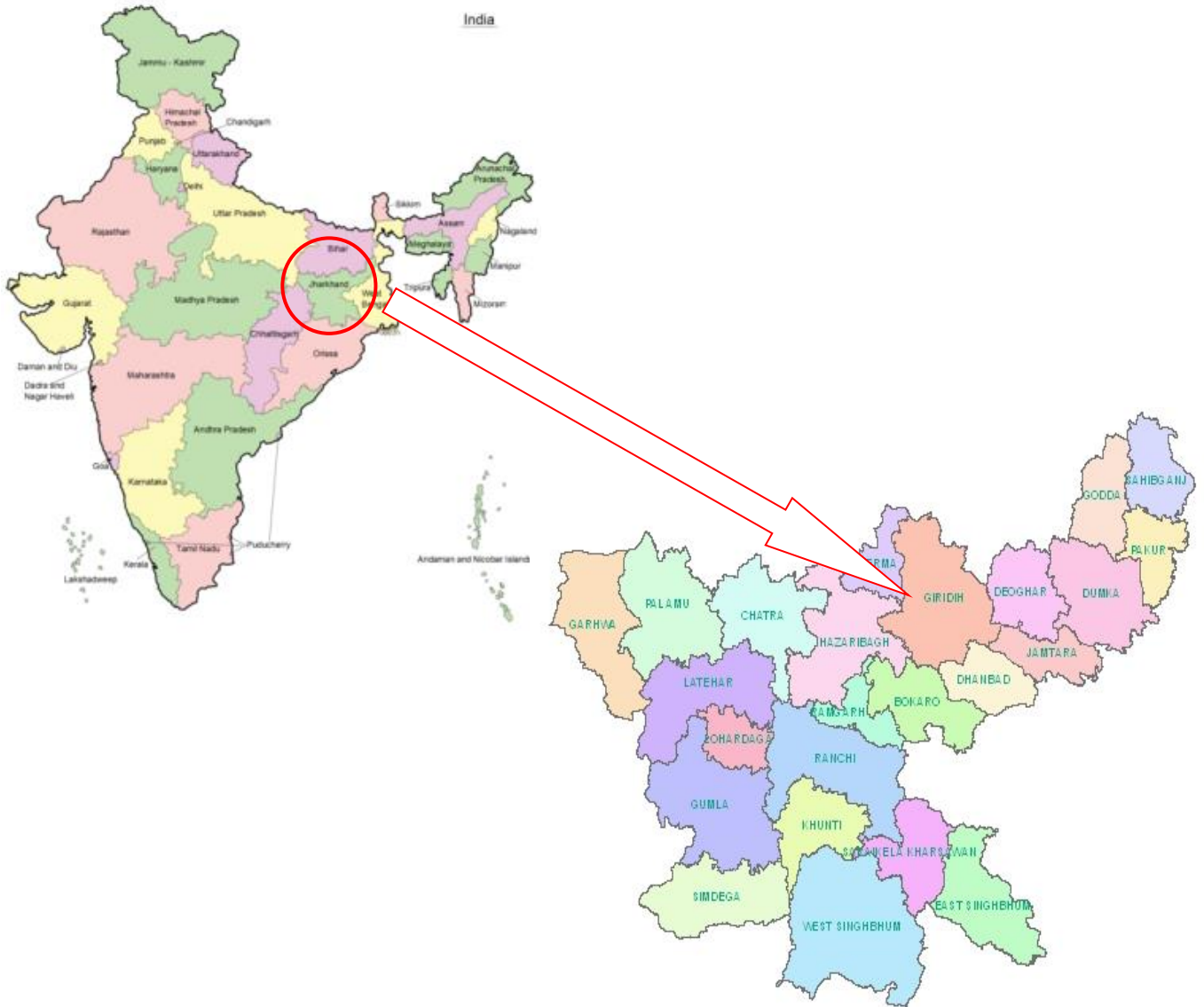
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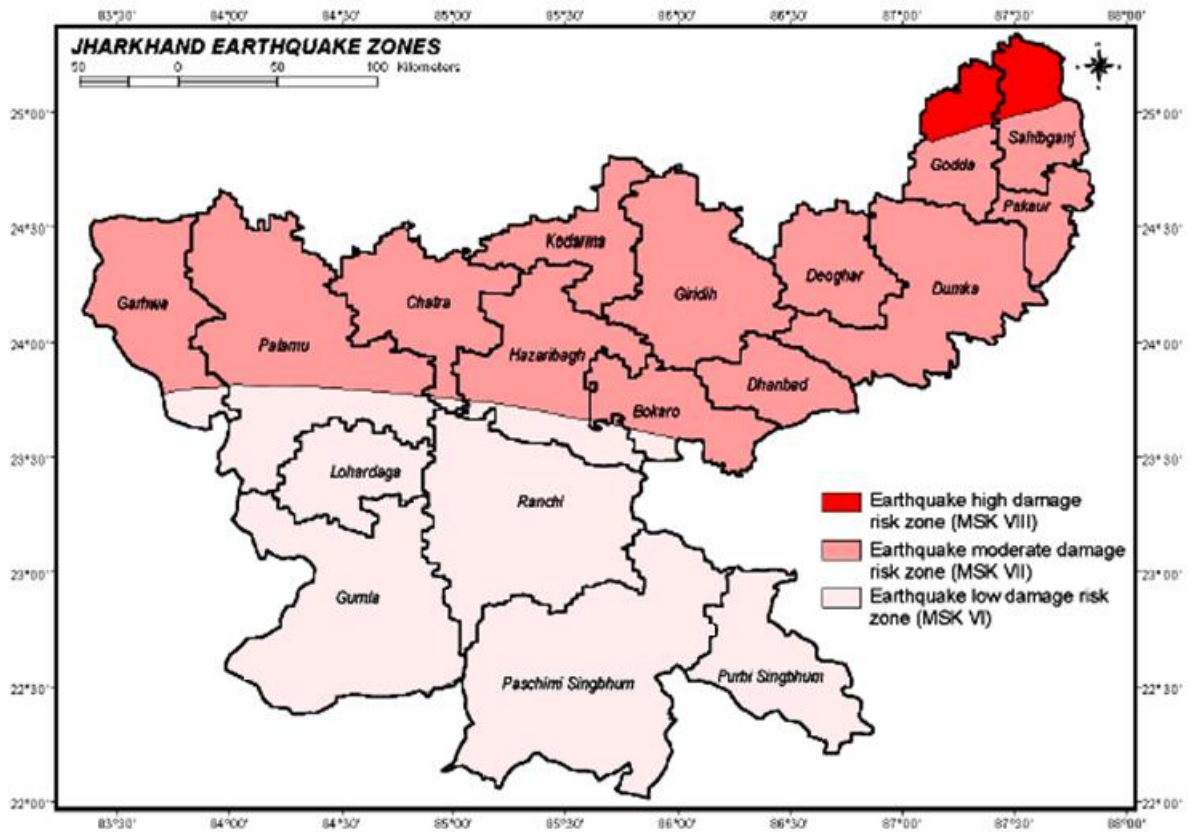
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1.0 DRAWINGS

1.1 LOCATION MAP OF JHARKHAND



1.4 SEISMIC RISK ZONES – JHARKHAND



1.5 WARD MAP OF CHAS TOWN

Refer Drawing TCE.7690A-176-LM-6154

1.6 TOPOGRAPHICAL SURVEY DETAILS FOR CHAS TOWN

Refer Drawings: TCE.7690A-110-TG-6151 (Sheet 1 of 2)
TCE.7690A-110-TG-6152 (Sheet 2 of 2)

1.7 TRENCH SECTIONS AND BEDDING DETAILS

Refer Drawing: TCE.7690A-160-WS-6121

1.8 PROPOSED SERVICE AREAS AND ROUTING PLAN FOR VACUUM TRUCKS FOR SERVICE AREAS CHAS TOWN

Refer Drawing: TCE.7690A-176-LM-6551
TCE.7690A-176-LM-6552
TCE.7690A-176-LM-6553
TCE.7690A-176-LM-6554
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1.9 LAYOUT OF SETP

Refer Drawing TCE.7690A-163-GA-6199

1.10 GENERAL ARRANGEMENT OF BOUNDARY WALL (3.0 M HEIGHT) WITH ENTRY GATE FOR CHAS TOWN

Refer Drawing TCE.7690A-160-WS-6349

1.11 LOCATION AND LAND IDENTIFIED FOR PROPOSED SETP

Refer Drawing TCE.7690A-176-LM-6194

1.12 LOCATION OF WASTEWATER SAMPLE FOR CHAS TOWN

Refer Drawing TCE.7690A-176-LM-6175

1.13 LOCATION AND CO-ORDINATES OF BOREHOLES FOR CHAS TOWN

Refer Drawing TCE.7690A-176-LM-6153

1.14 SINGLE LINE DIAGRAM OF PROPOSED SETP FOR CHAS TOWN

Refer Drawing TCE.7690A-733-AU-3012

**OPERATION AND MAINTENANCE OF SEPTAGE MANAGEMENT SERVICES FOR 10 YEARS
(TO COME INTO FORCE IMMEDIATELY AFTER THE COMPLETION OF SUCCESSFUL TESTING AND
COMMISSIONING OF SEPTAGE MANAGEMENT SERVICES)**

TRIPARTITE MAINTENANCE AGREEMENT

JUIDCO

THIS AGREEMENT made at Ranchi this _____

BETWEEN

JUIDCO, Jharkhand having its principal place of business or head office at Ranchi hereinafter referred to as "the Employer" of the **FIRST PART**.

AND

M/s _____ a company / firm having its registered office at _____, hereinafter referred to as "CONTRACTOR" (which expression shall unless repugnant to the subject or context be deemed to mean and include its successors, representatives and assigns) of the **SECOND PART**.

AND

ULB _____ (herein after referred to as "the ULB") of the **THIRD PART**.

WHEREAS the ULB is obliged to pay proportionate charges for maintenance of the said O & M and for provision of various services in the said O&M to the Contractor.

NOW, THEREFORE, THIS AGREEMENT WITNESSETH AND IT IS HEREBY AGREED AND DECLARED BY AND BETWEEN THE PARTIES HERETO AS FOLLOWS:

WHEREAS:

- A. The JUIDCO has appointed the Contractor to operate and maintain the Septage Management Services specified in the First Schedule (the Service Area);
- B. Following a process of competitive tender the JUIDCO has requested the Contractor to undertake the operation and maintenance of Septage Management services within the Service Area in accordance with this Operation and Maintenance Services Agreement(OMSA);
- C. The Contractor, having represented to the ULB that it has the required managerial, technical, scientific, engineering and operational skills and competencies in respect of the design, construction, operation and maintenance of the Septage Management , has agreed to be responsible for the operation and maintenance of the Septage Management system as described in this Agreement and based on existing standards in the sector and reflecting service delivery reliability and quality.

THE PARTIES AGREE AS FOLLOWS:

1. INTERPRETATIONS

- 1.1. In this OMSA, unless the context otherwise requires:
 - a) ULB means the Urban Local Body

- b) **Septage Management Services** include: (i) Procurement of equipments and provision of services for collection and transportation of septage from households; (ii) Supply, construction, installation, testing and commissioning of septage treatment plant at Chas Town; and (iii) Operation and maintenance of the above system for 10 years including public outreach activities and collection of user charges from consumers.
- c) **Commencement Date** means the date as specified by the ULB after successful completion and commissioning of the system and components including service connections existing at the time of commissioning.
- d) **Operation and Maintenance Contract** means the clauses and provisions contained in the agreement that relate to Operation and Maintenance of Septage Management Services.
- e) **Generally Accepted Accounting Principle** means the generally accepted accounting principles prescribed by the Institute of Chartered Accountants of India.
- f) **Service Area** means the Municipal limits of Municipal Council.
- g) **Project Manager** shall be the Project Manager of JUIDCO.

2. COMMENCEMENT OF THIS OMSA

This OMSA shall come into effect on the Commencement Date

3. DURATION OF THIS OMSA

This OMSA shall continue in force for a period of ten [10] years ending on the [tenth] anniversary of the Commencement Date.

4. NOTICE UNDER THIS OMSA

Any notice, instruction, direction, requestor permission to be given or made under this OMSA shall be in writing and signed by:

For the ULB: _____

For the Contractor: _____

The Contractor or any person authorized by and acting on behalf of the Contractor. Such authorizations shall become OMSA Documents

Such notice, instruction, request or permission under sub-clause 4.1 shall be deemed to be duly given or made when it shall have been delivered by hand or mail at the address of the party concerned as specified below:

For the ULB:

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

For the Contractor:

.....
.....

