JAIPUR DEVELOPMENT AUTHORITY

JDA, Ram Kishore Vyas Bhavan,

Indira Circle , Jawahar Lal Nehru Marg,

Jaipur Rajasthan - 302 004

DETAILED NOTICE INVITING TENDER

NIT No. EE(PHE-I)/03/2016-17

Date 24.08.2016

1. The Director Engineering-II, JDA, Jaipur on behalf of Commissioner, Jaipur Development Authority invites EPC (Engineering, procurement and constructing) tender under two envelope System, "POTENTIAL ASSESMENT'' system as (Envelop 1 - Technical & Qualification Bid and Envelop 2 -Financial Bid) from experienced, technically and financially sound and reputed contractor, who are registered in "A/AA" class in JDA/any central Govt. Deptt./State Govt. Deptt./Local Body/Railway or a Private/Public Limited Company and unregistered or registered in company Act for the construction of following work.

2. General Detail of Work :

1.	Name of work	Tender for Design, Construction, Erection, Commissioning, Trial Run of 1 MLD STP at Smriti Van (Jhalana), on Turnkey basis based on SBR technology with PLC, SCADA Systems, Allied works, and O & M for 3 years at Jaipur City.
	Estimated Cost (Rs in Lacs)	Rs. 331.00 Lacs
	Earnest Money	@2% Rs.6,62,000.00 (For Contractors enlisted outside JDA) @1/2 % Rs. 1,65,500.00 (For Contractor enlisted in JDA)
	Cost of Bid Documents	Rs. 1,000.00
	Date of Pre-Bid Meeting	N/A
	Date of receipt of Tender	23.09.2016 Up to 6:00 PM
	Date of Opening of Technical Bid	29.09.2016 Up to 3:00 PM
	Period of Completion	12 months
	O&M Period	3 years

3. Procedure:

Procedure for Pre-Qualification would be as follow:

a. Tender documents shall be submitted on line e-procurement website http://www.eproc.rajasthan.gov.in with their digital Signature. The Bid is to be submitted in 3 Covers which shall comprise of –

Cover-1 Scanned copy of payment details of Tender Cost & Earnest Money in the name of Secretary, JDA and e-procurement fees Rs.1000 in the name of MD, RISL.

Signature of Contractor

Cover-2 Complete Tender Document along with addendums/ amendments issued and uploaded by the Department on the above website, Tender form and schedules for pre-qualification Bid and scanned copies of supporting Documents as required for qualification as detailed herein after.

Cover-3 Financial offer (BOQ).

(b) The technical bid will be opened online only of those bidders whose proper Earnest money, Tender fee, e-procurement fee, VAT clearance certificate (Valid up to Six months back from the opening of Technical Bid) and copy of registration of contractor in required category if any are found to be in order. The earnest money will be accepted as per online procedure mentioned in JDA portal.

(c) The Technical Bid would be opened online on the date 29.09.2016 at 3.00. pm

(d) The Financial Bid would be opened only of those bidders who fulfill all the Pre-Qualification criteria.

Note:- If VAT clearance certificate is not applicable in any State then appropriate proof is to be enclosed by bidder with certificate which is applicable in place of VAT.

4. Eligibility Criteria :

Bidder must qualify following eligibility Criteria :

Technical Criteria :

Criteria for Potential assessment would be as follows:-

(a) The bidder should have successfully completed and commissioned during past five years one STP/CETP of minimum 1.0 MLD capacity or two STP/CETP of minimum 0.5 MLD capacity each based on Conventional Activated Sludge Process/Extended Aeration/ MBBR (Moving Bed Bio-reactor)/Sequential Batch Reactor (SBR) Technology as on date of receipt of Prequalification document.

Note :-

(i) Certificate issued by Govt. of India, State Govt., Union Territory, Govt. Undertakings, Autonomous Bodies shall only be considered.

Financial Criteria:-

(b) The bidder should have completed at least one similar nature work in last Five Financial Years (including current year, if opted by the bidder) of value not less than 33.33 % of the Estimated Cost of the work (bid cost) updated to present price level

Note :-

(i) The starting & completion date of the work is to be in between above said financial years. If no then maximum work (70%) is to be completed in above said financial years.
Note: The year wise financial break up of work is terms of quantity & expenditure should be submitted by the bidder duly certified by the executing authority.

Signature of Contractor

(ii) If bidder has submitted certificate having different components / nature of work then proper completion certificate of required similar nature component is to be enclosed.

(c) The bidder should have achieved an annual financial turnover of at least 33.33 % of the Estimated Cost of the work (bid cost) in any one of last Three financial years (including current year, if opted by the bidder)

Note :-

(i) The bidder should enclose certificate of Turn Over from Chartered Accountant for last Three financial years & audited balance sheet of the year which is considered by the bidder in criteria 4 (a).

(ii) If current year or last year has been opted by bidder whose balance sheet is not submitted till the submission of bid then certificate from Chartered Accountant should be enclosed.

(d) Bid Capacity : Bidders who meet the minimum qualification criteria will be qualified only if available bid capacity is equal to or more than the total Bid value. The available bid capacity will be calculated as under:

Bid Capacity = (A x N X 3-B)

Where

A= Maximum value of civil engineering work executed in any one year during the last 3 financial years (up dated to present price level) taking in to account the completed as well as works in progress. However, the bidder may opt current year in the five year assessment period.

N= Number of year prescribed for completion of the work for which bids are invited. In present case value of **N shall be 1.0**

B= Value, at present price level of existing commitments and on going works to be executed during 'N' period (period prescribed for completion of the works for which the bids are invited)

Note:-

i. **Certificate from Chartered Accountant should be enclosed by bidder clearly indicated maximum value of Civil Engineering Work in one Financial Year.**
ii. **The present price level for turnover, cost of completed work & disputed amount of similar nature, the previous years value shall be given weight age of 10% per year as follows:-**

(a)	**For current year**	**1.00**
(b)	**For last year**	**1.00**
(c)	**For one year before**	**1.10**
(d)	**For two year before**	**1.21**
(e)	**For three year before**	**1.33**
(f)	**For four year before**	**1.46**

Important:

(a) The bidder must ensure that all the information required in the Documents is furnished by him complete in all respects. He would not be allowed to withdraw any document, or to rectify any information furnished therein, after submitting the bid.

(b) The bidder should give an affidavit that the information furnished in schedule I to VII is correct. If any information is found incorrect, the offer of the bidder shall be rejected and action be taken as per rules.

Signature of Contractor

(c) Bidders must do paging of all enclosure of bid documents.

Rejection of bids

The department reserves the rights to reject any bid or to disqualify any or all the bidders, without assigning any reasons at any stage.

(i) If Bid is not accompanied with the requisite documents mentioned in clause 4 or is not in accordance with procedure specified in Para 1, or is not accompanied with Bid Security& VAT clearance Certificate and registration of contractor in required category it would be liable for rejection

(ii) Furnishing of incorrect or incomplete or concealment of any information required in the bid documents would render the bid liable for rejection.

(iii) If all the copies enclosed in support should be self attested.

(a) The Bidders should have **Sales Tax Clearance certificate** at least up to 31.12.2015 from the concerned authorities without which the tenders may not be entertained.

(e) The Bidders should have VAT Clearance certificate / Latest VAT Returns **valid up to Six months back from the opening of Technical Bid.**

5. Earnest money for the work mentioned is **Rs. 1,65,500.00** for the contractor enlisted with JDA and **Rs. 6,62,000.00** for the contractor not registered with JDA.

6. Last date of receipt of completed tender documents online is 23.09.2016 **up to 6.00 PM** and will be opened on dated 29.09.2016 at **3.00 PM** in the presence of tender(s) or their authorized representative(s) who may choose to be present at the time of tender opening.

7. The bidder may carefully note that Joint venture is not allowed.

8. Validity period of the bids shall be 120 days from the date of opening of tender.

9. Bidders will need to produce in original of their all-supporting enclosure for verification by JDA, if required. Failure to comply with this requirement will result in disqualification of the applicant without any recourse.

10. The bidding documents include the following volumes, together with any Amendments / Addendum there to.

A : Technical Bid

Volume I : Instructions to bidders & conditions of contract

Scope of Work and Technical specifications

Schedules & Drawings

B : Financial Bid

Volume II : Schedule of Price

11. Complete tender document (Volume I and II) including drawings and addendum, if any, duly completed in all respects shall be submitted online as described further, so as to reach before **3.00 P.M. on or before 23.09.2016**

12. The bid security (Earnest Money Deposit) along with documents as per Clause - 16 of Instruction to bidder must be included with the Technical bid in separate envelope.

13. The financial bid containing financial proposal will be opened in the presence of only those bidders who are qualified and are found to have submitted substantially responsive technical proposals or their representatives; and who choose to attend at the time, date and at the address to be advised by the employer, at a later date.

14. If any bidder withdraws his tender prior to expiry of said validity period or mutually extended period or makes modification in the rates, terms and conditions of the tender within the said period, which are not acceptable to the department or fails to commence the work in the specified period/, fails to execute the agreement, the department shall,

without prejudice to any, other right or remedy, be at liberty to forfeit the amount of earnest money given in any form absolutely. If any contractor, who having submitted a tender does not execute the agreement or start the work or does not complete the work and the work has to be put to re-tendering, he shall stand debarred from participating in such re-tendering in addition to forfeiture of Earnest Money/Security Deposit/and other action under agreement.

15. All tenders, in which any of the prescribed conditions are not fulfilled or which have been vitiated by errors in calculations totaling or other discrepancies or with contain over-writing in figures or words or corrections not initialed and dated will be liable to rejection.
16. Enlisted Contractors in JDA, will be required to pay Earnest Money @ 1/2% of estimated cost of work put to tender, in case of work for which they are authorized to tender under Rules for enlistment of contractors, but the amount to the extent of full Earnest money shall be liable to be forfeited in the event of circumstances explained in **Clause - 14 above.**
17. The right to reject any or all tenders without assigning any reason is reserved with the Jaipur Development Authority.
18. Any other information can also be collected from the office of Executive Engineer PHE-I on Cell No. 9166669955.
19. **All the relevant documents submitted in support of this tender by the tenderer can be verified by JDA from the issuing authority if needed.**

Signature of Contractor	:
Name	:
Company's Seal	:
Date	:
E-mail	:

INSTRUCTIONS TO BIDDER

Volume-1

Signature of Contractor

INSTRUCTIONS TO BIDDER

(A) GENERAL INFORMATION AND RULES FOR GUIDANCE OF CONTRACTOR

1. EXECUTING AUTHORITY

The Executing authority of this project is Jaipur Development Authority.

2. TYPE OF CONTRACT

The work described in this tender document is considered to be single responsibility contract [turnkey basis] on lump sum basis. The Post qualification method comprising of two envelopes systems shall be used to evaluate the tender

3. PRIORITY OF CONTRACT

The documents forming part of the agreement are to be taken mutually explanatory documents of one another. In case of discrepancies they shall be explained and adjusted by the Engineer-In- charge. The Priority of the contract documents shall be as follows:

1. Letter of Award
2. Special Conditions of Contract.
3. Instructions to Bidders
4. General Conditions of contract
5. Work description/ Scope of work
6. Technical specifications
7. Drawings
8. Schedule of Prices

4. GENERAL

4.1 The bidder shall submit his offer along with tender letter as per **Annexure-01.**

4.2 In the event of the tender being submitted by a firm, it must be signed separately by each partner, thereof, or in the event of the absence of any partner, it must be signed on his behalf, by a person holding a Power of Attorney, authorizing him to do so. Such power of Attorney will be submitted with the tender and it must disclose that the firm is duly registered under the Indian Partnership Act, by submitting the copy of registration certificate.

4.3 Receipts for payments, made on account of a work when executed, by a firm must also be signed by the several partners, except where the contractors are described in their tender as a firm, in which case the receipts must be signed in the name of the firm by one of the partners or by some other person having authority to give effectual receipts for the firm.

4.4 The memorandum of work tendered for shall be filled in enclosed format at **Annexure-02**.

4.5 The bidder shall sign a declaration under the Official Secrets Act as per **Annexure-03** for maintaining secrecy of the bid documents, drawings or other records connected with the work given to him in form given below, the unsuccessful bidder shall return all the drawings given to them.

4.6 Sales tax or any other tax on materials, or Income Tax in respect of the contract shall be governed by Clause 36A, B and C and D of the Conditions of Contract. Deduction of Income Tax at sources will be made as per provisions of the Income Tax Act, in force from time to time.

4.7 The Contractor shall comply with the provisions of the Apprenticeship Act, 1961, and the rules and orders issued, there under, from time to time. If he fails to do so, his failure will be a breach of the contract and the original sanctioning authority in his discretion may cancel the contract. The Contractor shall also be liable for any pecuniary liability arising on account of violations by him of the provision of the Act.

4.8 The bidder, while submitting tender, must provide adequate information regarding his financial, technical and organizational capacity and working experience to execute the work of the nature and magnitude.

4.9 All additions, deletion, correction and overwriting must be serially numbered and attested by the Contractor at every page, so also by the officer opening the tenders, so as to make further disputes impossible on this score.

a) If a bidder reduces the rates voluntarily after opening of the tender/negotiations, his offer shall stand cancelled automatically, his Bid Security shall be forfeited and action for debarring him for business shall be taken as per Enlistment rules.

b) If a non-bidder offers lower rates after opening of tenders, action for debarring him from business shall be taken as per enlistment rules.

4.10 Contractors shall submit only unconditional tenders. Conditional tenders are liable to be rejected summarily.

4.11 Any person who submits a tender shall fill up the furnished schedules in price bid **(Vol.- III)** stating at what price he is willing to undertake the work. Tender which proposes any alternation in works specified in the said form of invitation to tender or in the time allowed for carrying out the work or which contain any other condition of any sort, will be liable to rejection. No single tender shall include more than one work but contractors who wish to tender for two or more works shall submit a separate tender for each. Tender shall have the name and the number of the work (to which they refer) written outside the envelope.

4.12 The Executive Engineer (PHE-I), JDA or his duly authorized assistant shall open tenders in the presence of any intending contractors who have submitted tenders or their representatives who may be present at the time and he will enter the amounts of the several tenders in a comparative statement in a suitable form. In the event of a tender being accepted, the contractor shall, thereupon, for the purpose of identification, sign copies of the specifications

Signature of Contractor

and other documents mentioned in this tender. In the event of tender being rejected, the Engineer JDA shall refund the amount of the Bid Security deposited, to the contractor making the tender on his giving a receipt for the return of the money.

4.13 The Officer competent to dispose of the tenders shall have the right of rejecting all or any of the tenders.

4.14 All works shall be measured net by standard measure and according to the rules and customs of the Jaipur Development Authority without reference to any local custom.

4.15 Under no circumstances shall any contractor be entitled to claim enhanced rate/price in this contract.

4.16 All Corrections and additions or pasted slips should be initialed.

4.17 The measurements of work will be taken according to the usual method in use in the Jaipur Development Authority and no proposals to adopt alternative methods will be accepted. Director (Engineering) decision as to what is 'the usual method in use with the Jaipur Development Authority will be final.

4.18 The Director Engineering or other duly authorized Engineer reserves the right to ask for submission of samples as in respect of materials for which the bidder has quoted his rates before the tender can be considered for acceptance. If the bidder, who is called upon to do so, does not submit within seven days of written order to do so, the Engineer-in-Charge shall be at liberty to forfeit the said Bid Security absolutely.

5 EXTENT OF SCOPE OF WORK

The scope of work under this Single Responsibility Contract includes construction of all works as described in subsequent paras to achieve the objective to treat the raw sewage as per the stipulated discharge standards and to dispose off the treated sewage as specified in layout plan, the work shall includes

- Tender for Design, Construction, Erection, Commissioning, Trial Run of 1 MLD STP at Smriti Van (Jhalana), on Turnkey basis based on SBR technology with PLC, SCADA Systems, Allied works, and O & M for 3 years at Jaipur City.
  - Providing operation and maintenance services for the above entire STP works in this campus, as specified, for 3 Years after commissioning the entire sewage treatment system. Battery limit of O & M is up to filling of OHSR/CWR.
  - To carryout campus development work of the area as marked in the drawing including internal road, walk way, street lights, water and sanitary arrangements, gardening, boundary wall, gates, etc. at the STP site.
  - Providing qualified and experienced consultant exclusively to JDA work who will assist them for checking and approval of design & drawing and also for execution of work. The scope of work of consultant has been defined in in this Volume.
- The contractor shall be responsible for taking electric connection as per requirement from JVVNL for which the demand note fee shall be paid by the contractor itself and the actual connection charges will be reimbursed afterwards by JDA. Similarly, the electric bills during O&M period shall be paid by contractor and thereafter reimbursed by JDA.
- The contractor shall be responsible for liasoning for getting environment clearance (Consent to establish and consent to operate) from Pollution control board and any other such clearance for which the requisite fee shall be paid by the contractor and the same will be reimbursed afterwards by JDA.
- Providing qualified and experienced consultant exclusively to JDA who will assist them for checking and approval of design and drawing and also for execution of work. The scope of work of consultant shall be defined separately in this volume. The contractor shall submit a panel of consultants after award of the job and JDA shall select appropriate consultant from the panel. Payment of consultants' fees would be the responsibility of contractor, which shall be maximum up to 1.0% of work order amount. However, being a principal employer, JDA shall have right to ensure timely payment to consultant by the contractor for which successful bidders shall submit proof of payments to JDA while raising the bill if EIC feel that list of consultant submit by bidder is not having sufficient experience EIC may direct carry out consultancy work by MNIT Jaipur or other NITs.
- The consultant shall have experience of designing and detailed engineering of minimum 2 nos. of sewage treatment plants up to 5 MLD capacities in last 15 years. He should have the following technical personnel for the design / approval of the engineering/ drawing.

- ✓ Process engineer / Environmental Engineer : The Engineer shall be post graduate in the environmental engineering with min. 10 years of experience in the design of sewage / water / waste water treatment plants.
- ✓ Structural Engineer: The Engineer shall be post graduate in the structural engineering with minimum 10 years of experience in the design of sewage / water / waste water treatment plants.
- ✓ Mechanical Engineer: The Engineer shall be post graduate in the mechanical engineering with minimum 10 years of experience in the design of sewage / water / waste water treatment plants.
- ✓ Electrical/Electronics/ instrumentation Engineer : The engineer shall be graduate in the electrical / instrumentation engineering with minimum 10 years of experience in the design/ execution of sewage / water / waste water treatment plants.

- In addition to the above, the consultants must have average receipt of consultancy fees as Rs.10 lacs during last three years ending March 2015. If EIC is not satisfied with proposal of consultant submitted by bidder he may direct to appoint MNIT as consultant.
- Any other Items which have not been specifically mentioned in specifications but are necessary for construction of the Plant as per good engineering practice, safety norms and successful operation and guaranteed performance of the entire Plant shall be deemed to be included within Scope of Work and shall be provided by the Contractor without any extra cost to the Employer.
- The Bidders are advised to visit the STP site before quoting for the proposed STP. JDA is reserved the right for physical verification for the credentials provided by the bidder if required. In such case all the expenses shall be borne by the bidder.
- The above works shall be completed within 12 months from the commencement date including 3 months trial run and including monsoon period and thereafter O & M for 36 months.

The rates quoted by the contractor for the items in the BOQ shall also include scope of work mentioned above and also the following works. Nothing extra shall be paid on these accounts.

- Supply, erection, testing & commissioning of all the piping, valves and specials etc. as per detailed technical specification.
- Water tightness/ testing of all the water retaining structures including Hydraulic Testing.
- Trial run of STP for start-up/ stabilization for a period of 3 months indicating satisfactory performance.
- Defect liability for a period of Twelve (12) months after the expiry of 3 months period of trial & run.
- Supply of equipment drawings, Technical specification/Catalogue.
- Supply of as built drawings after completion.
- Supply of Operation & Maintenance manual including manufacturer manual of the equipment supplied.
- Detailed structural drawings of all the structures.
- All RCC structures shall be designed as per latest relevant IS Codes.
- Proper earthquake analysis of over ground structures should be carried out. While designing these structures under seismic condition due attention to be paid towards 33.3% over stressing of structural materials and 25% overestimation of net bearing capacity of soil.
- While designing retaining walls effect of sub-soil water, possible surcharge and seismic effect of retained earth mass to be considered.
- Bearing capacity of soil at the site of STP is assumed about 10 MT / Sqm, however the contractor shall get it tested and account for the same in various structural design. If bearing capacity is found more than 10 T/ Sqm the design shall be based on 10 T/ Sqm.