5. APPOINTMENT AND RESPONSIBILITY OF THE CONTRACTOR

- 5.1. The ULB hereby appoints the Contractor to be the sole and exclusive manager of the Septage Management Services in the Service Area for the duration of this OMSA.
- 5.2. The Contractor shall, in such manner and at such times as it shall in its absolute discretion see fit, use all its skills and knowledge to manage, administer, conduct, maintain and develop the Septage Management Services in the Service Area in an efficient and professional manner, in the best interests of the ULB, and in accordance with Good Industry Practice and Applicable Law. In particular but without prejudice to the generality of the foregoing, Contractor shall carry out the duties and obligations set out in this Agreement to ensure that the performance of the Septage Management Services is in compliance with the terms and conditions of this Agreement and meets the Performance Standards specified in Schedule 4.
- 5.3. The qualification and experience of the key staff as identified in the Bid for the Operations and Maintenance Period is attached in Schedule 7 to this OMSA. The Contractor shall confirm the key staff being available and ready to start work in the Service Area at least 3 months prior to the commencement of the operation and maintenance Period. In case the Contractor is required to change any of the identified key staff due to unavoidable circumstances, such change will be subject to approval from the ULB in justification provided by the Contractor. The proposed replacement shall have to be of equivalent or higher qualification and experience specified in the above referred schedule for the respective key staff.
- 5.4. All other personnel deployed by the Contractor for the provision of services under this Agreement shall hold relevant qualifications and appropriate training and shall have sufficient relevant experience to ensure the operation and maintenance of the Septage Management Services is in compliance with the terms and conditions of this Agreement.
- 5.5. Notwithstanding Clause 5.1, the Contractor may sub-contract the day to day management of the Septage Management Services and Assets in the Service Area, or sections of the Service Area or any part of the system or Assets to any person or entity subject to compliance with the following requirements:
 - a. the Contractor shall not sub-contract the performance of any of its obligations under this OMSA without first informing the ULB in writing, providing such information about the sub-Contractor as the ULB may require, and obtaining the ULB's written consent (not to be unreasonably withheld);
 - b. the Contractor shall remain liable under this OMSA for the performance of any obligations subcontracted by it under this Clause; and
 - c. failure by the Contractor to inform the ULB and to obtain the ULB's written consent to any purported assignment of any of its obligations under this OMSA shall invalidate the sub-contract

as well as constitute a ground for termination of the OMSA by the ULB under Clause 21 of this OMSA.

The contractor shall sub-contract the OMSA only if the sub-contractor **satisfactorily completed as a prime contractor at least one similar O&M work of value not less than 35% of O&M contract value in any one year.**

6. SAFEGUARD, USE, MANAGEMENT AND CONTROL OF ASSETS

- 6.1. The ULB reserves the rights in the assets comprising the system in sub-clause 5.1 set out in the Third Schedule to this OMSA at all times.
- 6.2. The Contractor shall have access to, the right to use, and the duty to safeguard, manage and control the assets referred to in sub-clause 6.1, for the purpose of discharging its duties and obligations or exercising its rights under this Agreement, for the term of this Contract.
- 6.3. The Contractor shall maintain in good working condition, throughout the term of this OMSA, the assets referred to in sub-clause 6.1 and shall ensure that adequate control is maintained over assets owned by, or in the custody of the Contractor.
- 6.4. The Contractor shall not dispose of or create any lien, charge or proprietary interest of any nature whatsoever in favor of the Contractor or a third party in the assets referred to in sub-clause 6.1, except on the express written instruction of the ULB.
- 6.5. The Contractor shall comply with any directions of the ULB to use or dispose of any asset or any money or other consideration to which the ULB becomes entitled as a result of disposing of any asset referred to in sub-clause 6.1.
- 6.6. **Deleted.**

7. OBLIGATIONS OF THE CONTRACTOR

- 7.1. During the term of this Agreement, the Contractor shall be responsible for operation and maintenance of all components, including and without limitation components built new and existing, of the septage management system, and including ancillary equipment, in compliance with the terms and conditions of this Agreement to meet the Performance Standards specified in Schedule 4. This will include all systems supporting the provision of services including septage collection system, septage treatment system, customer grievance redressal system, billing systems and any other works included under the contract.
- 7.2. The Contractor shall procure grants, licenses and renewals of, and keep up to date, all Applicable Permits to enable the Contractor to perform the Services throughout the term of the Agreement other than those Applicable Permits that are to be applied for by the JUIDCO
- 7.3. If and as required, the Contractor shall provide assistance to the ULB or agencies/advisors nominated by it to liaise with other Governmental agencies in any interface in the operation of the septage management system;
- 7.4. The Contractor shall collect septage from individual households as per the schedule fixed for the service area, transport the same to the septage treatment plant, treat the septage to prescribed

effluent quality, dispose the treated effluent and sludge as per requirements of the bid document, and collect the user charges as applicable.

7.5. The Contractors shall fully operationlise the Customer Grievance Redress System through establishing and maintaining two(2) Customer Service Centers in identified locations of the Service Area (made available by ULB) for customer grievances and recording and keep them open between 0800 hours and 1900 hours, for a minimum 5 days a week. At each such office, make arrangements for recording of complaints (through web site or register) from Customers/citizens. Additionally, operationalize and maintain atleast one centralized call centre, online web based system complaint registration systems which shall be accessible on24X7basis.

7.6. Deleted

7.7. Deleted

7.8. In discharging the duties and obligations referred to in sub-clauses above, the Contractor shall:

- a) exercise due diligence, efficiency and economy in accordance with generally accepted professional conduct and practice, and shall employ sound management practices and appropriate technology in the best interests of the ULB;
- b) comply with:
 - 1) Codes of workmanship prescribed by the legislation of India and Jharkhand
 - 2) the service standards specified or referred to in the Fourth Schedule to this Operations and Maintenance Agreement
 - 3) provisions of all relevant laws relating to the duties and obligations referred to in sub-clause7.1, including as relating to occupational health safety of employees, to the environment, to the collection and payment of taxes and to any other matter whatsoever.
 - 4) the terms of any water or waste discharge permit granted to the ULB.
 - 5) any notice, instruction or direction issued in accordance with clause4
- c) familiarize himself and be in confirmation with the terms of the Indian legislation for Septage Management and any statutory clearances for the Septage Management Services and shall perform the Service in conformity with all of the conditions of these consents.
- d) pay all taxes, rates, charges, fees, and penalties and provide all returns, files and documents required of it under applicable tax laws or other laws and discharge all obligations imposed on it by such laws Failure by the Contractor to comply with the foregoing provisions shall amount to a breach of this OMSA, subject to clause 21 at the discretion of the ULB.

8. SYSTEM MAINTENANCE AND IMPROVEMENT

8.1. One month prior to the commencement of the operations period, the Contractor shall prepare and provide JUIDCO a plan containing its proposed operating strategy and programme of preventive and other scheduled maintenance for the first year of operations (Draft Operations and Maintenance Plan). Subject to approval by the JUIDCO, the plan shall comply with the operation and maintenance manual and safety requirements. The Draft O&M Plan shall include:

- a) Implementation plan for effective operations and maintenance, leakage control, asset management and customer services and emergency repairs.
- b) required and proposed extensions or additions to the septage management systems, along with the justification and the cost implications

- c) other information that the Contractor may consider appropriate or that may be specified by the ULB

Upon approval by JUIDCO, or expiry of 30 days from submission, the Draft O&M Plan shall be the approved O&M Plan to be implemented by the Contractor.

- 8.2. The Plan shall be prepared and submitted for approval every two years before the start of next cycle of operations.
- 8.3. The Contractor shall be responsible, at its own cost, for managing all preventive maintenance and normal repairs, major maintenance or replacements (if any required) to the system as per the O&M Plan, including rectifying damage to the system due to any act of negligence in performance of its functions, deemed necessary to maintain the value of the assets included in the Third Schedule and ensure operations in compliance with the Performance Standards in the Fourth Schedule.
- 8.4. If the Contractor is of the opinion that matters have arisen that may prevent, or significantly affect the implementation of the O&M Plan, the Contractor shall immediately notify the ULB of its opinion and there as on thereof.
- 8.5. In case of occurrence of an insurable event, the Contractor shall be responsible for informing the insurance agency about the event, complete any survey, follow-up with the insurance agency for insurance claim settlement and repair/replacement of assets affected by the insurable event. The expenditure on repair/replacement shall be certified by the Project Manager. In the event the expenditure on repair/replacement of assets due to insurable event is more than the insurance claim settlement, the difference would be borne by the Owner.

9. BILL GENERATION, DISTRIBUTION AND COLLECTION

- 9.1. During the Operation and Maintenance Period, the Contractor shall be responsible for generation of bills to customers as per user charges fixed by the ULB and provided in Sixth Schedule; delivery of bills to customers and collection of the same from the users.
- 9.2. The Contractor shall under take generation of bills in the name of ULB and distribution of bills on behalf of ULB
- 9.3. The Contractor shall follow good industry practices including use of modern technology including but not limited to mobile hand-held devices for billing and distribution
- 9.4. The responsibility for collections also remains with the Contractor. All the collections shall be deposited in the Escrow Account (as referred to in the main bid document). In case of defaulters who are not paying the user charges as per requirements, the Contractor may submit the list of same to ULBs for their assistance. The ULBs shall assist the Contractor in the collections part by issuing warning letters to such users.
- 9.5. The records for billing and collections of water charges shall be updated in real time in the financial management system and customer data base developed by the Contractor, and accessible to the ULB. Viewing access for collection records for each and all customers in the Service Area shall be provided by the ULB to the Contractor.

10. CONTRACTOR FEE

- 10.1. Subject to the provisions of this Contract and in consideration of the Contractor accepting the rights under this Contract, and undertaking to perform and discharge its obligations in accordance with the provisions of this Contract, the JUIDCO agrees and undertakes to pay to the Contractor Fees in accordance with Schedule 4.
- 10.2. The payment of Contractor Fee for services shall be on basis of quarterly invoices specified in Schedule to this Agreement.
- 10.3. The Contractor Fee payable shall be subject to meeting Performance Standards and adjusted in the manner provided in Schedule 4.
- 10.4. The Contractor should raise invoice within 15 days of completion of a quarter for services relating to the previous quarter and submit the same to ULB. The ULB shall certify and approve the payment of the invoice within 45 days of submission of the invoice.
- 10.5. The ULB shall be responsible for making quarterly payment to the Contractor for services provided.
- 10.6. During the Operations Period, all requests for new users will be submitted to the Contractor, but require to be authorized and approved by the ULB.
- 10.7. *Deleted*
- 10.8. *Deleted*
- 10.9. *Deleted*

11. TO MAINTAIN AND KEEP RECORDS

- 11.1. The Contractor shall keep proper and adequate accounts and records of the transactions and affairs of the septage management and shall keep records that are necessary to explain the financial operations and financial position of the system.
- 11.2. During the O&M Period the Contractor shall keep a computerized data base of customer's records including billing and collection. Collection information would be updated based on actual collection information for each customer as available with the accounting system of ULB. The contractor shall be given access to the water charge collection accounts of ULB. The Contractor shall keep a record in an electronic format using simple office management software. There should be suitable controls to prevent unauthorized access to these records. The Contractor shall be required to allow inspections of these records to the ULB or his authorized representatives.
- 11.3. The Contractor shall develop and maintain an adequate budgeting and accounting system. The Contractor shall develop and maintain an adequate internal accounting control system.
- 11.4. The accounting period of the Contractor shall coincide with the accounting period of the ULB.
- 11.5. Without detracting from sub-clause 11.1, the Contractor shall keep the records referred to in the Fifth Schedule of this Operations and Maintenance Agreement and shall retain those records for the period prescribed in the Schedule..
- 11.6. Except as provided below and specified otherwise in any other clause, all records are confidential to the Contractor and the ULB.
 - a) Any customer or former customer of the Contractor may apply to the Contractor for a copy of all records held by the Contractor concerning that customer, in such a form as may be prescribed by the ULB.

- b) The Contractor shall provide a customer or former customer under sub-clause 11.6(a) with a copy of the relevant records, but may impose a reasonable charge to cover the costs to the Contractor of making the copy available in accordance with clause 11.6(a).

12. REPORTING REQUIREMENTS

- 12.1. The Contractor shall, in respect of each quarter of a financial year and no later than 15 calendar days after the end of such quarter, prepare a report to the ULB containing:
 - a) information about, and an analysis of, its operations for the quarter and cumulatively for the year to date; and
 - b) Financial statements in accordance with Generally Accepted Accounting Principles for the quarter and cumulatively for the year to date.
- 12.2. The report referred to under sub-clause 12.1 shall:
 - a) be prepared in a form acceptable to the ULB;
 - b) contain the information specified in the Fifth Schedule of this Operations and Maintenance Agreement and any other information determined by the Contractor to be appropriate; and
 - c) Contain any other information reasonably required by the ULB.
- 12.3. The financial statements referred to under sub-clause 12.1(b) shall:
 - a) contain information determined by the ULB to be appropriate;
 - b) include an assessment of the cost of carrying out any other obligation that is imposed on the Contractor under this OMSA and that requires the Contractor to act otherwise than in accordance with normal commercial practice;
 - c) be prepared in a manner and form approved by the ULB; and
 - d) Present fairly the results of the financial transactions of the Contractor during the financial period to which they relate and the financial position of the Contractor as at the end of that period.
- 12.4. The Contractor shall, in respect of each calendar month, and no later than 5 days after the end of such month, prepare a report to the ULB containing:
 - a) the billings for the month showing distinctly the net billings, and gross billings;
 - b) collections for the month showing distinctly the net billings, and gross billings collected;
- 12.5. The ULB may require and the Contractor, when notified, is obliged to appear in meetings of the ULB convened to discuss the affairs of the ULB. The ULB may request the Contractor to make such presentations, reports, demonstrations or take such actions as the ULB may deem necessary with reasonable prior notice.
- 12.6. Failure of the Contractor to comply with the provisions of this clause shall amount to a breach this OMSA, subject to clause 21 at the discretion of the ULB.