Signature of Contractor

No extra payment shall be made for variation in bearing capacity.If bearing capacity is found less than 10.0 t/sqm, then design shall be done on actual SBC without any extra payment.

- The contractor shall make all arrangement for the water for construction purposes and shall get water tested at his own cost.
- The contractor shall make own arrangements for power supply for construction purposes & for testing purposes however department shall assist him for obtaining such Power connection.
- During the trial run period of STP, the bidder shall provide all the required man-power, consumables, repair and up-keep of civil, electrical, mechanical and instrumentation works within the STP, and also Electricity charges during Trial Run period shall be borne by the employer.
- During the trial run period, the bidder shall install and operate a generator set of adequate capacity to cater to the minimum load of the STP and the pumping station in case of power failures / load shedding.
- The bidder / tenderer shall supply all equipment drawings, Technical specification/ Catalogue of all electrical, mechanical and instrumentation works associated with STP.
- Supply of Operation & Maintenance manual including manufacturer manual of the equipment supplied and a list of spares prior to 90 days of the expiry of the trial run period.
- Routine and / or periodic maintenance of all civil, electro mechanical, electrical and instrumentation works within the Pumping Station and STP including minor and major repair / replacements. The quoted prices for O&M are deemed to be inclusive of all costs and nothing extra shall be paid to the bidder.
- Regular cleaning and clearing of all screenings of industrial waste, shrubs, vegetation, polythene or other un-desired materials and dispose the same in the approved municipal waste disposal site.
- All general facilities and utility services associated with sewer waste pumping station and STP.
- Provision of on job training to the JDA staff as per requirement finalized by JDA.
- The bidder's scope shall include supply of all necessary spares that may be required during O&M period of Three Years. The rate offered for O&M shall include cost of spares.
- Submission of operation and maintenance manuals of instructions and all as-built drawings for civil works, mechanical and electrical equipment.
- Submission of Monthly Operation Management Reports of all required parameters with respect to the operation and the regular preventive and breakdown maintenance of all components.
- Maintenance of Landscaping within Treatment Plant site.
- Handing over of the STP in complete & good working condition.
- An inventory of the civil, mechanical, electrical, instrumentation installations will be prepared jointly by the contractor and JDA prior to handing over and / or taking over of the pumping station & STP.

- Disposal of sludge at a suitable place shall be in scope of bidder during Trial Run and also during O&M of 3 years after that it will be handed over to JDA Body
- Physical inspection of the STP sites and finalization of the layout of the site in consultation with JDA.
- Carrying out & confirming the detailed topographical survey along finalized Gravity main/Rising main alignment, and treatment plant site, and establishing bench marks at least two locations within the STP site and one at pumping station site.
- The contractor will also provide luminous painted warning / caution notice boards with flickering light arrangements, where the work is in progress.

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- The sub-soil water is likely to be encounter during excavation at the STP site. The Contractor is advised to carry out its own investigations and gather information on the water table/subsoil conditions. The suitable and approved dewatering system should be adopted for execution of work. Nothing extra shall be paid on this account.
- The sub-soil water pumped will be drained off to the proper disposal points contractor will have to make arrangements to disposal off the pumped sub-soil water to satisfaction of Engineer in charge/JDA and nothing extra for dewatering of sub-soil water drain etc. will be paid.
- If as result of excavation of trenches, the underground services such as water, mains, electric-poles, cables, telephone cables and sewer lines etc., become exposed and un-supported it will be the responsibility of the contractor to make suitable & necessary arrangement for supporting and to keep them functional such arrangement will be done as per directions of the Engineer-in-Charge / JDA. No payment for supporting such utility services will be made by the JDA. Any damage caused to the above mentioned underground services due to negligence of the contractor or otherwise shall be made good by the contractor at his own cost.
- The contractor shall have to make his own arrangements for labour camp site and its hutments. On completion of work, these shall be removed by the contractor, failing which the JDA will arrange to dismantle the same at the risk and cost of the contractor and the dismantled material will become the property of the JDA for which the contractor shall have no legal claim. The expenditure so incurred will be recovered from the dues of the contractor. The contractor shall also be responsible for keeping all hygienic conditions in his labour camp / hutments as desired by Local Health Authorities.
- The contractor shall take all precautions for the safety of existing nearby/adjoining main or lateral sewers and dewatering equipment shall be kept as a standby in view the existing sewer lines.
- The contractor will provide a board indicating the name of work, name of contractor, name of division, cost of work, date of start, date of completion; telephone number etc., at site at his own cost and nothing will be paid by the JDA on this account.

- All the civil works under this contract shall be executed in conformity of PWD, CPWD specifications, CPHEEO Guidelines and relevant/applicable BIS codes (latest revisions), with up to date correction slips.
- The contractor will be solely responsible for any mishaps, during the execution of the work. The contractor must get his labour insured before the start of work, for the entire period of completion of work.
- The contractor shall not disturb/damage or pull down any hedge, tree, building etc within the site or his area of operation without the written permission of the Engineer-in-Charge Wherever there is any clash among the certain clauses of the conditions of contract, general conditions, special conditions and general notes / rules and directions for the guidance of the contractor, etc. the most stringent will govern for which the decision of the Engineer in Charge / JDA shall be final & binding.

6 NECESSITY OF SEWAGE TREATMENT FACILITIES

The above STP at Smriti Van has been proposed to reuse the recycled water for horticulture works and saving fresh water.

7 ADDRESS FOR COMMUNICATION :

The Executive Engineer (PHE-I)
JDA, Ram Kishore Vyas Bhavan,
Indira Circle, Jawahar Lal Nehru Marg,
Jaipur Rajasthan - 302 004

8 ELIGIBILITY CRITERIA:

Signature of Contractor

The contractor meeting following requirement will only be considered :

(I) TECHNICAL

The bidder should have successfully completed and commissioned during past five years one STP/CETP of minimum 1.0 MLD capacity or two STP/CETP of minimum 0.5 MLD capacity each based on Conventional Activated Sludge Process/Extended Aeration/ MBBR (Moving Bed Bio-reactor)/Sequential Batch Reactor (SBR) Technology as on date of receipt of Prequalification document. *Attested Copy of original certificates of the same shall be enclosed for verification, certified by the respective employer or his authorized representative, not below the rank of an Executive Engineer or equivalent. Original Certificates of the same shall be produced for verification on demand by employer.*

Note :-

For the purpose of bid evaluation, if the employers representatives feel necessary to visit a specific or all such plants as mentioned above by the bidder, the bidder shall make necessary arrangements for the same. The cost of such visits shall be borne by the bidder.

(II) FINANCIAL

(a) The bidder should have completed at least one similar nature work in last Five financial year (including current year, if opted by the bidder) of value not less than 33 % of the Estimated Cost of the work (bid cost) updated to present price level)

Note :-

(i) The starting & completion date of the work is to be in between above said financial year. If no, then maximum work (70%) is to be completed in above said financial year.

(ii) If bidder has submitted certificate having different components / nature of work then proper completion certificate of required similar nature component is to be enclosed.

(iii) The year wise financial breakup of work in terms of quantity & expenditure should be submitted by the bidder duly certified by the executing authority.

(b) Bid Capacity: Bidder should have assessed available bid capacity of more than **Rs. 331.00 lacs** as per following formula.

Assessed available bid capacity = (A X N x 3-B) Where,

A = Maximum audited turnover achieved(civil engineering works executed) during last three financial year (updated to present price level).

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

B =Value of existing commitments and on-going works in hand to be completed during the "N" years (period prescribed for completion of works for which bid are invited)

Note :-

1. *The present price level for turn over and cost of completed work and disputed amount of similar nature; the previous year's value shall be given weight age, of 10% per year..*
2. *Hiding and or not disclosing the value of "B" by the bidder shall lead to rejection of his tender.*
3. *All statement should be submitted duly certified by the statuary auditors who have signed their financial statement*
4. *Net worth means paid up capital + reserves and surplus (excluding, revaluation reserves) reduced by the losses/expenditure to be write off.*
5. *Net working capital shall be calculated as current assets minus current liabilities (including all loan & deposits payable in next 12 months). The assured line of credit given specifically for this project by any nationalized Bank / Financial institutions to the bidder shall also be considered for the purpose.*

9 ELIGIBLE BIDDERS :

Engineer-In-Charge will review the qualification and experience of the Bidders in respect of :

(a) Past experience
(b) Major works in hand
(c) Technical personnel
(d) Financial capacity

Signature of Contractor

(e) Any other relevant information as per tender documents.

The bidders who, after studying the qualification criteria, feel that they will be qualified can participate in this single stage – two bidding procedure. The participating bidders shall be subject to evaluation of their qualification, technical and financial competence to carry out the work under this tender, as per the qualification criteria. Only the bidders qualified under this procedure will become eligible for opening their financial bids.

Bidders shall provide such evidence of their continued eligibility satisfactory to the employer along with their tender offers.

Bidders shall not be under a declaration of ineligibility for corrupt or / fraudulent practices.

A Bidder shall not have a conflict of interest. All bidders found to be in conflict of interest shall be disqualified. A Bidder may be considered to have a conflict of interest with one or more parties in this bidding process if they;

(a) have controlling shareholders in common; or
(b) receive or have received any direct or indirect subsidy from any of them; or
(c) have the same legal representative for purpose of this Bid; or
(d) have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the Bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or
(e) participated as a consultant in the preparation of technical specifications of the goods and related services that are the subject of the Bid.

Government-owned enterprises shall be eligible only if they can establish that they are legally and financially autonomous and operate under commercial law, and that they are not a dependent agency of the Employer.

10 QUALIFICATION OF THE BIDDER:

To be qualified for the award of the Contract

The bidder is required to :

(i) Submit attested copies of documents defining the constitution of legal statutes, place of registration and principal place of business, a written power of attorney authorizing the signatory of the bidder to commit the bid.

(ii) Have adequate qualification requirements specifying financial capacity and technical capability with minimum acceptable levels with regards to bidders experience in relevant project etc. to undertake the contract and assessment of bidder's proposals regarding work method, scheduling and resourcing; which shall be provided in sufficient details to confirm the bidder's capability to complete the works in accordance with the employer's requirement and the time for completion. The bidder shall have to furnish the details of qualification criteria given in bidding document.

(iii) Submit proposals regarding work methods, scheduling and resourcing which shall be provided in sufficient detail to confirm the bidder's capability to complete the work in accordance with the Employer's Requirements and the time for completion.

Bid Submission By Joint Venture Is Not Allowed.

The determination of eligibility of bidder will take into account the bidder's financial, technical and experience capabilities and past performance; it will be based upon an examination of documentary evidence of the bidder's qualifications submitted by the bidder, pursuant to Sub- Clause 11.1(ii), as well as such other information as the employer deems necessary and appropriate; and

Technical

(i). Overall completeness and compliance with the Employer's Requirements; the technical merits of plant and equipment offered and deviations from the Employer's Requirements; suitability of the facilities offered in relation to the environmental and climatic conditions prevailing at the site; quality, function and operation of any process control concept included in the bid shall be judged.

(ii). Proven capability of the principal treatment process plant, equipment and instruments of forced

(iii). Achievement of specified performance criteria by the facilities;

(iv). Compliance with the time schedule called for in Technical proposal.

(v). Type, quantity and long-term availability of spare parts and maintenance services;

(vi). Any deviations to the commercial and contractual provisions stipulated in the bidding documents.

(vii). An affirmative determination will be a prerequisite - for the employer to continue with the evaluation of the technical proposal: a negative determination will result in rejection of bidder's bid.

11 SITE VISIT:

The bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the bid and entering into a contract for the design-build and completion of the Works. The costs of visiting the Site / testing if required or any other cost shall be at the bidder's own expense.]

The bidder and any of its personnel or agents will be granted permission by the Employer to enter upon its premises and lands for the purpose of such inspection, but only upon the express condition that the bidder, its personnel and agents, will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of the inspection.

The Employer may conduct a site visit concurrently with the pre-bid meeting, if possible.

B. BID DOCUMENT

12 CONTENT OF BID DOCUMENT

The details of works, bidding procedure, contract terms and technical requirements are prescribed in the bidding documents. The Bidding Documents include the following volumes, together with any Amendments/Addenda there to which may be issued in accordance with Clause 17.

1.	**Volume-I**	**INSTRUCTION TO BIDDERS & CONDITIONS OF CONTRACT**
2.	**Volume-II**	**SCOPE OF WORK AND TECHNICAL SPECIFICATIONS**
3.	**Volume-III**	**SCHEDULE OF PRICES**

The bidder is expected to examine carefully the contents of the Bid document. Failure to comply with the requirements of bid submission will be at the bidder's own risk. Bids, which are not substantially responsive to the requirements of the bid document, will be rejected.

AMENDMENTS OF BID DOCUMENT:

At any time prior to the deadline for submission of bids, the Employer may, for any reason, whether at its own initiative or in response to any clarifications requested by a prospective bidder, modify the bid document by issuing addenda.

To afford prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may if required extend the deadline for submission of bids, in accordance with Clause 29.

Signature of Contractor

C. PREPARATION OF BIDS

13 LANGUAGE OF BID:

The bid, and all correspondence and documents, related to the bid, exchanged between the bidder and the Employer shall be written in the English language. Supporting documents and printed literature furnished by the bidder may be in another language provided they are accompanied by an accurate translation of the relevant passages in the English language, in which case, for purposes of interpretation of the bid the English translation shall prevail.

14 DOCUMENTS COMPRISING THE BID:

Tender documents shall be submitted on line e-procurement website http://www.eproc.rajasthan.gov.in with their digital Signature. The Bid is to be submitted in 3 Covers which shall comprise of –

Cover-1 Scanned copy of DD/BC of Tender Cost, Earnest Money and e-procurement fees.

Cover-2 Complete Tender Document along with addendums/ amendments issued and uploaded by the Department on the above website, Tender form and schedules for pre-qualification Bid and scanned copies of supporting Documents duly signed and attested as required for qualification as detailed herein after.

Cover"2" shall content following documents:

i) Covering letter
ii) Power of attorney
iii) Registration Certificate
iv) Sales Tax / VAT clearance certificate**.**
v) Technical Proposals and Appendix / Annexure as contained in Volume-I
vi) Information regarding financial resources and capability in **Sc –5.**
vii) Information regarding works of similar nature executed in the last five years.
viii) Certificates from the concerned Engineer-In-Charge in support and verification of the information furnished in **Annexure – 4.**
ix) Information regarding details of maximum value of civil engineering works executed in any one year during the last five years taking into account the completed as well as works in progress in **Annexure – 7.**
x) Information regarding existing commitments and ongoing works to be completed in **Annexure – 6.**
xi) Information regarding details of litigation or arbitration contracts to be furnished in **Annexure-17.**
xii) Calculation of Bid capacity in **Annexure – 18.**
xiii) Affidavit as per **Annexure – 16.**
xiv) Key personnel details as per **Annexure-10.**

(b) The technical bid will be opened online only of those bidders whose proper Earnest money, VAT clearance certificate (Valid up to Six months back from the opening of Technical Bid) and copy of registration if any of contractor in required category are found to be in order.

Cover-3 Financial offer (BOQ).

Price Schedule giving details of unit wise breakup of Civil, Pipe, Mechanical, Electrical works and year wise O& M.

15 BID FORM & PRICE SCHEDULES:

The Bidder shall complete the Bid Forms and schedules furnished in the bidding documents in the manner and detail indicated therein, following the requirements of Clauses 18 and 19.

16 BID PRICES:

Unless specified otherwise in Employer's Requirements, Bidders shall quote for the entire facilities on a "single responsibility" basis such that the total bid price covers all the Contractor's obligations mentioned in or to be reasonably inferred from the bidding documents in respect of the design, engineering, manufacture, including procurement and subcontracting (if any), supply, construction, installation, testing, commissioning and completion of the facilities. This includes all requirements under the Contractor's responsibilities for testing, pre-commissioning and commissioning of the facilities and, where so required by the bidding documents, the acquisition of all permits, approvals and licenses, etc. operation, maintenance and training services and such other items and services as may be specified in the bidding documents, all in accordance with the requirements of the Conditions of Contract.

Bidders shall give a **breakup of the prices**, in the manner and detail called for in the schedules of prices. The bidder shall fill in rates, prices, and line item total (both in figures and words) for all items of the works described in the schedule of prices along with total bid price (both in figures and words). Items for which no rates or price is entered by the bidder will not be paid by the Employer when executed and shall be deemed covered by the other rates and prices in the schedule of prices. Corrections, if any, shall be made by crossing out, initialing, dating and rewriting.

In the Schedules, Bidders shall give the required details and a breakup of their prices, including all taxes, duties, levies and charges payable as follows:

(i). Design (detailed hydraulic and structural calculations) including all necessary working drawings and documentation for the Work; for approval of the employer / client, well before starting the work.
(ii). Plant and equipment to be supplied by the bidder.
(iii). Plant and equipment manufactured or fabricated shall be quoted on FOR Site basis and shall be inclusive of all costs as well as duties and taxes paid or payable on components and raw materials incorporated or to be incorporated in the facilities.
(iv). Civil Works, Installation, commissioning and O & M works along with other services shall be quoted separately and shall include rates or prices for all labor, contractor's equipment, temporary works, materials, consumables and all matters and things of whatsoever nature, including local transportation, operations and maintenance services, provision of operations and maintenance manuals, training etc. where identified in the bidding documents, as necessary for the proper execution of the Civil Works, Installation and Other Services.

17 Prices quoted by the bidder shall be firm.

18 BID CURRENCIES:

The prices shall be quoted in Indian currency only. The department will not arrange any foreign currencies for import of any type of material/ plant / spares etc.

19 BID VALIDITY:

Bids shall remain valid for a period of not less than 120 days after opening of the Tender. A bid valid for a shorter period shall be rejected by the Employer as non-responsive.

In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request the bidders to extend the period of validity for a specified additional period. The request and the responses thereto shall be made in writing or by verbal. A bidder may refuse the request without forfeiting its Earnest Money. A bidder agreeing to the request will not be required or permitted to modify its bid, but will be required to extend the validity of its Bid Security for the period of the extension, and in compliance with the relevant Clause in all respects.

The bid security may be forfeited

(a) If the bidder withdraws its bid after bid opening during the period of Bid validity, except as provided in relevant Clauses / Sub-Clauses

(b) In the case of a successful bidder, if fails within the specified time limit to Sign the Contract Agreement, or

(c) If a bidder reduces the rates voluntarily or modifies his offer voluntarily after opening of the financial tenders/ negotiations, his offer shall stand cancelled automatically, his Bid Security shall be forfeited and action for debarring him from business shall be taken as per enlistment rules.

20 MAKES AND ORIGIN OF THE EQUIPMENT

It is expected that the Bidder will quote his rates or submit his offer with a view to supply equipment of best makes and conforming to highest standard. Bidder has to consider for his financial offer, only makes of reputed manufacturers of equipments corresponding to the state of art technology and to the latest Indian standards.

Bidder shall offer rates as per the makes given of the equipment in the tender document or of any superior make if makes are not prescribed of the items, conforming to prescribed specifications indicated in the Volume II - "Scope of Work & Technical specifications". The bidder shall quote only one price for each item mentioned in Schedule of Prices, irrespective of the finally selected make. The JDA reserves the right to reject the offer if the makes given in Tender Document are not accepted and alternative makes are offered. By signing his offer, the bidder agrees to supply any one make given in the tender document and/or accepted by the JDA. for the price quoted in Schedule of Prices.

Whichever equipment is proposed in the tender or considered by the bidder for the financial offer, the equipment to be finally provided in case of award shall correspond to the specifications of the tender documents and shall be subjected to the approval of the Engineer in Charge.

In case, the Bidder proposes to use any imported equipment/part of equipment/material he shall indicate so clearly in his tender and shall be responsible for arranging import license etc. for the same. All expenses to be incurred by the Contractor in connection with such import including customs duty shall be included in the prices quoted.

E. TENDER OPENING & EVALUATION

21 OPENING OF TECHNICAL BID :

The Employer will open the Technical Bid, "A" of all the bids received (except those received late), in the presence of bidders' representatives who choose to attend; at 3.30 P.M. on the Bid opening date at the office of Executive Engineer(PHE-I), JDA Jaipur.

The bidders' representatives who are present shall sign a register evidencing their attendance.