13. INSPECTION BY THE ULB

The Contractor shall allow the ULB and/or any person representing the ULB, access at anytime to:

- (a) any land owned or occupied by the ULB;
- (b) any assets renewed, acquired or constructed by the ULB;

- (c) any assets under the contract owned by the Contractor;
- (d) inspect any land, works, buildings or any other assets;
- (e) make any tests, take any measurements or take any samples;
- (f) take any photographs or make any plans or drawings; and (g) inspect and, if necessary, make any copies of any records or documents referred to in clause 10 in order to ascertain whether the Contractor is complying in every respect with this OMSA.

14. INDEMNIFICATION

Provided that the Contractor, their servants and employees shall use diligence and care in carrying out their duties here under, neither they nor any of their servants and employees shall be liable for any damage to persons or property arising out of any information, advice or service supplied to the ULB or act performed for the ULB or otherwise in the course of their duties here under. The ULB shall indemnify the Contractor and every such person against all claims, demands, losses, liabilities, actions, lawsuits, costs and expenses arising directly or indirectly out of or in consequence here of or in the implementation of this OMSA.

DUTIES, RIGHTS AND OBLIGATIONS OF THE AUTHORITY

Without detracting from any duties, obligations and rights imposed on or conferred upon (whether expressly or by implication) the ULB by this Operation and Maintenance Agreement, or implied by law or commercial custom on persons similar to the ULB, the ULB shall have duties obligations or rights in the following:

15. ADJUSTMENT OF TARIFFS, FEES, RATES AND CHARGES

- 15.1. The Owner shall have the right and obligation to set and adjust the tariffs, fees, rates and charges to be charged under clause 9, subject to the provisions of the Second Schedule.
- 15.2. At the Commencement Date the water tariff is set at the level given in the Sixth Schedule to this Operation and Maintenance Agreement.
- 15.3. In exercising its rights under sub-clause 15.1, the ULB shall, from time to time and whenever tariff adjustments have taken place, publish a schedule of approved tariffs, fees, rates and charges and related instructions and shall furnish the Contractor with such schedule.

16. RECOGNITION OF THE CONTRACTORS RIGHTS TO CHARGE TARIFFS AND CONNECTION FEES

- 16.1. The Contractor has no right to charge individual beneficiary/user connected to the septic tanks in accordance with Clause 9. **This does not seem to be valid in our case. Can be deleted??**

17. AUDITING OF ACCOUNTS

- 17.1. The ULB shall have the right to appoint an audit or to examine the accounts, books and records of the Contractor.
- 17.2. The ULB shall pay the costs of any audit or engaged under sub-clause 17.1.

18. NON-INTERFERENCE WITH OPERATIONS

The provisions in this OMSA notwithstanding, the ULB shall not interfere with the day to day operations of the Contractor. In particular, the ULB shall not:

- a) issue instructions to the Contractor regarding operational decisions or actions except by way of the ULB's approved business plan or amended business plan or as required by the law;
- b) Withhold payments due to the Contractor on account of the Contractor refusing or failing to comply with instructions issued in contravention of this clause;
- c) Contravention of this clause by the ULB shall constitute a breach of this OMSA subject to termination of the OMSA under clause 21.

MISCELLANEOUS PROVISIONS

19. WAIVER

- 19.1. A failure, delay or indulgence on the part of either party in exercising any power or right under this OMSA does not waive that power or right.
- 19.2. Any single exercise of a power or right under this OMSA does not preclude any other or further exercise of it or the exercise of any other power or right under this OMSA.

20. AMENDMENT OR VARIATION

This OMSA may be amended or supplemented, at anytime, in writing signed by both parties.

21. SUSPENSION AND TERMINATION

As per provisions in Article 11 of the General Conditions.

22. TRANSFER

- 22.1. The Contractor shall be responsible for transfer of all assets, equipment, customer records and other material created or maintained by the Contractor for the smooth operation and maintenance of the Septage management System.
- 22.2. At least three months before expiry of the O&M Agreement, the Project Manager shall assess, with assistance from IVT and/or PMC, if required, the useful life of the assets pertaining to the ULB which are part of service area. If the remaining useful life of assets is substantially less than what it should be if these were operated as per prescribed methodology, the Contractor shall be responsible for undertaking any refurbishment or replacement as required before hand over of the system at the end of O&M Period. If the Contractor fails to undertake such refurbishment or replacement, such reasonable amount as may be recommended by the value or otherwise can be deducted from any payments due to the Contractor including termination payment or Performance Security.

FIRST SCHEDULE

SERVICE AREA

Service Area under this contract is the area under the jurisdiction of Municipal Council as on the bid submission date. The Contractor shall, for the full term of the Operation and Maintenance Agreement, have obligations to provide services in compliance with the terms and conditions of this Agreement to the entire Service Area.

SECOND SCHEDULE

TECHNICAL SPECIFICATIONS FOR OPERATION AND MAINTENANCE SERVICES

OPERATION AND MAINTENANCE REQUIREMENTS

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General

Septage Management System i.e. Collection of septage from household to its treatment at Septage Treatment Plant (SeTP) and further to disposal of treated effluents shall be operated & maintained by contractor for a period of 10 years (120 months) post defect liability period. While activities involved in the operation & maintenance of works are given in subsequent paragraphs, it would be the duty of the Contractor to maintain the Plant to keep the grassy lawns & flower beds in the plant area in tip top condition & general upkeep of the balance area. Contractor has to ensure proper functioning and management of the overall system. The broad level task shall be as mentioned below but not limited to:

1. Collection of septage from household at planned interval of once in 2 years.
2. Collection of user charges as per prevailing rates. Refer detailed description of the same in clause 1.32 of this section.
3. While Collecting septage from household, contractor has to ensure that septic tanks shall not be physically damaged and no littering on roads while travelling to SeTP. If damaged, Septic Tanks shall be restored to its original positions by contractor.
4. Check the functioning of vacuum emptier and equipment
5. Check personal protective equipment – All employees should be responsible for maintaining their own personal protective equipment (such as gloves, boots, hat, face mask, Davy's lamp) in good condition
6. Check disinfecting and spill control equipment – Operators should be trained on identifying spills and proper methods of disinfecting. Sprinkle lime over spilled area, wait 15 minutes, then wash with water
7. Check Hoses – inspect hoses for cracks and wear– discard or repair worn and broken hoses. Connecting the Hose in the correct manner using the clamp style fitting ensures a tight and leak proof connection. Use of twine and plastic for making connections causes leaks and require cleanup.
8. Treatment of collected septage to the dedicated SeTP.
9. Final disposal of treated septage sludge and reuse/ disposal of treated effluent as per the tender requirements.
10. Depositing of collected user charges into Escrow Account.
11. During Operation & Maintenance, the Contractor is to ensure that the effluent to SeTP, shall not exceed the estimated quantity of Septage per day.

12. Operating the Plant at the design capacity maintaining the output quality in accordance with CPCB norms.
13. Keeping the down time of any equipment as low as possible and should be in compliance with Clause no. 1.2 (c) of this section of tender document.
14. Operating and Maintaining all the Plant, Equipment and Tools and making necessary repairs to civil structure and electro-mechanical part during the period of 10 years.
15. Technical and administrative monitoring of the Plant. Also, all necessary documents/records shall be maintained and properly stored.
16. The Laboratory for maintaining the overall performance of the Plant & those of any individual Units shall also be maintained & staffed by the Contractor. He will be responsible for daily monitoring of the Plant. Contractor shall maintain necessary records regarding quality at various stages of treatment.
17. General Tests such as BOD, COD, Suspended Solids etc. both for influent & effluent will have to be monitored on daily basis while any other test such as VSS, TSS, MLSS, MLVSS etc. may also be required to be done routinely. Contractor will be responsible for Manpower, Chemical Consumption & replacement of any broken Glassware.
18. Bonafide Electricity/ Diesel charges as per the meter reading of the Plant, Street Lighting, Plant Lighting and Laboratory Consumption will be paid by the contractor. Use of electricity by the Contractor for any purpose other than that elaborated above is prohibited and detection of any such case will attract action from client. The SeTP shall be maintained by following the specifications and directions given in Manual for Sewerage and Sewage Treatment published by CPHEEO, New Delhi.
19. Minimum staff which the Contractor will have to deploy for proper operation and maintenance & upkeep of the collection system and plant shall be as per this tender document.

Introduction

Maintenance comprises those operations which are well planned systematic programme of maintaining the Machinery and equipments by taking appropriate steps to prevent breakdown well in advance before it causes major damage. This prevents wastage of time, production loss and prolongs the life of Machine. This maintains better efficiency in the system and economizes the running cost of the Plant. It can be classified as:

- (a) Preventive Maintenance which constitutes works and precautions to be taken to prevent breakdown and
- (b) Corrective Maintenance which involves carrying out repairs after breakdown.

Preventive maintenance is more economical than corrective maintenance and provides uninterrupted service which is essential to achieve the basic objectives of collection and treatment viz. protection of health of the community and prevention of nuisance.

The primary aim is the running and maintenance of the collection system and Plant efficiently and economically so that the effluent from the Plant meets the prescribed standards in terms of pH/BOD/COD/TSS etc. laid down while discharging the treated septage safely in public sewer, on land, in the water body or for recycling.

The basic requirements of successful operation and maintenance of collection system and SeTP are:

- Collection of Septage from households without damaging Septic tank using vacuum suction machine and carrying it to SeTP.
- Cleansing of septic tanks as plan and transport septage to the SeTP for treatment.
- A thorough knowledge of Vacuum Suction Machine, Treatment Plant, Machinery and Equipments provided in the Septage Treatment Plant and their functions.
- Maintain proper fencing with entry gate to the facility. All incoming and outgoing details shall be maintained.
- A thorough knowledge of the processes.
- Proper and adequate tools.
- Adequate stock of Spares and Chemicals.
- Assignment of specific maintenance responsibilities to operating staff.
- Systematic and periodic inspection and strict adherence to servicing schedules.
- Training of all operating Staff in proper Operating Procedures and Maintenance Practices.
- Overall supervision of Operation & Maintenance Schedules for vehicles and units of SeTP.
- Good housekeeping.
- Proper logging of all Operation & Maintenance activities for technical and financial aspects i.e. maintain a ledger for revenue generation and expenditure receipt.
- Observation of safety precautions & procedures.
- Provision for water supply for drinking and other uses in the seTP.

The various Units of the Plant are designed for maximum efficiency within a certain flow range and input effluent quality. Close control and co-ordination of operation of different Units are therefore, required within the limits of design so as to achieve maximum efficiency. Hence, accurate measurements of flow of raw septage, treated effluent and sludge are required. For this purpose, Flow Measuring Devices and Meters are provided to guide the Operator in his supervision and obtain data for progressive improvement. For quality control, analysis of raw effluent, sludge, digested sludge etc. as they pass through different Units of the Treatment Plant and of the treated effluent should be carried out on a regular basis. Proper recording of data is essential for an accurate assessment of deficiency of operation. On the chemical side, dosages must be closely and accurately proportioned to the varying rates of flow of influent and sludge based on analysis.

Better operation is possible only when the Septage Collection, Operating, Maintenance and Laboratory Staff is fully conversant with the characteristics and composition of raw effluent handled and the results achieved during each State or Unit of the treatment process.

Operation and Preventive Maintenance of collection vehicle and several treatment units and the frequency of cleaning, lubrication of mechanical equipments etc. are to be strictly adhered to if optimum results are to be expected.

Operation & Maintenance Services

The Operation and Maintenance Services shall be made according to the following specifications.

a) Collection of Septage from Households

Contractor shall deploy trained staffs for collection of Septage and clean the septic tanks as per Cleansing/collection plan of Septic tank for households based on Frequency and Routing. Households shall be informed well in advance to household owners regarding septage collection to avoid/hurdles in the collection.

Proper receipts for work done and collection of user charges shall be provided to household owner and properly documented in the records.

b) Resolution of complaints

Contractor shall act upon the complaints received at the earliest and resolve. There should be proper record of consumer complaint and its corrective action taken by the Contractor. After resolution of complaint, the counter signed copy by complainant should be duly preserved. The consumer complaint redressal system has been detailed in Clause 1.30 of this section.

c) Maximum Downtime

The Plant shall never be operated at less than 50% of its design capacity due to maintenance and repair reasons. The period of 50% operation shall not exceed more than two consecutive days and not more

than three days in a week. The maximum downtime to the whole Plant shall not exceed more than 8 continuous hours. The periods for repairs and maintenance have to be communicated to ULB at least one month in advance.

d) Operation of the Plant

The Plant shall be operated according to the rules and procedures laid down in the Operation & Maintenance Manual as required according to the required raw septage characteristics of the SeTP. The Plant must be in a position to work at the design and overload capacity at any time and to produce the design / overload output.

e) Carefulness and Cleaning

The Contractor and his staff have to ensure a maximum of carefulness in the operation and maintenance of the Plant. At any time, the Plant and its equipment and surroundings have to be kept clean and proper.

f) Preventive maintenance frequency

The preventive maintenance will be made according to the Preventive Maintenance Schedule of the Plant. Short term specialists of the Contractor for special Maintenance tasks may reinforce the regular staff. The operation, maintenance and repair shall be made with the help of the equipment and tools available at the Plant, backed-up and completed with the facilities of the Contractor at his HQs or brought to the Plant by him temporarily for a special maintenance

e) Repairs

Repairs shall be made as and when needed on the spot or at the Contractor's Workshop has to be defined in co-ordination with the ULB and according to the status of the spare parts availability.

f) Spare Parts

The Contractor has to keep reasonable stock of Spare Parts so that the downtime of equipment can be kept in the limits. The content of the stock has to be approved by ULB.

g) Transportation

All necessary transports shall be arranged and made by the Contractor at his own costs.