The tenders shall be opened in two stages. The Committee of Executive Engineer (PHE–I), JDA, shall open the Bid–A (Technical bid) in first stage, in the presence of Bidder (s) or their Authorized Representative(s) who may choose to be present at the time of tender opening. The Bid – B (Financial bid) shall be opened by the Committee of Director Engineering-II, JDA or his authorized person in respect of responsive bidder at a later date, which will be informed to all responsive bidders

The bidders' names, bid modifications and withdrawals, the presence or absence of bid security, and such other details, as the Employer may consider appropriate, will be announced and recorded by the Employer at the time of opening of bid. The bidders' representatives will be required to sign this record.

22 INVITATION TO ATTEND OPENING OF PRICE BIDS

At the end of the evaluation of the technical proposals, the Employer will invite only bidders who have submitted substantially responsive technical proposals to attend the opening of the financial bid and shall be intimated to responsive bidders accordingly. Bidder shall be given reasonable notice for the price bid opening.

23 EVALUATION AND COMPARISION OF PRICE BIDS:

The Employer will evaluate and compare only the bids determined to be substantially responsive in accordance with Clause .

Evaluation will be made on the basis of total bid price including Capital cost, O&M cost inclusive of all taxes and duties.

The Employer's evaluation of a bid will take into account, in addition to the bid prices indicated in the Schedule of Prices, the following costs and factors that will be added to each Bidder's bid price in the evaluation using pricing information available to the Employer, in the manner and to the' extent in the Employer's Requirements.

(a) The additional price, if any, reflected in the supplementary price proposal. If the price stated is not realistic the bid is liable to be rejected,

(b) Compliance with the time schedule called for in the Appendix to Price Proposal and evidenced as needed in a milestone schedule provided in the bid;

(c) The projected operating costs during the initial period of operation of the facilities,

(d) The functional guarantees of the facilities offered against the specified performance criteria of the plant and equipment; and

(e) The extra cost of work, services, facilities, etc., required to be provided by the Employer or third parties.

24 The following evaluation methods will be followed:

(a) **Time Schedule**: The plant and equipment covered by this bidding are required to be manufactured, transported, installed and the facilities completed within the period specified in Clause 2 of NIT and the Appendix to Technical Proposal. Bidders submitting bids that deviate from the time schedule specified will be rejected.

(b) Any adjustments in price that result from the above procedures shall be added, for purposes of comparative evaluation only, to arrive at an "Evaluated Bid Price." Bid prices quoted by Bidders shall remain unaltered.

(c) The Employer reserves the right to accept or reject any variation or deviation and other factors which are in excess of the requirements of the bidding documents or otherwise result in the accrual of unsolicited benefits to the Employer shall not be taken into account in bid evaluation.

(d) The estimated effect of the price adjustment provisions of the Conditions of Particular Application, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.

(e) If the bid of the successful bidder is substantially below the Employer's estimate for the contract, the Employer may require the bidder to produce detailed price analyses to demonstrate the internal consistency of those prices. After evaluation of the price analysis, the Employer may require that the amount of the Security deposit set forth in Clause 1 of General Condition of Contract 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.

G. AWARD OF CONTRACT

25 AWARD:

The Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents and who has offered the Lowest Evaluated Bid Price.

Signature of Contractor

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26 EMPLOYER'S RIGHT TO ACCEPT ANY BID OR TO REJECT ANY OR ALL BIDS:

The Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids, at any time prior to award of Contract, without thereby incurring any liability to the affected bidder or bidders or any obligation to inform the affected bidder or bidders of the grounds for the Employer's action.

27 NOTIFICATION OF AWARD:

Prior to expiration of the period of bid validity prescribed by the Employer, the Employer will notify the successful bidder by fax, confirmed by registered letter, that its bid has been accepted. This letter (hereinafter and in the Conditions of Contract called the "Letter of Intent / Letter of Work Order Acceptance") shall state the sum which 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 Conditions of Contract called "the Contract Price").

28 SIGNING OF CONTRACT AGREEMENT:

Within ten (10) days of department's notice, the successful bidder shall sign the contract agreement.

The following duly filled in and signed documents, shall form the contract agreement;

a) Agreement
b) Letter of award and any pre-award correspondence between Department and the Bidder
c) Tender documents contained in;

- **Vol-I : Instruction to Bidders & Conditions of Contract**
- **Vol-II: Scope of Work and Technical Specification**
- **Vol-III : Schedule of Prices**
- **All addenda issued**

d) The Tender Offer

On acceptance of the tender, the name of the accredited representative(s) of the Bidder (with a photograph and signature attested), who would be responsible for taking instructions from the Department / Engineer in charge, shall be communicated to the Engineer-in-charge.

After acceptance of the tender, the Bidder or all partners (in the case of partnership firm) or the authorized representative of the firm with a valid power of attorney will append photographs and signatures duly attested, at the time of execution of Agreement.

29 PERFORMANCE SECURITY DEPOSIT: DELETED

30 CORRUPT OR FRAUDULENT PRACTICES:

The employer requires that bidders/suppliers/contractors under his financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, the employer:

(a) Defines for the purposes of this provision, the terms set forth below as follows:

(i) "corrupt practices" means behavior on the part of officials in the public or private sectors by which they improperly and unlawfully enrich themselves and/or those close to them, or induce others to do so, by misusing the position in which they are placed, and it includes the offering, giving, receiving, or soliciting of anything of value to influence the action of any such official in the procurement process or in contract execution; and

(ii) "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 employer, 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 employer of the benefits of free and open competition;

(b) 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;

(c) Will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a contract if it at any time determines that the firm has engaged in corrupt of fraudulent practices in competing for, or in execution of contract.

Signature of Contractor :

Name :

Company's Seal :

Date :

General Conditions of Contract

(Appendix XI of PWF & AR. Govt. of Rajasthan effective up to date shall be applicable)

Signature of Contractor

ANNEXURE TO APPENDIX XI
RAJASTHAN PUBLIC WORKS DEPARTMENT
CONTRACTOR LABOUR REGULATIONS

1. **Short title:** These regulations may be called "The Rajasthan Public Works Department Contractor's Labour Regulations."

2. **Definition** : These regulations unless otherwise expressed or indicated, the following words and expressions shall have the meaning hereby assigned to them respectively, that is to say :

(i) **"Labour"** means workers employed by a Rajasthan P.W. Department contractor directly or indirectly through a sub-contractor or other person or by an agent on his behalf.

(ii) **"Fair Wage"** means minimum wages for time or piece work fixed or revised by the State Government under the Minimum Wages Act., 1948.

(iii) **"Contractor"** shall include every person whether sub-contractor or headman or agent employing labour on the work taken on contract.

(iv) "**Wages"** : shall have the same meaning as defined in the Payment of Wages Act. and includes times and piece rate wages.

3. **Display of Notice regarding wages etc.** : The contractor shall (a) before the commences his work on contract, display and correctly maintain and continue to display and inconspicuous places on the work notices in English and the correctly maintain in Hindi by the majority of the workers giving the rate of wages which have been certified by the Executive Engineer, the superintending engineer, the Chief Engineer or Labour Commissioner, as fair wages and the hours of works for which such wages are earned, and (b) send a copy of such notices to the Certifying Officers.

4. **Payment of Wages**

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

(ii) No wage period shall exceed one month.

(iii) Wages of every workman employed on the contract shall be paid before the expiry of ten days after the last day of the wage period in respect of which the wages are payable.

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

(v) All payments of the wages shall be made on a working day except when the work is completed before the expiry of the wage period in which case, final payments shall be made within 48 hours of the last working day.

5. **Wage Book and Wage slips etc.**

(i) The Contractor shall maintain a Wage Book of each worker in such form as may be convenient but the same shall include the following particulars.

(a)Rate of daily or monthly wages.

(b) Nature of work on which employed.

(c)Total number of days worked during each wage period.

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

(e)Wages actually paid for each wage period.

(ii) The contractor shall also maintain a wage slip for each worker employed on the work

(iii) The Executive Engineer may grant an exemption from the maintenance of the wage books and wages slips to a contractor who, in his opinion, may not directly or indirectly employ more than 50 persons on the work.

7. **Fines and deductions which may be made from wages**

(i) The wages of a worker shall be paid to him without any deductions of any kind except those authorized, namely the following

(a) Fines

(b) Deductions for absence from duty i.e. from the place or places where, by the terms of his employment, he is required to work. The amount of deduction shall be in proportion to the period for which he was absent.

(c) Deductions for damages to or loss of goods expressly entrusted to the employed person for custody or for loss or any other deductions of money, which he is required to account where such damages or losses are directly attributable to his neglect or default.

(ia) The Rajasthan Government may, from, time to time, allow deductions other than those specified in clause I above.

(ii) No fines shall be imposed on a worker and no deductions for damage or loss shall be made until worker has been given an opportunity of showing cause against each fine or deductions.

(iii) The total amount of fines, which may be imposed in any one wage period on a worker, shall not exceed an amount equal to three paise in rupee of the wage payable to him in respect of that wage period.

(iv) No fine imposed on any worker shall be recovered from him by installment or after the expiry of 60 days from the date on which it was imposed.

8. **Register of fines etc. :** The contractor shall maintain a register of fines and of all deductions for damage or loss. Such register shall mention the reasons for which fine was imposed or deduction for damage or loss was made.

The contractor shall maintain both in English and local Indian Language, a list approved by the Labour, Commissioner clearly stating the acts and omission for which penalty of fine may be imposed on a workman and display it in a good condition in a conspicuous place on the work.

9. **Preservation of Register:** The wage register, the wage card and the register fines deductions required to be maintained under these regulations, shall be preserved for 12 months after the date of the 1st entry made in them.

10. **Powers of Labour Welfare Officer to make investigation of enquiry**: The Labour Welfare Officer or any other person, authorized by the State Government on their behalf, shall have power to make enquiries with a view to ascertaining and enforcing due and proper observance of the fair wage clauses and provisions of the regulations. He shall investigate into any complaint regarding default made by the Contractor or Sub-Contractor in regard to such provisions.

11. **Report of Labour Welfare Officer :** The Labour Welfare Officer or other person, authorized as aforesaid, shall submit a report of the result of his investigation or enquiry to the Executive Engineer concerned indicating the extent, if any, to which the default has been committed with a note that necessary deductions from the contractors bill be made and the wage and other dues be paid to the labour concerned in case an appeal is made by contractor under clause 12 of these regulations, actual payment of labours will be made by the Executive Engineer after the Labour Commissioner had given decision on such appeal.