Buildings

Building should be well ventilated and illuminated. They should be maintained and kept in good repair, white or colour washed metallic parts being painted annually. The effect of corrosive gases could be minimized by proper ventilation, proper collection and disposal of corrosive gases and painting the structures which are prone to be attacked by the gas, with anticorrosive paints. Dampness inside buildings

could be reduced by proper ventilation. Wherever necessary, exhaust fans and forced ventilation should be adopted.

Equipments

- The Operator should maintain a book of Catalogues supplied by the Manufacturers containing instruction sheets of all equipments. In addition, printed or written Operating and Maintenance Schedules should be displayed near each equipment in the language understood by all operating staff.
- Lubrication Schedules, Cleaning and Painting Schedules, Checks for efficiency, leaks and wear and tear and testing of Safety Devices should be followed strictly according to manufacturer's instructions.
- All Metering Devices should be maintained in proper working condition including calibration. Charts should be changed at the same hour every day. Records maintained should show total maximum and minimum rates of flow.

Operating, lubricating and maintenance instructions for all Pumps and other mechanical equipments should be strictly followed. Special attention should be given to maintaining Pumps in an efficient operating condition, free from clogging, excessive friction or entrance losses and abnormal power consumption due to wear and tear. Sludge level in the Wet Well should not be lower than the minimum designed level and all accumulation of grease and other deposits removed promptly. Floats and sequence switches controlling the pumping cycles should be examined at the beginning of each shift. All Pumps including standby pumps should be operated in rotation so that the wear and tear is distributed evenly. All bearings, motors and electrical control equipment should be inspected daily for any over-heading. The manufactures directions for operation and lubrication should be strictly followed. Packing glands should be checked for over-tightening. When pumps may have to be operated automatically time interval between start & stop, should not be less than 5 minutes. A reversing switch shall be installed for dislodging the clogging materials. This can also be achieved by taking the backflow from the header main. Valves and piping should be regularly checked for leaks. Leaks should be attended to as per the instruction in the manufacturers catalogues. Gas masks must be used while attending to chlorine leaks. Operation records should show the volume of sewage chlorinated, rate of application of chlorine, residual chlorine in the plant effluent and the amount of chlorine consumed each day.

Safety in the Plant

- The work of an Operator in a SeTP presents many hazards that must be guarded against. Common type of accident is injuries from falls, deaths from drowning and asphyxiation. Narrow walks or steps over tanks (particularly in darkness, rains and wind) ladder and spiral staircases are potential danger spots where the operator should be alert; overexertion during operation of valves, moving weights and performing other arduous tasks should be avoided. All open tanks should be provided with guard rails to prevent accidental falls. Glass parts as well as moving parts should be protected

by screen or guards. Adequate lighting within the plant and around the plant should be provided which gives better working facility reducing accidents on account of slipping etc. Honeycomb grating be provided on open channels to avoid accidents on account of falling down or drowning. The staff should be trained and compelled to use helmets, gumboots, hand gloves etc. Wherever necessary, precautionary boards/danger boards/sign boards should be displayed in the plant (wherever necessary), drawing attention to the potential danger spots. Gas poisoning, asphyxiation and gas explosion are other hazards. Hence smoking or carrying open flames in and around digesters should be prohibited. Covered tanks, wet wells or pits should be well ventilated. Before entering, they should be kept open for sufficient time or preferably forced ventilated as the present problems of asphyxiation. Entry into them should be permitted only after ensuring the safety by testing for the presence of hazardous gases. Gas masks should be stored in location where no possibility of contamination by gas exists and should be easily accessible. A first aid kit should be available readily at hand. Fire extinguishers of the proper type should be located at strategic points and maintained in good operating condition at all times by testing them.

- All staff should be trained in rendering first aid and operating fire extinguishing equipment. Adequate number of toilets and bathing facilities, drinking water facilities and locker should be provided for the convenience of operating staff and protection from risk of infection. canteen should be maintained hygienically.
- All workers should be compelled to observe personal, hygiene such as washing with soap after work as well as washing before taking food. The use of antiseptics along with washing should be emphasized. The employees should be medically checked after every six months especially for eye sight, hearing, indigestion, mental capability, T.B. Diabetes, heart troubles etc.

Training of Personnel

All operating staff engaged in technical and skilled work should be trained. This plant is to be headed by a plant manager who should have the necessary training with considerable experience in effluent treatment. All junior operation staff should receive in service training. It is desirable that all components of SeTP are run and maintained by operators who hold certificates of competency. The person who would be looking after the maintenance and operation of the plant should be preferably involved in the activities at the time of design, procurement and installation including inspection of equipment at manufacturer's place and their test and trials on completion of system. The operation and maintenance staff should undergo training from time to time as to keep them conversant with the operations, health, safety and environment. The staff should also be encouraged by sending them to other similar plants. They should also be provided with well-equipped library for references and also be sent for higher studies. The contractor would impart necessary training to the designated ULB staff for taking over and carrying out proper maintenance after the expiry of his contract. The training shall be imparted in a training institute as well as at the field. The total training shall not be less than 6 months.

Recording and Reporting

All operating records of the septage management system comprising collection of septage through vacuum suckers to various treatment units in a plant should be properly compiled on a day-to-day basis and daily, monthly and yearly reports prepared, maintained and periodically reviewed. These reports will form a valuable guide to optimise the septage collection system and better operation and serve as an important document in the event of a legal suit resulting from nuisance or danger attributed to the plant or for meeting the statutory requirements about the satisfactory performance of the plant, computers should be used for storing and compiling such voluminous information and to have easy access for prompt information when called for. This would also help in reviewing the performance of the various equipments and plant as whole.

Operations

Operating the Septage Collection Vehicles - Vacuum Suckers

Operators should become familiar with the proper operation of the equipment in use for each operation. This includes the physical operation of the truck, and all valves, piping, power take-offs and ancillary equipment for the vacuum emptier (including the tank, valves, hoses, and fittings). The following steps can be followed for operating the vacuum emptier:

1. Reach the first site and meet the building owner.
2. Before pumping, check the tank to look for obvious damage to the structure and to verify proper piping is in place.
3. Check the water level to get clues as to tank condition: high levels (above outlet level) indicate a clogged outlet; low levels (below outlet level) indicate a leaking tank (or tank not in use).
4. Check for back flow into tank during pumping and when pumping is complete. Flow back may indicate a problem with plumbing in the house or clogged disposal.
5. Open the access covers, inspect the interior and exterior of the tank. If more than one, locate and remove lids from all compartments.
6. Each compartment will require pumping after ventilating. Probe the tank with the last length of hose. This will provide an indication on the volume of sludge to pump.
7. Start the pump or vacuum equipment. The operator will make sure there is suction and that the pump is operating.
8. Volume in the tank should start decreasing rapidly. Use hose to break up sludge and scum to the extent possible.
9. After pumping is complete, check the tank for remaining sludge. If there are accumulated solids remaining, initiate the pump-back procedure, which is to send the pumped faecal sludge under pressure back into the tank and direct this flow toward the sludge mass. This will break up the

mass, making it possible to pump out. When pump-back is complete, pump out the tank again (suction). When pumping is complete, wash the hoses and replace the tank lids. Leave back small amount of sludge of around 1 to 2 inches in the tank so that its microorganisms can act upon the new incoming faecal waste. Clean up any spills and disinfect with lime or bleach solution. Chemicals such as lime can also be added into the suction trucks to neutralize the septage, to render the septage more treatable and to reduce odours

Daily Operations of Septage Treatment Plant

The Contractor shall carry out all facility operation and waste water disposal operations indicated below; in accordance with Good Operating Practices, as set out in this Contract. The Facility operation and waste water disposal operations shall include, but not be limited to the following:

- Operating Septage Treatment Plant to maintain the quality of treated effluent within the standards prescribed in the Tender/CPCB's norms, operate electrical equipment during power failures by operating generators, operate the Centrifuge for sludge drying and treat incoming effluent at prescribed standards through optimal dosing.
- Carrying out daily cleaning of grit channels and removal of screenings and disposal of floating matter in grit dewatered sludge out of premises. Carrying out continuous flow measurements of treated & raw effluent and recording the same as per tender requirements. Collecting samples of influent and effluent and analyzing them daily to determine the quality of effluent and performance of the treatment plant and providing security for facilities and system at all times.

Contingency Plan

Developing and implementing contingency plans in respect of responses to natural disasters, periods of power failure, storm water inflow into Septic tanks during monsoon, de-silting of units of treatment plants, constraint operations or other similar emergencies to maintain the quality of treated effluent.

Energy Audit

The Operator shall take all necessary measures to minimize the power consumption in carrying out its operations. The energy audit operations shall include, but not be limited to the following. Reducing electricity consumption by regulating equipment operation through suitable modifications to the operating schedules. Maintaining power factor and demand to avoid penalty installing more efficient pumping equipment and following better maintenance practices for electrical installation.

Repairs and Maintenance (Collection vehicles and SeTP premises)

The Contractor shall carry out preventive, routine maintenance and break down maintenance Operations for proper upkeep of collection system and plant in accordance with good operating practices. The following items shall be included in such maintenances.

i) Machinery and Treatment Plant Equipment

- Vacuum Suction Machine and its vehicle
- Dewatering and de-silting of sludge Sump, chemical dosing tanks at least twice a year as per approved programs and disposal of silt.
- Cleaning and maintaining all rising mains/sewers in the plant area at least four times a year.
- Repairing and replacing damaged pipes, fittings and valves for suction and delivery pipe.
- Repairing and replacing pump impellers, body, bearings shafts column pipes.
- Repairing and replacing motors
- Repairing and replacing starters, circuit breakers, capacitors
- Repairing and replacing vanes and/or gears of agitators
- Repairing and replacing transformer.
- Repairing of blowers, decanter, diffusers, chlorinator, chemical dosing equipments & Centrifuge.

ii) Building and Civil Structures

- Water proofing leaking roofs of the Buildings.
- The preventive and routine maintenance shall include all repairs and provision of spares material and tools required for these repairs. The Contractors shall also carry out breakdown maintenance and repairs. The labour, tools and plant, spares shall be arranged by the Contractor. The following spares shall be the respective responsibility of the Contractor and the Employer during preventive routing and breakdown maintenance.

Advice Early Warning:

The Contractor is to warn the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the operations or the condition of the facilities and / or system. The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstances can be avoided or reduced and in carrying out any resulting instruction of the Engineer.

The Contractor shall also advise the Employer from time to time, on improving the quality of operations, reduction in water / energy losses and betterment practices.

Replacing

The Contractor shall utilize the office space, provided by the Employer to establish its monitoring and reporting office along with computer and peripherals. It shall also obtain a telephone connection and maintain the same through the Contract period. All data transfers and updates made to the Employer shall be affected through the said telecommunications medium. The Contractor shall carry out all reporting indicated below and as set out in this Contract. The reporting shall include, but not be limited to the following

- Daily summary of Operations at Septage Treatment Plant – A daily report of operation of the diffusers, agitators, decanter and other equipment at the Septage treatment plants providing information on the quantity of Septage treated, hours of operation of equipment, energy consumed and use of chemicals.
- Effluent Quality Monitoring – A daily report monitoring the quality of raw and treated effluent through the analysis of samples.
- Sewer / Storm Water Drains / wet well & other units etc. - Monthly cleaning report of sewer / storm water drain de-silted and record of silt disposed at disposal sites.

Employer's Responsibilities

The Employer shall be responsible for procuring obtaining and maintaining Employer Clearances required, however that the Contractor shall be responsible for maintaining the conditionality of any such clearance, if such maintenance falls within the purview of the Contractor. The Employer shall supervise the Contractor's Operations at all times and notify the Contractor of any defects that are found. Such checking shall not affect the Contractor's responsibilities. The Engineer-in-charge may instruct the Contractor to search for a defect and to uncover and test any work that the Employer considers may have a defect.

The Employer shall be responsible for:

- Treated effluent testing charges from State PCB if required.
- Maintaining administrative control over the personnel, facilities and system.

Contractors Responsibilities

The Contractor shall maintain properly and keep intact all assets /vacuum suckers/works/facilities/ system of the Employer throughout the Contract period and shall hand over the same in good working condition at the end of the Contract. The Contractor shall not modify or alter any operations regarding the facilities and / or system without prior written permission of the Employer or its representative. The Contractor shall procure all spare parts required for the maintenance of equipment excluding those to be supplied by the Employer. The Contractor shall warrant to the effect that all the spares shall be procured from the authorized sources and be of the better quality or quality mentioned in this Bid Document and fit for the purpose for which it is being used.

The Contractor is expected to carry out the work in such a manner as not because any damage to public property on account of negligence or otherwise. The Contractor shall be fully responsible for making good the damages so caused by him entirely at his own cost.

The assets / works / facilities / systems of the Employer shall be at the risk and in the sole charge of the Contractor and it shall be responsible for making good any loss or damage there to arising from any cause whatever including that due to a theft or robbery.