Signature of Contractor

12. **Appeal against the decision of Labour Welfare Officers :** Any person aggrieved by the decision and recommendation of the Labour. Welfare Officer or other persons, so authorized, may appeal against. Such decision to the Labour Commissioner within 30 days from the date of decision forwarding simultaneously a copy of his appeal to Executive Engineer concerned but subject to such appeal the decision of the Officer shall be final and binding upon the contractor.

12a No party shall be allowed to be represented by a lawyer during any investigation, enquiry, appeal or any other proceedings.

13. **Inspection of wage books and slips** : The contractor shall allow inspection of the wage books and wage slips and register of lines and deductions to any of his workers or to his agent at a convenient time and place after due notice is received or to the Labour Welfare Officer or any other person authorized by the State Government on his behalf.

14. **Submission of Returns** : The Contractor shall submit periodical returns, as may be specified from time to time.

15. **Amendments** : The State Government may, from time to time, add to or amend these regulations and on any questions as to the application, interpretationer effect of these regulations, the decision of the Labour Commissioner to the Government of Rajasthan or any other person authorized by the State Government in that behalf, shall be final.

CHEDULE OF FAIR WAGE TO BE GIVEN BY EXECUTIVE ENGINEER LIST OF ACTS AND COMMISSION FOR WHICH FINE CAN BE IMPOSED

(I) Willful insubordination disobedience whether alone or combination with another (2) The fraud or dishonesty in connection with the contractor business or property of the Rajasthan P.W.D. (3) Taking or giving bribes or any illegal gratification. (4) Habitual late attendance. (5) Drunkenness, fighting riot or disorderly or indecent behaviour (6) Habitual negligence (7) Smoking near or around the area where combustible or other materials are stocked. (8) Habitual indiscipline (9) Causing damage work in progress or to property of the Rajasthan P.W.D. or the contractor (10) Sleeping on duty (11). Malingering or sowing down work (12). Giving of false information regarding name, age, father's name (13) Habitual loss of wage cards supplied by the employers. (14) Unauthorised use of employer's property or manufacturing or making of unauthorized articles at the work places (15) Bad workmanship in construction and maintenance by skilled workers which is not approved by the department and for which contractors are compelled to undertake rectification (16) Making false complaints and / or misleading statement. (17) Engaging, in trade within the premises of the establishment. (18) Any delinquency of business affairs of the employers. (19) Collection or canvassing for the collection of any money within the premises of an establishment unless authorized by the employer. (20) Holding meeting inside the premises without previous sanction of the employer (21). Threatening or intimidating any workman or employee during the working hours within the premises.

Schedule showing (approximately) material to be supplied from the Public Works Store for work contracted to be executed and the rates of which they are to be charged for

DELETED

Note : The person or firm submitting the tender should see that the rates in the above schedule are filled up by the Engineer-in-Charge on the issue of the form prior to be submission to the tender.

Signature of Contractor **Signature of Engineer**

Progress Statement referred to in Clause 3 of Condition of Contract

Name of Works	Date from which the work should be commenced	Date by which the work should be completed	Monthly rate of progress

The contractor has been informed that his tender has bee accepted.

Date : Date :

Engineer-in-Charge Contractor

Notes for filling in the Progress Statement Form on the Last Page

1. Columns 2, 3 and 4 must be initialed and dated by the Contractor.
2. Column 4 must be initialed and dated by the Chief Engineer or other authorized Engineer also.
3. The date in column 2 should correspond to the date on which the order to commence works is given to the contractor read with Clause 2 of the conditions of contract.
4. The date of column 3 must correspond to the period stated in sub class (e) of the Memorandum below "Tender for works".
5. Column 4. This will ordinarily be worked out proportionately ; thus if Rs. 24,000/- is the cost of the whole or portion of work tendered for, and six months period of completion, then the monthly rate of progress should be Rs. 4,000. If necessary, quantities may also be specified in this column at the discretion of the Chief Engineer.
6. The Certificate as to intimation of acceptance of tender printed at the foot of the form, must be signed and dated both by the Chief Engineer or other duly authorized Engineer and the Contractor.

Signature of Contractor

SCHEDULE 'H'

SPECIAL CONDITIONS

01. Use of Bitumen mixture Tar mechanical lime grinder, cement concrete mixer & vibrator is essential for the work. Which shall have to be arranged by the contractor at his own level/cost?
02. If there is any typographical error or otherwise in the 'G' Schedule the rates given in the relevant BSR on which schedule 'G' has been prepared, shall prevail.
03. The contractor shall follow the contractor labour regulation and abolition Act 1970 & Rule 1971.
04. The JDA shall have right to cause on audit and technical examination of the work and the final bills of the contractor including all supporting vouchers, abstract etc. to be made within two years after payment of the final bills and if as a result such audit any amount is found to have been over paid/excess in respect of any work done by the contractor under the contract or any work claimed by him to have been done under this contract and found not to have been executed the contractor shall be liable to refund such amount and it shall be lawful ;for the JDA to recover such sum from him in ;the manner prescribed in special condition no. 8 or any other manner legally permissible and if it is found that the contractor was paid less then that was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be paid bay the JDA to the contractor.
05. The contractor shall not work after the sunset and before sunrise without specific permission of the authority Engineer.
06. Whenever any claim against the contractor for the payment of a sum of money arises out or under the contracts, the JDA shall be entered to recover the sum by appropriating in part or whole of the security deposit of the contractor. In the event of the security being insufficient or if no security has been taken from the contractor then the balance of the total sum recoverable as the case may shall be deducted from any sum then due or which a any time there contract with the JDA should this sum be sufficient to recover the full amount recoverable, the contractor shall pay to JDA on demand the balance remaining due. The JDA shall further have the right to effect such recoveries under P.D.R. Act.
07. The rate quoted by the contractor shall remain valid for a period of 120 days from the date of opening of the tenders.
08. By submission of this tender the contractor agree to abide with all printed conditions provided in the PWD manual from 64 (Chapter 3-para 36) and subsequent modification.
09. No conditions are to be added by the contractor and conditional tender is liable to be rejected.
10. All transaction in the execution of this work and this tender will be liable to sale-tax vide section 2(B) read with sub clause (4) Sale-tax Rule, 1954.
11. If any tenderer withdraws his tender prior to expiry of said validity period given at S.No. 7 or mutually extended prior or makes modifications in the rates, terms and conditions of the tender within the said period which are not acceptable to the department or fails to commence the work in the specified period, fails to execute the agreement the department shall without prejudice to any, other right or remedy, be at liberty to forfeit the amount of Bid Securitygiven in any form absolutely. If any contractor, who having submitted a tender does not execute the agreement or start the work or dose not complete the work and the work has to be put to retendering, he shall stand debarred for six months from participating of tendering in JDA in addition to forfeiture of Bid Security/ Security Deposit and other action under agreement
12. Rules regarding enlistment of contractors provide that work ;upto five times limit for which they are qualified for tendering can be allotted to them Therefore, before tender the contractors will keep this in mind, and submit the details of work. Tenders with incomplete or incorrect information are liable to be rejected.
13. Any material not conforming to the specifications collected at site shall have to be removed by the contractor within a period of 3 days of the instructions, issued by the Engineer-Incharge in writing. Failing which, such material shall be removed by the Engineer-Incharge at risk and the contractor after expiry of 3 days period.
14. The material collected at site and paid provisionally shall remain under the watch and ward of the contractor till it is consumed, fully on the work.
15. The rates provided in tender documents are inclusive of all Taxes royalty.
16. No extra lead of earth/material shall be paid over and above as specified in 'G' schedule. Source/borrow pit area for earth shall have to be arranged by the Contractor at his own cost.
17. Undersigned has full right to reject any or all tenders without given any reasons.
18. Mortar of Masonry work and lean concrete will be permitted mixer with hopper.
19. As per Supreme Court decision "All contracts with Governments shall require registration of workers under the building and other construction workers (Regulation of Employment and Conditions of Service) Act, 1996 and extension of benefits to such workers under the act."
20. The tenderer are required to submit copy of their enlistment as contractor.
21. Conditions of RPWA-100 will be mandatory & acceptable to the contractor.
22. Any tender received with unattested cutting/overwriting in rates shall be rejected and such bidder will be debarred from tendering for three months in JDA.
23. All the provisions of THE RAJASTHAN TRANSPARENCY IN PUBLIC PROCUREMENT ACT, 2012 and Rules, 2013 will be applicable. If there is any contradictions in existing special conditions and provisions of THE RAJASTHAN TRANSPARENCY IN PUBLIC PROCUREMENT ACT, 2012 and RULES, 2013, provisions of THE RAJASTHAN TRANSPARENCY IN PUBLIC PROCUREMENT ACT, 2012 and RULES 2013 shall be applicable.

Signature of Contractor
with full address & Mobile No.

Executive Engineer (PHE-I)
JDA, Jaipur

Signature of Contractor

Annexure A : Compliance with the code of Integrity and No Conflict of Interest

Any person participating in a procurement process shall –

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

Conflict of Interest:-

The Bidder participating in a bidding process must not have a Conflict of interest.

A conflict of interest is considered to be a situation in which a party has interests that could improperly influence that party's performance of official duties or responsibilities, contractual obligations, or compliance with applicable laws and regulations.

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

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

Signature of Contractor

Annexure B : Declaration by the Bidder regarding Qualifications

Declaration by the Bidder

In relation to my/our Bid submitted to …….. for procurement of …….. in response to their Notice inviting Bids No. ……..Dated …….. I/We hereby declare under Section 7 of Rajasthan Transparency in Public Procurement Act, 2012, that :-

1. I/We possess the necessary professional, technical, financial and managerial resources and competence required by the Bidding Document issued by the Procuring Entity;
2. I/We have fulfilled my/our obligation to pay such of the taxes payable to the Union and the State Government or any local authority as specified in the Bidding Document;
3. I/We are not insolvent, in receivership, bankrupt or being wound up, not have my/our affairs administered by a court or a judicial officer, not have my/our business activities suspended ant not the subject of legal proceeding for any of the foregoing reasons;
4. I/We do not have, and our directors and officers not have, been convicted of any criminal offence related to my/our professional conduct or the making of false statements or misrepresentations as to my/our qualifications to enter into a procurement Contract within a period of three years preceding the commencement of this procurement process, or not have been otherwise disqualified pursuant to debarment proceedings;
5. I/We do not have a conflict of interest as specified in the Act, Rules and the Bidding Document, which materially affects fair competition;

Date : Signature of bidder

Place : Name :

Designation :

Address :

Annexure C : Grievance Redressal during Procurement Process

The designation and address of the First Appellate Authority is Commissioner, JDA, Jaipur.

The designation and address of the Second Appellate Authority is Principal Secretary /Addl. Chief Secretary, UDH, Rajasthan, Jaipur.

(1) Filing an appeal

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

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

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

(2) The officer to whom an appeal is filed under para (1) shall deal with the appeal as expeditiously as possible and shall endeavour to dispose it of within thirty days from the date of the appeal.

(3) If the officer designated under para (1) fails to dispose of the appeal filed within the period specified in para (2), or if the Bidder or prospective bidder or the Procuring Entity is aggrieved by the order passed by the First Appellate Authority, the Bidder or prospective bidder or the Procuring Entity, as the case may be, may file a second appeal to Second Appellate Authority specified in the Bidding Document in this behalf within fifteen days from the expiry of the period specified in para (2) or of the date of receipt of the order passed by the First Appellate Authority, as the case may be.

(4) Appeal not to lie in certain cases

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

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

(5) Form of Appeal

(a) An appeal under para (1) or (3) above shall be in the annexed form along with as many copies as there are respondents in the appeal.

(b) Every appeal shall be accompanied by an order appealed against, if any, affidavit verifying the facts stated in the appeal and proof of payment of fee.

(c) Every appeal may be presented to First Appellate Authority or Second Appellate Authority, as the case may be, in person or through registered post or authorized representative.

(6) Fee for filing appeal

(a) Fee for first appeal shall be rupees two thousand five hundred and for second appeal shall be rupees ten thousand, which shall be non-refundable.

(b) The fee shall be paid in the form of bank demand draft or banker's cheque of a Scheduled Bank in India payable in the name of Appellate Authority concerned.

(7) Procedure for disposal of appeal

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

(b) On the date fixed for hearing, the First Appellate Authority or Second Appellate Authority, as the case may be, shall,-

(i) Hear all the parties to appeal present before him; and

(ii) Peruse or inspect documents, relevant records or copies there of relating to the matter.

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

(d) The order passed under sub-clause (c) above shall also be placed on the State Public Procurement Portal.

Signature of Contractor

FORM No. 1

[See Rule 83]

Memorandum of Appeal under the Rajasthan Transparency in Public Procurement Act, 2012

Appeal No. …… of …… Before the ……..…….. (First/Second Appellate Authority)

1. Particulars of appellant :
   (i) Name of the appellant :

   (ii) Official address, if any :

   (iii) Residential address :

2. Name and address of the respondent (s) :
   (i)
   (ii)
   (iii)
3. Number and date of the order appealed against and name and designation of the officer/authority who passed the order (enclose copy), or a statement of a decision, action or omission of the Procuring Entity in contravention to the provisions of the Act by which the appellant is aggrieved:
4. If the Appellant proposes to be represented by a representative, the name and postal address of the representative:
5. Number of affidavits and documents enclosed with the appeal :
6. Grounds of appeal : ……..
   (Supported by an affidavit)
7. Prayer : ……

Place ……..

Date ……..

Appellant's Signature

Annexure D : Additional Conditions of Contract

i. Correction of arithmetical errors

Provided that a Financial Bid is substantially responsive, the Procuring Entity will correct arithmetical errors during evaluation of Financial Bids on the following basis:

i. If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Procuring Entity there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected;

ii. It there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected ; and

iii. If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (i) and (ii) above.

If the Bidder that submitted the lowest evaluated Bid does not accept the correction of errors, its Bid shall be disqualified and its Bid Security shall be forfeited or its Bid Securing Declaration shall be executed.

ii. Procuring Entity's Right to Vary Quantities

i. At the time of award of contract, the quantity of Goods, works or services originally specified in the Bidding Document may be increased or decreased by a specified percentage, but such increase or decrease shall not exceed twenty percent, of the quantity specified in the Bidding Document. It shall be without any change in the unit prices or other terms and conditions of the Bid and the conditions of contract.

ii. If the Procuring Entity does not procure any subject matter of procurement or procures less than the quantity specified in the Bidding Document due to change in circumstances, the Bidder shall not be entitled for any claim or compensation except otherwise provided in the Conditions of Contract.

iii. In case of procurement of Goods or services, additional quantity may be procured by placing a repeat order on the rates and conditions of the original order. However, the additional quantity shall not be more than 25% of the value of Goods of the original contract and shall be within one month from the date of expiry of last supply. If the supplier fails to do so, the Procuring Entity shall be free to arrange for the balance supply by limited Bidding or otherwise and the extra cost incurred shall be recovered from the supplier.

iii. Dividing quantities among more than one Bidder at the time of award (In case of procurement of Goods)

As a general rule all the quantities of the subject matter of procurement shall be procured from the Bidder, whose Bid is accepted. However, when it is considered that the quantity of the subject matter of procurement to be procured is very large and it may not be in the capacity of the Bidder, whose Bid is accepted, to deliver the entire quantity or when it is considered that the subject matter of procurement to be procured is of critical and vital nature, in such cases, the quantity may be divided between the Bidder, whose Bid is accepted and the second lowest Bidder or even more Bidders in that order, in a fair, transparent and equitable manner at the rates of the Bidder, whose Bid is accepted.

Date :

Place :

Signature of bidder

Name :

Designation :

Address :

Signature of Contractor

SPECIAL CONDITIONS OF CONTRACT (Part 'A')

DEFINITIONS

"JDA" means the Jaipur Development Authority. It is the Executing Agency of the Project.

"Director (Engg)" means **Director (Engineering-II)**, JDA, Jaipur.

"Materials" means things of all kinds (other than equipment) intended to form or forming part of the permanent works, including the supply of materials to be supplied by the contractor under the contract.

"Equipment" means the apparatus, machinery, articles and things of all kinds to be provided under the contract or intended to form or forming part of the permanent works.

"Contractor's Documents" means the calculations, computer programs and other software, drawings, manuals, models and other documents of the technical nature supplied by the contractor under the contract; as described in sub clause [Contractors Documents].

"Specifications" means the specifications according to which the works are to be executed as referred to in the agreement documents and any other specifications agreed thereon.

"Contract price" means the sum quoted in the tender subject to such additions thereto or deduction there from as may be made under the provisions contained in the contract and as defined in Volume IV of tender Document.

COMMUNICATION BETWEEN THE JDA AND THE CONTRACTOR

ADDRESSES FOR NOTICES

Notices shall be addressed to the "Executive Engineer (PHE—I), Jaipur Development Authority, Jaipur" or any changed address".

It shall be essential for the contractor to obtain a receipt of authorised officer otherwise the notice shall be treated as "null & void".

CONTRACT

TYPE OF CONTRACT

The Work described in these tender document are considered to be turn key job. The contractor shall execute the work for **Design, Construction, Erection, Commissioning, Trial Run of 1 MLD STP at Smriti Van (Jhalana), on Turnkey basis based on SBR technology with PLC, SCADA Systems, Allied works, and O & M for 3 years at Jaipur City.**

PRIORITY OF CONTRACT

The documents forming part of the agreement are to be taken as mutually explanatory documents of one another. In case of discrepancies they shall be explained and adjusted by the Engineer in Charge. The priority of the Contract documents shall be as follows:

(i) Letter of award
(ii) Special Conditions of Contract Part A & Part B
(iii) Instructions to Bidders
(iv) General Conditions of Contract
(v) Scope of Work
(vi) Technical specifications
(vii) Drawings
(viii) Schedule of prices

MONTHLY REPORTS

Signature of Contractor

Monthly progress reports shall be prepared by the Contractor and submitted to JDA in six copies. The first report shall cover the period up to the end of the first calendar month following the commencement date. Reports shall be submitted monthly thereafter, each within 7 days after the last day of the month to which it relates.

Reporting shall continue until the contractor has completed all work.

Each Report shall include the issues desired by the Engineer in Charge, which shall be any of the following:

- Charts (PERT & CPM) / detailed descriptions of progress, including each stage of design Contractor's Document, procurement, manufacturing, delivery to site of construction, direction, testing, commissioning and the trial operation;
- Photographs showing status of manufacture and of progress on the site;
- For the manufacture of each main item of equipment and materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of:
- Commencement of manufacturing;
- Contractor inspections,
- Tests and
- Shipment and arrival at the site;
- Copies of quality assurance documents, test results and certificates of materials;
- Comparisons of actual and planned progress, with the details of any events or circumstances which may jeopardize the completion in accordance with the contract, and the measures being (or to be) adopted to overcome delays.
- Any other issues deemed necessary by the Engineer in Charge

RIGHT OF ACCESS TO THE SITE DURING EXECUTION &WORKS

The JDA shall give the contractor right of access to all parts of the site. The site for execution of the work will be made available as soon as the work is awarded. In case, it is not possible for the JDA to make the entire site available on the award of the work, the Bidder shall arrange his working program accordingly. No claim, whatsoever, for not giving the site in full on award of the work or for giving the site gradually in parts will be tenable.

However, if and to the extent that the JDA's failure was caused by any error or delay by the contractor, including an error in, or delay in the submission of, any of the contractor's documents, the contractor shall not be entitled to such extension of time.

The provisions of clauses and conditions of this contract shall also apply to all premises, workshops, factories, plants, quarries and all other places from where materials, manufactured articles and machineries are being obtained or stored for the works.

The client / Engineer-in-charge or their representative and other subordinates shall be furnished with such information, assistance and facility by the contractor as is required to make a complete and detailed investigation/ inspection / supervision of the said goods.

THE CONTRACTOR

CONTRACTOR'S GENERAL OBLIGATIONS:

The contractor shall design the civil structures, execute and complete the works in accordance with the contract, and shall remedy any defects in the works. The contractor shall conduct survey & verify the levels of the proposed system(s)

In addition to the above, the contractor is also required to confirm the availability of the material required for the contract in the time schedule given herein after, so as to complete the job within the prescribed time. No time extension shall be provided on this account. If required under such circumstances, the contract after prior approval of JDA shall be allowed to use superior type of material so as to complete the job within the prescribed time. No additional payments shall be made on account of use of superior quality material, on this account.