The Contractor shall provide adequate engineering equipment, maintenance staff, inventories plant and machinery and all other things, whether of a temporary or permanent nature required for carrying out operations under the Contract.

The Contractor shall carry out its Operations, so far as compliance with the requirement of the Contract permits, so as not to interfere unnecessarily or improperly with:

- The convenience of the public
- The access to use and occupation of public or private roads and footpaths to or of properties.

Permissions: The Contractor shall obtain all required permissions, sanctions clearances and permits for carrying out its Operations, including Contractors clearances and shall be fully responsible for carrying out the operations in a safe and secure manner, consistent with the law of the land, laws and regulations regarding such facilities and / or System and directives of any Authority and planning permissions.

Safety: The Contractor shall be responsible for the safety of all activities on the site and shall be absolutely and solely responsible for any and all kinds of injuries or damages to persons and property of any description whatever may be caused by or result from the operations carried out, whether these may have been carried out skilfully and carefully and strictly in conformity with the provision of the specifications or not.

Discoveries: All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall as between the Employer and the Contractor, be deemed to be the absolute property of the Employer. The Contractor shall take reasonable precautions to prevent its workmen or any other persons from removing or damaging any such article or thing and shall, immediately upon discovery thereof and before removal, acquaint the Engineer of such discovery and carry out the Employer instructions for dealing with the same.

The Contractor shall be responsible for payment of reinstatement charges for roads, footpaths and land as per the Employer's rates. The Contractor shall take full responsibility for the adequacy stability and safety of all Site operations.

Staff & Labour:

Engagement of Staff & Labour

The Contractor shall employ skilled, semi-skilled and unskilled labour in sufficient numbers to carry out its operations at the required rate of progress and of quality to ensure workmanship of the degree specified in the Contract for timely fulfilling of the Contractor's obligations under the Contract and to the satisfaction of the Employer.

The Contractor shall not employ in connection with the operations any child who has not completed his/her fifteenth year of age. It shall also not employ an adolescent who has not completed his / her eighteenth year unless he/she is certified fit for carrying out operations as an adult as prescribed under clause b) of such section (2) (of Section 69 of the factories Act 1948).

The Contractor shall provide its staff, a minimum of two sets of uniforms with the titles the Employer inscribed on the back and subject to approval of the Employer. Each worker on duty shall wear a clean uniform whenever on duty.

The Contractor shall be required by the Engineer deliver to it, to such forms and at such intervals as the Engineer may prescribed a return showing the numbers of the several classes of staff employed by the Contractor on the site and such other information as the Engineer may require.

If the Employer asked the Contractor to remove a person who is a member of the Contractor's staff stating the reasons, the Contractor shall ensure that the person leave the site within seven (7) days and has no further connection with operations under the Contract.

At all times during continuance of the Contract, the Contractor and its subcontractors shall abide by all existing and future labour enactment and rules made there under, regulations, notifications and bye-laws of the Central, State or Local Government. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by any Authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments.

If the Employer is caused to pay or reimburse such amounts as may be necessary to carry or observe, or for non-observance of the provisions stipulated in the notifications/bye-laws/acts/rules/regulations including amendments if any, on the part of the Contractor and in connection with labour enactment, the Engineer shall have the right to deduct any money due to the Contractor including its amount of security deposit. The Engineer shall also have the right to recover from the Contractor, any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

Contractor's Superintendence

The Contractor shall provide all necessary superintendence while carrying out its operations and as long thereafter as the Employer may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor shall nominate a competent and authorized representative (Contractor Representative) approved by the Engineer-in-Charge and that may be withdrawn any time. The Contractor's Representative shall give its whole time to the superintendence of the operations. The

Contractor's Representative shall receive, on behalf of the Contractor, instructions from the Engineer which shall be deemed received by the Contractor.

Contract Performance Review and Progress

(a) Management Meetings:

Either the Employer or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining Operations and to deal with matters raised in accordance with any advice. The Employer shall record the business of management meetings and is to provide copies of its record to those attending the meeting and to the Employer either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

The Employer may instruct the Contractor to rectify defects and deficiency in its Operations. Alternatively, the Employer shall carry out the operations on its own and deduct the amount incurred in attending to such defaults from the next payment due to the operation. The deduction of such damages shall not relieve the Contractor from its obligations to carry out the operations, or from any other of its obligations and liabilities under the Contract.

(b) Notwithstanding anything stated above:

If the Employer is of the opinion that the actions of the Contractor is deemed as an event of default of services and the event persists beyond even after 3 written reminders, the Employer shall be entitled to invoke the Security deposit and carry out the operations through another Contractor or departmentally. The Employer shall then proceed as per Tender conditions.

Intellectual Property & Confidential Information

The Parties agree that all details, plans, manuals documentation, specifications, schedules, programs, reports, calculations and other work relating to the Facilities and / or Systems and the provision of operations pursuant to this Contract (hereafter referred to as "Proprietary Material") which have been or are hereafter written, originated or made by any of them or any of their respective employees, sub-contractors or agents and by the persons related to the Contractor in connection with this Contract shall be owned by and be the property of the Employer. The determination of information as Proprietary Materials shall be made at the sole discretion of the Employer.

The Contractor shall have an irrevocable royalty-free, non-exclusive license to use the Proprietary Material during the term of this Contract for all purposes connected with fulfilling its obligations hereunder. However, this license shall not be transferable to any party other than to a permitted assignee under this Contract. Such license shall not continue after the suspension or termination of this Contract or the discharge by the Contractor of its duties hereunder.

Confidentiality

The Contractor shall cause the persons related to the Operator not to, without the prior written consent of the Employer, at any time, divulge or disclose to any person or use for any purpose unconnected with the operations, proprietary material under this contract. This shall not apply to information.

- Already in the public domain otherwise than by breach of this Contract.
- Already to the possession of the receiving party before it was received from the office party in connection with this Contract and which was not obtained under any obligation of confidentiality;
or
- Obtained from a third person who is free to develop the same and which was not obtained under any obligation of confidentiality.

The Contract shall, whenever required take necessary steps to ensure that all persons employed by it, under this Contract comply with the Indian Official Secrets Act 1923 (XIX of 1923) and agree that it applies to them and shall continue to apply even after completion of this Contract.

No photographs of the Facilities or System or any part there of or equipment employed thereon shall be taken or permitted by the Contractor to be taken by any of its employees or any employees of its sub-Contractor without the prior approval of the Engineer in writing and no such photographs shall be published or otherwise circulated without the approval of the Engineer in writing. The Employer shall use its best efforts to ensure that the confidential proprietary information relating to the Contractor is not made public. However, the Employer shall not be liable in any manner whatsoever in case such information becomes public.

Assignment

The Contractor shall not subcontract the whole of the operations or a substantial part thereof. Except where otherwise provided by the Contractual conditions, the Contractor shall not subcontract any part of the operations without the prior consent of the Engineer. Any such consent shall not relieve the Contractor from any liability or obligations under the Contract and it shall be responsible for the acts, defaults and neglects of any subcontractor, its agents, servants or workmen as fully as if they were the acts, defaults or neglects of the Contractor, its agents, servants or workmen.

The Contractor shall not be required to obtain such consent for:

- The provision of labour or
- The purchase of materials specified in the Contract.

In the event of a Subcontractor having undertaken towards the Contractor in respect of the work executed or the goods, materials, plant or operation supplied by such Subcontractor, any continuing obligation extending for a period exceeding that the of the Contract period under the Contract, the Contractor shall

at any time, after the expiration of such period assign to the Employer, at the Employer's request and cost, the benefit of such obligation for the unexpired duration thereof.

Default of Contractor

Event of Default

At any time after the Commencement Date, the Engineer may investigate each case where the Contractor has failed to properly perform the operations in accordance with this Contract. The Engineer shall issue a notice to the Contractor, instructing him to rectify the failure within a reasonable time.

a) In event of default on the part of the Contractor being unable to fulfil its services obligations under the Contract shall be deemed as a serious default and is said to have occurred due to any of the following causes.

b) The Engineer certifies to the Employer with a copy to the Contractor that in its opinion the Contractor

- Has repudiated the Contract **or**
- Without reasonable excuse has failed to commence Operations in accordance with the Contract and pursuant to the Commencement date; or failed to complete the Operations within the time stipulated for completion.

c) Gross misconduct of the Contractor.

d) Despite previous warning from the Engineer, in writing, is otherwise persistently or flagrantly neglecting to comply with any of its obligations under the Contract.

e) Contractor persistently fails to follow good operating practices in execution of the Contract.

f) If the Contractor changes the use to which any part or whole of the Site is put or initiates a variation without the required approval of the Engineer.

g) The Contractor stops providing the operation for one day and the stoppage has not been authorized by the Engineer.

h) The Engineer gives notice that failure to correct a particular defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer.

i) If the Contractor is in breach of any law or statute governing the operations.

j) The Contractor does not maintain a security which is required.

k) The Contractor, in the judgement of the Employer has engaged in Corrupt Practices fraudulent Practices in competing for or in carrying out the Operations under the Contract.

l) If the Contract fails to obtain or keep in force the insurance requirements under this Contract.

m) The Contractor (in case of a consortium) has modified the composition of the consortium and/or the responsibility of each member of the consortium without prior approval of the Employer.

n) The Contractor is unable to maintain the composition and structure of its organization due to any of the following causes:

- The Contractor enters into voluntary or involuntary bankruptcy, or liquidation.
- The Contractor becomes insolvent.
- A receiver, administrator, trustee or liquidator is appointed over any substantial part of its assets and
- Any act is done or event occurs with respect to the Contractor or its assets which under any applicable law has substantially similar effect to any of the foregoing acts or events.'

Consequences of Default

- a) If a default by the Contractor is said to have occurred pursuant to the Employer may after giving three days notice to the Contractor enter upon the Site, the facilities and / or system and terminate the Contract without thereby releasing the Contractor from any of its obligations under the Contract, or affecting the rights and authorities conferred on the Employer by the Contract. The Employer may use so much of the Contractor's equipment, temporary works and materials as it may think proper.
- b) If the Contract is terminated because of an Contractor's event of default, the Employer shall be entitled to invoke the Security Deposit and carry out the Operations through a successor Contractor or departmentally and at the risk and cost of the Contractor. If the total amount due to the Employer exceeds any payment due to the Contractor the difference shall be a debt payable to the Employer.
- c) If the Contract is terminated because of a Contractor's event of default, all materials on the site, plant, equipment and temporary works shall be deemed to be the property of the Employer.
- d) Unless prohibited by law, the Contractor shall, if so instructed by the Engineer within 3 days of such entry and terminated referred to, assigns to the Employer the benefit of any Contract for the supply of any goods or materials or operations which the Contractor may have entered into for the purposes of the Contract.

Default of Employer

Events of Default

- a) An event of default on the part of the Employer, affecting the performance of the Contractor's operations shall be deemed to have occurred due to any of the following causes.
- b) The Employer does not give access to part of the Site by the commencement date.
- c) The Employer does not make a payment certified by the Engineer within 90 days from the day of receipt of the Engineer's Certificate.
- d) The Engineer instructs the Contractor to stop providing the operations and the instruction is not withdrawn within 3 days and
- e) The Employer is in breach of any law or statute governing this Contract.

Consequences of Default

1. Pursuant to the Contractor may terminate its employment under the Contract by giving notice to the Engineer – in – Charge. Such termination shall take effect 14 days after giving the said notice.
2. If the Employer, before the expiry of the above notice period, or immediately thereafter removes the cause of its default, the Contractor's entitlement shall lapse in respect of such defaults, and the Contractor shall continue with / resume normal working as soon as is reasonably possible.

Risks, Indemnification's & Insurance

Risks

All risks of loss of or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract other than the risks stated, is the responsibility of the Contractor.

Indemnification

1. The Contractor shall indemnify and keep indemnified the Employer against all losses and claims for injuries or damage to any property whatsoever which may arise out of or in consequence of the operations and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto.

2. The Contractor shall at all times indemnify the Employer against all claims,

damages or compensation under the provision of:

- Payment of wages Act 1936
- Minimum Wages Act 1948
- The Employers Liability Act 1938

- The Workmen's Compensation Act 1923
- Industrial Dispute Act 1947.
- Indian Factories Act 1948 and
- Maternity Benefit Act 1961.

Or any modifications thereof and rules made there under from time to time or as a consequence or any accident or injury to any workman or other persons in or about the Operations, whether in the employment of the Contractor or not save and except where such accident or injury have resulted from any act of the Employer, their agents or servants and also against all cost, charges and expenses of any suit, action of proceedings arising out of such accident or injury and against all sum and sums which may with the consent of the Contractor be paid to comprise or compound any such claim without limiting its obligations and liabilities as above provided. The Contractor shall insure against all claims damages or compensation payable under the various acts mentioned above or any modifications thereof or any other law relating thereto.

Insurance

The Contractor shall provide in the joint names of the Employer and the Contractor insurance cover from the Commencement date to one year beyond the end of the

Contract Period for the Contractor's risks covering:

- Loss of or damage of property (except the Facilities, System and Equipment) in connection with the Contract.
- Personal injury or death; and
- The Contractor's All risk (CAR) Insurance Policy.
- The covers shall be obtained from the Directorate of Insurance, Maharashtra State only.
- The Contractor may at its own discretion provide for the following insurance covers
- Loss or damage to the Facilities and / or System and
- Loss of or damage to equipment.
- Such cover may be taken either from the Directorate of Insurance, State or from any other Insurance company with the approval of the Employer.

The Contractor shall deliver policies and certificates to the Engineer for an approval before the Commencement Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

If the Contractor or any of its Subcontractors does not provide any of the policies and certificates required, the Employer may affect the insurance, which the Contractor should have provided and recover the premiums the Contractor has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due to the Employer.

Alterations to the terms of insurance shall not be made without the approval of the Engineer and both parties shall at all times comply with any conditions of the insurance policies.

Force Majeure

Force Majeure Events

A Force Majeure Event as defined is said to have occurred if any such event arises after the issue of the Letter of Award of Contract and extends for a period greater than thirty days, outside the control of both parties, thereby rendering it impossible or unlawful for either party to fulfil its Contract obligations under the law governing the Contract. The Force Majeure Events are:

- War, invasion, mobilization, requisition or embargo;
- Rebellion, revolution, insurrection or military or usurped power or civil war.
- Contamination by radio-activity from any nuclear fuel or from any nuclear waste from the combustion of nuclear fuel radioactive toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component of such assembly.
- Riot commotion or disorder, unless solely restricted to employees of the Contractor or of its Subcontractors;
- Floods and any other calamity resulting from climatic imbalances and
- Provided always that such events are beyond the control of the parties and have a materially adverse effect on the operations.

The Contractor shall be under no liability whatsoever in consequence of any of the Force Majeure events referred to in this clause whether by way of indemnity or otherwise.

Both parties shall be released from further performance pursuant to any Force Majeure events occurring outside the control of both parties and extending for a period greater than 180 days.

If the Contract is frustrated by a Force Majeure event, the Employer shall certify that the Contract has been frustrated. The Contractor shall make the site safe and stop operations as quickly as possible after receiving this certificate.

Consultation and Duty to Mitigate

For so long as the period of Force Majeure is continuing the affected party shall consult with the other parties on the period and effect of the Force Majeure event, and the affected party shall use all reasonable endeavours to alleviate its effects on the performances of its obligations under this Contract. The other party shall afford reasonable assistance to the affected party to alleviate the effect of the Force Majeure event on the performance by the affected party of its obligations under this Contract. The affected Party shall use its best efforts to continue to perform its obligations hereunder and to correct or cure the same during the subsistence of such Force Majeure Event.

Consequences of Force Majeure

If and to the extent that any of the Force Majeure events listed above results in loss or damage to the Facility and / or System the Contractor shall promptly give notice to the Employer. The Employer may direct the Contractor to rectify this loss or damage to the extent required by the Employer at costs to be mutually agreed between the parties. The Contractor shall expeditiously rectify the loss or damage and shall be entitled to payment of such costs. In the event that the parties are not able to reach an agreement on the cost of rectification, the Employer may carry out the rectification works by itself or through any agency nominated by it. The Contractor shall provide all cooperation required to complete such rectification expeditiously.

Resumption of Performance

When the affected party is able to resume performance of its obligations under this Contract, it shall give to the other party a written notice to that effect and shall promptly, and in any event within 3 days resume performance of its obligation hereunder:

The obligations and liabilities of the parties under this Contract would continue as long as Force Majeure event does not impede the performance.

There shall be no penalty / liquidated damages applicable in the period of subsistence of a Force Majeure.

Taking over Process

At the end of the Contract period and subject to the provisions or its earlier terminations except on account of default of the Contractor, the Contractor shall request the Engineer to take over the Facilities and / or System. The Employer shall take over the facilities and / or System within 7 days of such a request being made. The Contractor shall:

- Cease all further operations except for such operations as may be necessary and instructed by the Engineers' Representative for the purpose of making safe or protecting those parts of the Facilities and / or System and any operations required to leave the Site in a clean and safe condition.
- Hand over all documents and supplies for which the Contractor has received payment and

- Remove Contractor's equipment which is on the Site and repatriate its entire staff and labour from the site.
- Provide adequate training to ensure complete transfer of technology of entire Operation & maintenance of systems/automation etc. to the successor Contractor to the satisfaction of the Engineer.

The Contractor shall supply to the Engineer a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Contract Period. The Engineer within 28 days of receiving the Contractor's account shall certify any final payment that is due to the Contractor, or indicate to the Contractor the corrections or additions that are necessary. If the final account is still unsatisfactory, after the Contractor resubmits it, the Engineer shall decide on the amount payable to the Contractor and issue a payment certificate. The Employer shall any time, within a period of 90 days from the Completion Date or Termination Date as applicable, carry out an independent assessment of the facilities and / or system departmentally or through a Successor Contractor. Any deficiencies in the facilities and/ or System shall be made good by or at the cost of the Contractor so as to bring the facilities and or /system into Good Repair and proper working condition as handed over at the Commencement Date and subsequent works done pursuant and normal wear and tear excepting.

Repairs and Maintenance Schedules

In order to ensure smooth and uninterrupted operations, routine maintenance of the project facilities shall be carryout as per following schedule but not limited to these to ensure the proper functioning of the system.

Vacuum Sucker Vehicles for Septage Collections:

Septage collection vehicles shall be periodically carryout checkups of all vehicles and equipments for septage collections. In addition to regular maintenance of the vehicle, contractor to ensure to carryout out repair and maintenance work as per schedule to:

Monthly

- Clean of Air filters
- Flush the vacuum pump.
- Clean and lubricate the shafts of all valves
- Grease all points of unit, vacuum pump, vacuum pump drive line and other units
- Check all bolts on unit and tighten as required, especially the bolts mounting the vacuum pump and
- Clean the vacuum tank (outer body).

- Check the fittings on the loading hoses.

(Above list can be modified for the proper functioning of the system)

Yearly

- Use only recommended oil as per pump manual. Keep container clean.
- On older pumps where oil tank is attached to the pump, it can collect condensation. It needs to be drained on a regular basis, especially in cold weather climate.
- Change the air filter.

Treatment Plant Complex:

As per indicated period checking the operation, correcting defects, attending to calibration and setting is required attending to minor repairs and proper up keeping) such as cleaning and painting) required for the following :

i. Monthly

- Roof and surroundings and
- Lightning arrestors.

ii. Annual

- Leakages in structures
- Ladders
- Railings
- Structural damages to the wet and dry well and
- Overflow drain.

(Note: Above Schedule of Maintenance and components to be included can be modified for the proper functioning of the system)

Pumping Machinery and Treatment Plant Equipment:

As per indicated period checking the operation, correcting defects attending to calibration and setting is required attending to minor repairs and proper up keeping(such as cleaning and painting) required for the following:

Daily

- Screens/ Grit Channels
- Moving parts of screens and grit removal equipment, Blowers /Agitators / Pumps/ Agitators /Return Sludge pumps/ Chemical mixer/Centrifuge/Decanter
- Bearing and
- Vibration, balancing on Decanter, chemical dosing and mixing, Motors
- Contact tightness
- Cable insulation near the lugs.
- Panels Breaker and Starter
- Contacts of relay and circuit breaker and
- Setting of over-current relay, no-volt coil and tripping mechanism and off in the dash pot relay.
- Transformer Sub-station
- Ground Operated Dis-connectors (GOD)
- Contacts of GOD and of Over Current (OC) relays
- Radiators and Earth pit

Monthly

- Screens and Grit channels
- Chains in mechanically operated components
- Screens performance
- Transformer
- Oil in transformer
- Relay alarm circuit
- Load (Amperes) and
- Voltage

Quarterly

- Transformer

- Bushing and
- Dehydrating breathers

Half -Yearly

- Pumps / Blowers /Agitators / Compressor /Decanters/Centrifuge
- Gland of stuffing box
- Gland bolts
- Gland packing
- Alignment of pump aerator and drive and
- Oil lubricated bearings
- Motors
- Tripping elements for motor protection
- Contact points and
- Fuse ratings

Annual

- Paint screens, grit removal mechanism, scrapers, scrapers , motors, pipes,
- Valves, fittings agitators and inlet/outlet weirs with two coats of anticorrosive paints.
- Replace worn out parts of mechanical equipment in effluent treatment plant.

(Note: Above Schedule of Maintenance and components to be included can be modified for the proper functioning of the system)

Contractor to follow the maintenance schedule of manufactures for package treatment plants and other parts. Manufacturers schedule may be clubbed with above mentioned repair and maintenance schedule in order to keep plant in operational stage.

Buildings and Civil Structures:

Carry out routine maintenance and minor repairs including cleaning, repairs to plaster, doors, windows and painting.

Daily

- Sweep the premises
- Clean the floors and parts inside the Building
- Clear the cobwebs and other biological growth
- Maintenance of horticulture
- Disposal and transportation of dewatered sludge

Half - Yearly

- Repair damaged floor, plaster, roof, leakages and
- Repair damaged doors, windows and other fixtures.

SCHEDULE OF PREVENTIVE MAINTENANCE:

Pumps

S.No.	Name of section or part to be attended	Maintenance to be carried out	Frequency/time interval at which inspection and maintenance can be done	Remarks
1.	Bearings	Checking of temperature with thermometer	Two months	Hot ball or roller bearing point to too much oil or grease; hot sleeve bearings need more oil or heavier lubricant. If does not correct, disassemble and inspect the bearing alignment of pump and driver.
2.	Glands	Changing of gland packing	Two months	
3.	Bearing	Lubricants (greasing)	Two months	Check for specification resulting in whitish colour; washout with kerosene.
4.	Gauges	Checking of pressure and vacuum gauge	Three months	

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5.	Valves	Changing of gland packing in delivery sluice valve, suction valve, bye pass valve, reflux valve	Six months	
6.	Exhaust pump and its auxiliaries	Checking of gland packing & its auxiliaries etc.	Six months	
7.	Impeller	Checking of impeller blades, sleeves, efficiency rings, bearings, neck ring impeller nut etc.	year	

Electrical Motors

S.No.	Name of section or part to be attended	Maintenance to be carried out	Frequency/time interval at which inspection and maintenance can be done	Remarks
1.	Induction motor stator and rotor	Opening of end covers dust blowing and checking of air gap	One month	Depending on the working conditions & maintenance staff available.
2.	Slip ring device	Cleaning of slip rings and adjustment of carbon brushes short circuiting jaws, oiling of clutch etc.	One month	
3.	Bearings	Proper lubrication	Two months	
4.	Windings	Checking of motor after taking out its rotor. Dust	Two years	

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		blowing. Checking of end connections of stator. Rotor and taking insulation test, no load test before putting the motor on load		
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Power Transformer

S.No.	Name of section or part to be attended	Maintenance to be carried out	Frequency/time interval at which inspection and maintenance can be done	Remarks
1.	Checking of silica gel. Topping of transformer oil. Temperature gauge vent pipe, voltage tap changing switch	Six months	Check and if required silica gel must be changed before the outbreak of monsoon.	
2.	Filtration of oil, checking of dielectric. Strength, checking of viscosity of oil, terminal boxes (HT < both) insulators, neutral earthing, lightening of nuts bolts, cable sockets stopping of leakages if any through points.	Year	If the transformer oil with stands insulation test upto 40KV for one minutes it is not necessary to dry and fill the transformer oil.	
3.	Checking of its functioning	Year		
4.	Checking of condition of core of the transformer and its windings insulation conditions.	5 Years		

Switchgears

S.No.	Name of section or part to be attended	Maintenance to be carried out	Frequency/time interval at which inspection and	Remarks

			maintenance can be done	
1.	Oil circuit breaker or air circuit breaker	Checking, cleaning and tightening of nuts, bolts of fixed auxiliary contacts, moving auxiliary Contacts, main fixed contacts. No volt coil, overload coil, interlock system, condition of transformer oil, knife switches & insulators etc.	Six months	
2.	Oil tank	Cleaning & topping of oil & checking dielectric strength of transformer oil.		
3.	Contacts	Changing of old & wearing out contacts (fixed moving auxiliaries etc.)	Three months	Depending on the source of power supply & its tripping
4.	Oil circuit breaker or air circuit breaker	Checking, cleaning and tightening of nuts, bolts of fixed auxiliary contacts, moving auxiliary contacts, main fixed contacts. No volt coil, overload coil, interlock system, condition of transformer oil, knife switches & insulators etc.	Six months	

Maintenance Staff

O & M Personal shall dedicate their 100% time and the Contractor will ensure that adequate number of his staff shall be available on duty 24 hours, 7 days per week including all holidays. Minimum O&M Personnel to be provided by the Contractor is mentioned in the Annexure II of ITB. However, if required,

contractor may increase the staff deployment at STP and on collection system for the proper functioning of the system.

The Contractor shall maintain & submit statements to client for consumption of power, chemicals, quantity & quality of treated effluent on the prescribed Performa to be laid down by client and shall get the treated effluent samples duly tested for submission to State pollution Control Board for NOC/ Consent and shall submit consolidated monthly statement at the time of claiming payment.

In case, the Contractor fails to operate & maintain the septage collection system and Treatment Plant to the rated capacity and quality, client shall be at liberty to terminate the Operation & Maintenance Contract without assigning any reason and take penal action as per the Contract and prevailing Law as this is covered under Essential Services Act. The Contractor shall adopt all necessary safety measures for all his Staff, Plant, Building and Machinery.

Scope of Work

- Collection of septage from household using vacuum sucker mounted vehicles
- Collection of user charges from user and depositing to escrow account
- Operate the plant i.e. SeTP as per the instructions in the operation manual.
- Carryout Routine, Annual & Breakdown Maintenance of the equipment in the system.
- Maintain record book/log book with the help of computer.
- ESI & PF Registration & Record keeping.
- Providing Safety Gear to O & M Staff.
- Maintain the log sheet for various equipments and systems and revenue collections..
- Draw samples and get analyzed for the parameters required and make the necessary process correction.
- Vendor will give enough lead-time to department to arrange and provide power and diesel free of cost to vendor for running of the plant.
- Maintain a record of stock levels and assist client on reordering levels.
- Maintain history card for the equipments.
- Submit report in the form and frequency required by the client.
- Housekeeping of the entire plant allocated area.

- Maintain clear record of attendance for his workmen and staff.
- Vender shall be responsible for preventive maintenance necessitated by normal usage of the equipment.

Maintenance

Contractor shall get the routine preventive, Annual & Breakdown maintenance done with the help of their own staff. All spare parts, consumable for maintenance will also be supplied by Vendor. The painting of Mechanical & Civil structures as and when necessary shall be carried out by contractor.

Consumables and spares

Various chemicals such as Coagulants, Chlorine, Polyelectrolyte, cleaning chemicals, lubricants, spares, cartridges etc. are either consumed continuously or replaced periodically to maintain the performance of the plant, will be procured by contractor. Sufficient stock level of these items shall be maintained by contractor. The contractor shall allocate adequate covered space for storage of consumables, chemicals and spares.

In addition to above any other test required by Pollution Control Board for grant of NOC shall be carried out by the contractor. This scope of work includes painting, white washing, distempering of plant, building & equipments at the time of handing over of the plant and after every 2 years of operation & maintenance period.

Laboratory and stores

The minimum lab equipment needed & tests recommended to be carried out at the SeTP are in accordance with the CPHEEO manual.

Waste Disposal

The disposal of the effluent/waste water/beyond battery limits site shall be the responsibility of the contractor. Disposal of hazardous sludge to a common hazardous waste management facility will be under the scope of contractor.

Extra Work

No extra work charges of any kind shall be entertained by the ULB during O & M contract period.

SPECIAL REQUIREMENTS OF THE CONTRACT DURING O&M

Consumer Relation Management Centre

The Contractor shall design, develop and set up consumer relation management centers (CRMC) 1 nos each of not less than 60 sqm including Central Control Center (CCC) to facilitate receiving and resolving consumer requests in the project areas of new septage collection point, service deficiencies, resolution of

billing disputes, payment of bills etc. The consumers shall file their complaints through e-mail, text message from mobile phones, telephone, Fax and other electronic media. Contractor will maintain 1 (One) toll free numbers each for septage collection services at CCC.

The Centers shall function between 8am to 8pm during all working days and between 8am to 1pm during public holidays including Sundays. The CRMC including CCC shall be air conditioned and have reasonable space and furniture for the Consumers to wait, interact and represent their requirements. During the other off peak times of 8pm to 8am, the Contractor shall have a facility to receive Consumer complaints through telephone, fax, text message, email and any other electronic means. The complaints once received should be acknowledged automatically and a registration number shall be given to the complainant immediately.

The CRMC and CCC shall be equipped with sufficient human resources, hardware and software to facilitate continuous record of consumer requests, monitoring the resolution, and reporting completion of necessary actions and tasks. There shall be an exclusive desk for servicing the urban poor consumers preferably serviced by an efficient local executive who can interact in local language.

Management Information System

Contractor shall develop, establish, operate and manage during the entire contract period a comprehensive Integrated Management Information System (MIS) in respect of all matters including but not limited to:

- i. Design Built activities
- ii. All the Operation and maintenance activities
- iii. billings and collection systems;
- iv. Consumer services, including data bases relating to complaints and questions, response times and resolution;
- v. Financial management, including accounting systems;
- vi. Performance information systems; and
- vii. Others as identified during SIP preparation and implementation.

Establishing Billing and Revenue Collection Systems

The Contractor shall:

- i. Prepare and monitor the profile of Septage Connection or Consumers in the Service Area describing consumer categories and other attributes collected through consumer survey in a **GIS platform geocoded to the property footprints**. The database and software shall be in a position to analyse the

number of Consumers under each category, estimated average volume of septage to be collected per month, and estimated average revenue per month;

ii. Develop and implement basic Standard Operating Procedures for (i) Septage connections, (ii) preparing, issuing, and collecting a bill for Septage, (iii) dealing with underpayment or non-payment; these SOPs shall be prepared in close coordination with Employer or Engineer.

iv. Set up and implement in detail the revenue collection procedures, and the facilities for achieving the high level of revenue collection efficiency.

1. Billing and Revenue Collection responsibility

- i) The contractor shall establish and operationalise billing and revenue collection system before commissioning of System. Contractor shall generate the septage collection bills with the tariff decided by GoJ. All bills will be processed, printed, collated, distributed and handled by the Contractor on behalf of and as an agent of Department UD & HD. All revenues shall be invoiced in the name of Department UD & HD. All revenues will be collected by the Contractor on behalf of Department UD & HD and deposited into the designated Escrow revenue account set up for the entire operation period.
- ii) The Department UD & HD shall have full and unrestricted access to the billing and revenue system comprising software, all current and historical billing data and the consumer service centers operated and managed by the Contractor upon request. All reasonable requests for data and analysis from the billing data system shall not be unreasonably refused by the Contractor.
- iii) The Contractor shall:
 - a) Collect all revenue amounts related to the septage collection:
 - o through CRM centers,
 - o through banks, electronic transfer, mobile banking and
 - o by other means as may be agreed to by JUIDCo, Jharkhand;

All the charges initial or annual required to be paid to the bank, payment gateways etc. will be paid by the contractor.

- b) Identify and record all outstanding accounts and take all necessary measures to collect outstanding accounts with the knowledge of the Employer;
- c) Submit to Employer a summary and analysis of unpaid accounts on monthly basis; and
- d) Manage all aspects of consumer services with the Consumers.

- iv) The Contractor shall directly deposit all of the collected consumer payments, whether in the form of cash, cheques or any other form, into the designated revenue account by the next working day.

2. Training to Employer (JUIDCo/ULB)

Contractor will provide on the job training during operation services to the staff of JUIDCo/ULB. Such trainings will be commenced 30 days prior to commissioning the SeTP. Also that in the last year of O&M period and before 30 days from the date of handing over the assets back to the Employer, the Contractor shall organize detailed training to the identified staff in technical, commercial and financial aspects of septage collection to enable the Employer to build sufficient capacity and skills to manage the water services after the Contract Completion Date. Commencing from 30 days before the Contract Completion Date, the staff either from Employer or from a future Contractor will overlap and co-manage the operations to ensure continuity in service delivery.

THIRD SCHEDULE

ASSETS UNDER MANAGEMENT OF THE CONTRACTOR

Type of Assets- Initial Assets (to be operated and maintained by the Contractor)

S.No.	Type of Assets	Assets to be constructed under this Bid Document (to be operated and maintained by the Contractor)
A	Civil Structures	Septage Treatment Plant (89 kld capacity)
		Administrative Building of SeTP
		Staff Quarters in SeTP
B	Mechanical Items	Trailer Mounted Sewage Suction Machine of capacity (4m ³ capacity – 25nos. each)
		Backhoe Loader
		Tipper
		Electro Mechanical Equipments installed in the Septage Treatment Plant
		Effluent Disposal Pipe
C	Miscellaneous	GPS tracking system installed in sewage suction vehicles
		Transformer, DG Set
		Flowmeters and other instrumentations used in the SeTP
		Customer Grievance Centre

Upon termination of contract the management of the above assets shall be transferred to the ULB.

FOURTH SCHEDULE

PERFORMANCE STANDARDS, CONTRACTOR FEE AND INCENTIVES

1. PERFORMANCE STANDARDS

The following Key Performance Indicators (KPIs) are framed for this tender:

1. Coverage of HH and Frequency of septage collection
2. Quantity of total septage to be treated at SeTP
3. Efficiency in consumer complaint redressal
4. Achieving quality of effluent at the outlet of SeTP as stipulated in tender
5. Collection efficiency of User Charges

There shall be 50% fixed pay and 50% performance linked pay - with 10% linked to each of the 5 KPIs. However, the contractor shall be eligible for the 50% fixed pay only if he achieves at least 20% performance linked pay. Up to 10% Performance Pay, the Fixed Pay shall be 40% and upto 5% it shall be 30%. There shall be no Fixed Pay if Performance Pay is below 5%. These KPIs will be monitored by the Employer before releasing any payment against O&M bills submitted by the Contractor.

Performance link payment against the KPI no 1, 3 and 5 (i.e. Coverage of HH and Frequency of septage collection, Efficiency in consumer complaint redressal and Collection efficiency of User Charges respectively) shall be made to Contractor based on pro-rata basis; whereas payment against the KPI no 2 and 4 shall be paid only on 100% achievement.

In case contractor fails to achieve targets (mentioned in Table 2) for any of the KPI 1, 3 and 5 consecutively for 3 months, then Pro-rata basis for payment will not be applicable. This operational behaviour of Contractor shall be considered as Non Compliance and No Payment shall be paid to contractor from 3rd Month onwards until contractor performs to achieve the target.

The targets for these KPIs alongwith their monitoring system has been as presented in the table below:

Table-2 : Key Performance Indicators for the Project

S.No.	Indicator	Annual Cumulative Targets					Monitoring System
		FY 2018		FY 2019	FY 2020	FY 2021-2027	
		1 st half	2 nd half				
1	Coverage of HH and Frequency of septage collection	30%	50%	80%	100%	100% with frequency of once in two years	Number of households covered shall be based on validation of receipts produced by the operator duly signed by the Employer. Frequency shall also be verified through supporting receipts produced by the operator.
2.	Quantity of total septage to be treated at SeTP	27 KLD	45 KLD	71 KLD	89 KLD	89 KLD	Inflow : Measurement of each lot of septage at weighbridge located at entry to SeTP. Outflow: Measurement of dried sludge And flow measurement of treated effluent for disposal / reuse
3	Efficiency in consumer complaint redressal	70%	90%	100%	100%	100%	Checking of Complaint redressal receipts against the complaints received.

S.No.	Indicator	Annual Cumulative Targets					Monitoring System
		FY 2018		FY 2019	FY 2020	FY 2021-2027	
		1 st half	2 nd half				
4	Achieving quality of effluent and sludge at the outlet of SeTP as stipulated in tender	100%	100%	100%	100%	100%	SeTP Log books
5	Collection efficiency of User Charges	15%	40%	90%	100%	100%	Comparison of logbook of household covered for cleaning and logbook of revenue collection.

2. CONTRACTOR'S FEE

PAYMENTS OF CAPITAL GRANT, O&M CHARGES

a. Payment of capital grant for construction and procurement phase

The capital cost of the project shall be the estimated project cost as per the DPR prepared by consultant and approved by the UDD. The capital cost shall be provided through the UDD grant.

The Grant shall be credited to the Escrow Account in the form of payment made for actual work done as per the payment terms set out in Clause 42 of Contract Data.

b. Measurement of Works

Measurement of work shall be done as per the actual progress of work and standards of work done by contractor and approved by PMC and Employer. Each milestone shall represent percentage of work completed till that milestone.

c. Payments

Contractor shall prepare monthly running for the work actually done during previous month on the basis of BOQ prepared by Contractor and approved by PMC and Employer. The bill shall be submitted by contractor on or before 7th day of each month. The Contractor shall submit three numbers of hard copies and one soft copy of floppy/ CD for all bills. After certification of bills by PMC and Employer, payment shall be made to contractor after applicable deductions. All other statutory deductions shall be made on the basis of prevailing taxation rules of GOI and GOJ. The payment due to the contractor shall be made within Thirty days of bill submission.

All running payments shall be regarded as payments by way of advance against the final grant/payment only and not as payments for work actually done and completed and / or accepted by Employer and shall not preclude the recovery for 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 the due performance of the contract, or any part thereof, in this respect, or the accruing of any claim, nor shall it conclude, determine or affect in any way the powers of the Employer under these conditions or any of them as to the final settlement and adjustments of the accounts or otherwise, or in any other way vary/ affect the contract. The final bill for grant shall be submitted by the contractor within three months of the completion of work, otherwise GNP's certificate of the measurement and of the total amount payable for the work accordingly shall be final and binding on contractor Each Running Bills should be accompanied by two sets of at-least 20 (twenty) photographs as per direction of Project in charge taken from various points depicting status of work as on Report/ Bill date along with Monthly Progress Report for the concerned month in the pro-forma to be given/ approved by Engineer-in-Charge. Intermittent progress Photographs as and when required shall also be provided by the Contractor at his own cost as per direction of Engineer-in-Charge. No payment of running account bill shall be released unless it is accompanied by progress photographs and Monthly Progress Report as above.

All payments shall be released by Employer by Payee's Account Cheque or through transfer in Payees account. In case of Payments is made by Demand Draft at the request of the Contractor, Bank Commission charges shall be debited to the account of contractor.

d. Mechanism of Payment

During Construction phase, payment to the Contractor shall be made as per details in Clause 42(c) of Contract Data, whereas in O&M phase, it shall be as per KLD basis linked with key performance Indicators.

(a) Employer shall, within 30 days from the date of receipt of the invoice supported by necessary documents, Pay to the Contractor, only in Escrow account.

(b) Any delay in making any payment in accordance with the invoice shall, without prejudice to any other consequences under this Agreement, entail payment of interest on the amount in default at prevailing annual prime lending rate of State Bank of India calculated for the duration of delay. The period of delay shall be counted from 60 days after; the day of submission of the Invoice.

(d) All payments to the Contractor shall be made in Escrow account by way of Cheque/electronic transfer.

Clause 42 of CONTRACT DATA : Terms of Payment

1.1 General

The Employer shall pay the Operator in the manner and at the times set out in this Terms and Procedures of Payment.

1.2 Payment during the Design-Build Period

(a) Mobilisation Advance:

Advance payment as an interest free loan for mobilisation and cash flow support for an amount equal to 10 % of the Design-Build Price stipulated in the contract shall be paid to the Operator against Bank Guarantee for Advance Payment for the same amount in two installments as under subject to the provisions of this Contract.

(i) 5% within 30 days of effective date of contract; and

(ii) 5% on mobilization at the site including setting up of the Operator's office, deployment of manpower and machinery & equipment for construction.

(b) Repayment of Mobilisation advance

The Mobilization Advance paid to the Operator by the Employer shall be recovered commencing from the date on which the payment to the Operator has reached 20% of the value of Design, Build and Commissioning Services and shall be recovered at the rate of 25% of Mobilization Advance from each bill submitted by the Operator for the payment. The entire amount of mobilization advance shall be recovered latest by the time payments up to 90% of the value of Design Build & Commissioning services have been paid to the operator.

(c) Payment for Design-Build Price

In respect of the amount for Design-Build Services payable by Employer listed in Price schedule of the Operator's Bid (the Design-Build Price) the Owner shall make the payments against the Operator's monthly bills prepared for the work done in the preceding month in accordance with the agreed billing. The PMC will certify the Bill within 15 days of its receipt to confirm completion of portions of the Design-Build Services for which payment has been claimed in the Bill. Liquidated damages for delay in completing the specified milestones/activities, shall be deducted from the bill and reflected in the amount certified for payment. Employer will make payment of the amount certified in the Bill by the PMC no later than 30 days after receipt of the certified Bill.

The payment shall be made as per the following payment breakup schedule:

S.No	Description of Item	% Payment	Timeline from Start of Contract
1	Completion of Survey and Basic Engineering Package (BEP) and preparation of Good for construction drawings	3%	2 Months
2	On completion of Site Clearance Boundary Wall, Fencing and Gate	3%	3 Months
3	On completion of SeTP - Civil Works	25%	7 Months
4	On completion of SeTP - Mechanical Works	32%	9 Months
5	On completion of SeTP - Electrical and instrumentation Works	10%	9 Months
6	On commissioning of SeTP	5%	
7	On completion of Trial Run of SeTP	5%	10 Months
8	On completion of DLP of SeTP	5%	12 Months
9	Procurement of Equipments and Machineries for Collection System	12%	8 Months
	Total	100%	12

(d) The amounts to be paid to the Operator during the Design-Build Period shall include only costs and expenses of the Operator in building the Facility and providing the Design-Build Services, including all costs and expenses relating to the Plant and Equipment payable by Employer as per Price Schedule.

1.3 Payment during the Operation Period

In respect of the Operations Services performed by the Operator after the Operations Starting Date, the Employer shall pay the Operator on monthly basis (Monthly Operations Payment). For this purpose, monthly bills for the Operations services performed by the Operator shall be submitted to the PMC at the end of each month and the bills will include the fee calculated in the following manner.

- a) Treatment fees payment will be calculated based on the quantity of septage treated at SeTP facility per month.

- b) Payment shall be made after review of Key Performance Indicators (KPIs) set out for this contract as per Clause no. 3 in Special Conditions of Contract.

3. INCENTIVES

Employer shall reward contractor with incentives as per the following for their out of box thinking / marketing skill:

a. On Sale of Composted Sludge

Contractor shall be rewarded for revenue generation from the sale of Composted Sludge with 50% of the revenue generation as reward through Escrow Account only.

FIFTH SCHEDULE

REPORTING FORMAT

During the operation period the Contractor shall prepare monthly, annual and final reports. All reports shall be prepared in the English and Hindi languages in hard and electronic version for submission to the ULB.

Monthly Reports

Throughout the assignment the Contractor shall submit Monthly Reports to the ULB by the seventh day of the following month. Each report will show events and summary operations for the Contractor's activities for each of the main tasks.

The monthly progress reports should be short and whenever possible prepared in a tabular format for easy reference and comparison. A format for this report will be submitted by the Contractor for approval by the Project Manager.

I Number of Connections: The section will present

- (a) The percentage of the households in the Service Area listed as owners/ users of septic tanks.
- (b) The number of new users operationalized during the period, and also specifying the number of new/additional users operationalized in every month under this Operations and Maintenance Agreement since Commencement Date.
- (c) The electronic registry of dated requests for septage collection service received during the period; date of clearance by ULB and date of connection, as per the signed report of the User.
- (d) *Deleted*
- (e) The total number of users under various categories

II Septage Generation: This section will present

- (a) The total quantity of Septage treated – daily and monthly (in KL)

III *Deleted*

IV Efficiency of Operations

This section will present information on the efficiency of operations showing:

- (a) Coverage of Household and frequency of septage collection

V Quality of Service–

This section will present information on

(a) Quality of treated effluent at the outlet of SeTP, by presenting the aggregated reports of wastewater quality tests undertaken as well as registry of online data on wastewater quality at SeTP for the period under review

(b) Efficiency in Addressing Customer Complaints, indicating (i):Total complaints received during the reporting period (ii): type of complaints (iii) Service Area in which complaint occurred (iv):Time and date of resolution of complaint

VI Pricing and Revenue Collection: This section will present information on

(a) The collection efficiency of user charges by providing total amount of bill generated (with numbers of households and applicable tariff) and revenue collected

VII Investments: This section will present a summary of the capital works carried out and the investment incurred during the period, with a breakdown of type of investments. The repair and maintenance works undertaken during the reporting period will be presented separately indicating the type of repair and maintenance work undertaken.

VIII *Deleted*

IX Financial Performance: This section will present (all relevant information required will be procured from ULB):

(a) An audited summary balance sheet prepared in accordance with Generally Accepted Accounting Principles.

(b) An audited income statement prepared in accordance with Generally Accepted Accounting Principles. The income statement will be at a level of detail, which provides the following details: (a):Revenues (specifying Tariff revenues, and Other income) and (b): Recurrent Costs – Monthly O&M - (distinguishing between Staff costs, Repairs and maintenance, electricity, Diesel, Chemicals, Interest costs and Other costs).

X Final report

The Contractor will prepare a draft of Final report and hand it over to the ULB one month prior to the end of the Operation and Maintenance Period. The report will present a review of the Contractor's major obligations under the Contract, as undertaken and completed/ delivered and include the necessary conclusions. Upon receipt to of the ULB's comments and suggestions, the Contractor will prepare the finalized version of the report

SIXTH SCHEDULE

TARIFFS AND TARIFF CHANGES

Initial Tariff at Commencement Date

At the Commencement Date of this OMSA the following tariffs shall be applicable in the Service Area.

Regular Tariff Review and Adjustment

The annual increase in tariffs will be linked to the customer price index (CPI) and will be effective April 1 of each financial year.

Appendix I to SCC : User Charges for Septage collection (Reference Clause 2 of SCC)

Sl.No.	Type of User	User Charges (Rs./Month)
	<i>Residential Area</i>	
1	Slums	10
2	LIG	50
3	MIG	65
4	HIG	80
	<i>Hotel</i>	
5	up to 10 Room	275
6	11-20 Rooms	550
7	21-30 Rooms	800
8	31-50 Rooms	1350
9	Above 50 Rooms	2700
10	Dharmshala/Community Halls	275
11	Restaurant	550
12	Bakery	275
13	Sweetshops	275

Septage Management for
Chas Town, Jharkhand

Sl.No.	Type of User	User Charges (Rs./Month)
14	Shopping Complex-Non AC	1350
15	Shopping Complex- AC	2700
16	Cinema Hall	1350
	Factory and Workshop	
17	Small Scale	275
18	Medium Scale	550
19	Large Scale	1350
20	Shops-Wholesale	
	Office/Commercial Area	
21	Up to 2 Rooms or 10 Sqm	100
22	3-5 Rooms or 25 Sqm	195
23	6-10 Rooms or 50 Sqm	250
24	11-20 Rooms or 100 Sqm	550
25	above 20 Rooms or 100 Sqm	1100
	Hospitals /Dispensary/Private clinics	
26	without Bed	275
27	Up to 20 Beds	550
28	21-50 Beds	1350
29	above 50 Beds	2700
	School/ Colleges/ Coaching Centers	
30	Government Institutes	40
31	Private Institutes	80
32	With Hostel Facilities-Up to 50 Rooms	550

*Septage Management for
Chas Town, Jharkhand*

Sl.No.	Type of User	User Charges (Rs./Month)
33	With Hostel Facilities-Above 50 Rooms	1350
	Banquets/Comminute Halls	
34	Up to 3000 Sqm. Area	800
35	above 3000 Sqm. Area	1500

Note: Above User Charges are estimated for Year 2018. An Additional Escalation of 10% per year may be added for revised user charges in coming years on approval of Engineering in Charges.

SEVENTH SCHEDULE

LIST OF KEY STAFF OR O&M PERIOD

(as identified by the Operator in the bid in response to contract requirements. List, with all relevant information, to be appended herewith)

Section 7
PRICE BID

General

The Price Bid shall contain items for the Procurement, construction, installation, testing, commissioning and maintenance of the Works to be carried out by the Contractor. The Price Bid shall be uploaded by the employer in the e-portal and the bidder cannot alter the configuration of the Price Bid in PDF format. The bidder will quote the price under the appropriate column provided for bidding. The Price Bid shall be evaluated in accordance with clause no. 29 of ITB to establish the lowest bidder.

The rates quoted in the Price Bid shall be for carrying out the work complete in all respect in conformity to the BIS, Specification and Technical Specifications and other Terms and Conditions, including all man & material (including construction material, water & electricity) set out in the Bid Document.

Contractor to ensure that rates is inclusive of all taxes and accordingly the same will be deducted from each bill.

S.No.	Description of Item of Works	Unit	Estimated Quantity	Rates in Rs.		Amount in Figures and Words
				Figure	Words	
1	Procurement of septage collection equipments including trailer mounted sewage suction machine and appurtenances works <u>Specifications:</u> i. Type Sewer Suction Machine with Blow Back arrangement; ii. Tank Capacity 4000 Ltrs (Sludge); iii. Exhauster / Compressor -	Job	1			

S.No.	Description of Item of Works	Unit	Estimated Quantity	Rates in Rs.		Amount in Figures and Words
				Figure	Words	
	Reputed ISO Certified Company with specifications - FAD : 432 CuM/Hr (minimum); Vacuum : 90% Max; Over Pressure : 1.50 Bar; iv. Truck Chassis 2 Axle GVW 7 Ton GVW with Non-Sleeper Drivers Cabin fitted with PTO)					
2	Construction of septage treatment facility of capacity 89 KLD at Chas Town Including weighing bridge , and pre treatment facilities (including Inlet chamber, Screen chamber, Grit chamber and Equalization tank, followed by mechanical dewatering of septage using Centrifuge, Packaged Treatment Plant for centrate to meet effluent characteristics as specified in tender for proper reuse / disposal, Stabilization of dewatered sludge for proper disposal / sale, Backhoe loader and tipper for conveyance of sludge from centrifuge to manure	Job	1			

S.No.	Description of Item of Works	Unit	Estimated Quantity	Rates in Rs.		Amount in Figures and Words
				Figure	Words	
	shade, office, staff quarter, laboratory, Shed for Sludge cake, Chemical Storage, boundary wall of premises, Parking lot, DG and Transformer room, , GPS Tracking System Expenses etc. complete in all respect for all civil and electro-mechanical works including 3 months of Defect Liability Period inclusive of 1 month trial run (period of construction completion – 9 months excluding DLP and Trial Period) and any other requirement as per the direction of Employer to complete the proposed septage management facility in all respects.					
3	Operation and maintenance cost for the entire system (collection and treatment part) for 10 Years Including Cost of water, electricity, fuel, repair, renewal and insurance, Cost of Machineries, Maintenance Cost – Civil, Electrical, Mechanical					

S.No.	Description of Item of Works	Unit	Estimated Quantity	Rates in Rs.		Amount in Figures and Words
				Figure	Words	
	Works, Manpower and material Cost, Safety Tools, Power and Energy Cost, etc. complete in all respects to ensure successful operation of the proposed septage management facility.					
3.1	For 1 st Year of O&M	Bidder to quote per KLD rate				
3.2	For 2 nd Year of O&M					
3.3	For 3 rd Year of O&M					
3.4	For 4 th Year of O&M					
3.5	For 5 th Year of O&M					
3.6	For 6 th Year of O&M					
3.7	For 7 th Year of O&M					
3.8	For 8 th Year of O&M					
3.9	For 9 th Year of O&M					
3.10	For 10 th Year of O&M					
	GRAND TOTAL	Rs.				