The Contractor shall provide the equipment and Contractor's Documents specified in the

contract, and all Contractor's personnel, goods, consumables and other things and services, whether of a temporarily or permanent nature, required in and for this design, execution, completion and remedying of defects including O & M period for 3 years.

The works shall include any work, which is necessary to satisfy the JDA's requirements, or is implied by the contract, and all works, which (although not mentioned in the contract) are necessary for the completion, or safe and proper operation of the works.

The Contractor shall be responsible for the adequacy, stability and the safety of all site operations, of all methods of construction and of all the works.

The Contractor shall provide all facilities including conveyance required for verification of survey data, supervision, quality control tests, tests for material, equipment and equipment(s), and/or all other facilities otherwise referred in the conditions of contract(s) and/or otherwise necessary to complete the works with due supervision of Engineer-in-charge. The testing of material, quality control tests, etc. may be got done through government-recognized labs after approval of Engineer-in-charge.

The Contractor shall, whenever required by the JDA, submit details of the arrangements and methods, which the contractor proposes to adopt for execution of the works. No significant alteration to the arrangements and methods shall be made without this having previously been notified to the JDA.

The contractor shall also establish an acceptable and decent office premises for the client's site office at the suitable location adjacent to the contractor's site office nearby with necessary amenities as may be required in running the site office.

CONTRACTOR'S REPRESENTATIVE :

THE CONTRACTOR SHALL APPOINT THE CONTRACTOR'S REPRESENTATIVE AND SHALL GIVE THEM ALL AUTHORITY NECESSARY TO ACT ON THE CONTRACTOR'S BEHALF UNDER THE CONTRACT.

UNLESS THE CONTRACTOR'S REPRESENTATIVE IS NAMED IN THE CONTRACT, THE CONTRACTOR SHALL, PRIOR TO THE COMMENCEMENT DATE, SUBMIT TO THE JDA FOR CONSENT THE NAME AND PARTICULARS OF THE PERSON THE CONTRACTOR PROPOSES TO APPOINT AS CONTRACTOR'S REPRESENTATIVE. IF CONSENT IS WITHHELD OR SUBSEQUENTLY REVOKED, OR IF THE APPOINTED PERSON FAILS TO ACT AS THE CONTRACTOR'S REPRESENTATIVE, THE CONTRACTOR SHALL SIMILARLY SUBMIT THE NAME AND PARTICULARS OF ANOTHER SUITABLE PERSON FOR SUCH APPOINTMENT.

THE CONTRACTOR SHALL NOT, WITHOUT THE PRIOR CONSENT OF THE JDA, REVOKE THE APPOINTMENT OF THE CONTRACTOR'S REPRESENTATIVE OR APPOINT A REPLACEMENT.

THE CONTRACTOR'S REPRESENTATIVE SHALL, ON BEHALF OF THE CONTRACTOR, RECEIVE INSTRUCTIONS.

THE CONTRACTOR'S REPRESENTATIVE MAY DELEGATE ANY POWERS, FUNCTIONS AND AUTHORITY TO ANY PERSON, AND MAY AT ANY TIME REVOKE THE DELEGATION. ANY DELEGATION OR REVOCATION SHALL NOT TO TAKE EFFECT UNTIL THE JDA HAS RECEIVED PRIOR NOTICE SIGNED BY THE CONTRACTOR'S REPRESENTATIVE, NAMING THE PERSON AND SPECIFYING THE POWERS, FUNCTIONS AND AUTHORITY BEING DELEGATED OR REVOKED.

WHENEVER SERVICES OF CONTRACTOR STAFF ARE FOUND / NOTICED UNSATISFACTORY BY THE JDA, THEY SHALL BE REMOVED / TERMINATED BY THE CONTRACTOR IMMEDIATELY AS PER DIRECTION OF ENGINEER IN CHARGE.

SETTING OUT:

The contractor shall set out the works in relation to original points, lines and levels of reference specified in the contract. The contractor shall be responsible for the correct positioning of all parts of the works, and shall rectify any error in the positions, levels, the dimensions or alignment of the works.

THE SAFETY PROCEDURES:

Signature of Contractor

The contractor shall:

(a) Comply with all applicable safety regulations & other provisions as detailed in **Appendix-"A"**

(b) Take care for the safety of all person's entitled to be on the site,

(c) Choose reasonable efforts to keep the site and work clear of unnecessary obstruction so as to avoid danger to these persons,

(d) Provide fencing, lighting, guarding and watching of the works until completion and its taking over by the JDA at end of O & M period as defined in clause 1.6. of Special Conditions Part 'B'.

(e) Provide any temporary works (including road ways, foot ways, guards and fences) which may be necessary, because of the execution of works, for the use and protection of the public and of owners and occupy a server adjacent land.

QUALITY ASSURANCE:

In addition to the provisions of clause of General conditions of contract, the contractor shall institute a quality assurance system to demonstrate compliance with requirements of the contract. The system shall be in accordance with the details stated in the contract and the Quality Assurance Programme will be got approved from the competent authority as directed by EIC. The JDAs shall be entitled to audit any aspect of the system.

Details of all procedures, if adopted, other than those laid down in the tender document, and compliance documents shall be submitted to the JDAs for information before each design and revocation stage is commenced. When any document of a typical nature is submitted to the JDA, evidence of the prior approval by the contractor himself shall be apparent on the document itself.

Compliance with the quality assurance system shall not relieve the contractor of any of his duties, obligations or responsibilities under the contract.

SITE DATA:

The contractor shall be responsible for verifying and interpreting all site data. The JDA shall have no responsibility for accuracy, sufficiency or completeness of such data, irrespective of its use by the JDA while making preliminary designs.

Tenderer must visit the work site and see for himself the site and ground conditions in all respects including availability of labour (skilled and unskilled), approaches, availability of water, electricity, materials, and all other matters affecting the work before submitting the tender.

Owner will not, therefore, after acceptance of the tender, pay any extra charges for any reason whatsoever in case Contractor find later on to have misjudged the site and other conditions.

UN-FORESEENABLE DIFFICULTIES**:**

The contractor shall be deemed to have obtained all necessary information as to risk, contingencies and other circumstances that may influence or affect the works i.e

(a) By signing the contract, the contractor accepts the total responsibility for having sustained all difficulties and costs of successfully completing the works: and
(b) the contract price shall not be adjusted to take account of any unforeseen difficulties or costs.

RIGHTS OF WAY AND FACILITIES;

(a) The Contractor shall bear all costs and charges for special and/or temporary rights of Way, which he may require, including those for access to the site. The contractor shall also obtain, at risk and costs, any additional facilities outside the site which he may require further purposes of the works.

Signature of Contractor

(b) Contractor shall make his own arrangement for Water supply/electricity at his own cost and nothing extra shall be paid by the JDA.

AVOIDANCE OF INTERFERENCE:

The contractor shall not interfere unnecessarily or improperly with:

(a) the convenience of the public, or

(b) in the access to and use and occupation of all roads, existing electric/I.O.C pipeline and other land, irrespective of whether they are public or in the possession of the JDA or others.

(c) with the existing amenities, whether natural of man made. No tree shall be felled without permission of the Engineer's Representative and clearance of the site shall generally be kept to the minimum necessary for the works and temporary works.

The contractor shall indemnify and hold the JDA harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from any such unnecessary or improper interference.

SECURITY OF THE SITE:

Unless otherwise stated in particular conditions:

a. The contractor shall be responsible for keeping unauthorized persons off the site, offices, campus etc. within the scope of work and
b. authorized person's shall be limited to the Contractor personnel and the JDA's personnel; and to any other personnel notified to the Contractor, by (or on behalf of) the JDA, and
c. Providing adequate manpower for the security of the material brought to the site for which payment has been made to the contractor.

CONTRACTOR'S OPERATIONS ON-SITE:

The Contractor shall confine his operations to the site, and to any additional areas, which may be obtained by the Contractor and agreed by the JDA as working areas. The Contractor shall take all necessary precautions to keep Contractor's equipment and Contractor personnel within the site and these additional areas, and to keep them off adjacent land.

During the execution of the works, the Contractor shall keep the site free from all unnecessary obstruction, and shall store or dispose of any Contractor's equipment or surplus materials. The Contractor shall clear away and remove from the site any wreckage, rubbish and temporary works which are no longer required.

LAND FOR THE WORK AND FOR THE CONTRACTOR'S ESTABLISHMENT:

The land or the land rights for the sites of the permanent Work will be provided by JDA, during the progress of work. However, sufficient land and site for works shall be provided to the contractor as per the agreed execution plan submitted by the contractor and approved by the JDA.

For the purpose of constructing Contractor's yard, godown, site office, staff quarters, etc. the contractor may utilize the land and existing buildings / structures allocated to him by JDA after obtaining requisite permission from the Engineer in Charge. All expenses in connection with purchase or construction or maintenance or removal etc. of such items shall be borne by the Contractor.

JDA may allocate the land and buildings for use by the Contractor according to its possibilities only. If the land or buildings are not available or are insufficient for the purposes of the Contractor's establishment, additional land or buildings will have to be procured/rented by the Contractor himself at his own cost and expenses as per his requirement.

Recovery of rent towards the use of building by contractor for office/store/residence provided by the JDA shall be done on fair rent assessment basis.

WORKS TO BE KEPT CLEAR OF WATER:

The Contractor shall keep the works well drained until the Engineer certifies that the whole of the works is substantially complete and shall ensure that so far as is practicable, all work is carried out in the dry. Excavated areas shall be kept well drained and free from standing water.

The Contractor shall construct, operate and maintain all temporary dams, water-courses and other works of all kinds including pumping and well-point dewatering that may be necessary to exclude water from the works while they are in progress and till they are handed over to the Development Authority. This refers mainly to surface water that may enter into the excavated construction work. No separate payment will be made for such dewatering works / measures. price quoted by Contractor will be deemed to have covered expenses for such dewatering works / increase. Such temporary works shall not be removed without the approval of the Engineer's Representative.

Notwithstanding any approval by the Engineer's Representative of the Contractor's arrangements for the exclusion of water, the Contractor shall be responsible for the sufficiency thereof and for keeping the Works safe at all times, particularly during any floods and for making good at his own expense any damage to the works including any that may be attributable to floods. Any loss of production or additional costs of any kind that may result from floods shall be at the Contractor's own risk.

ORGANIZATION ON THE SITE

CONTRACTOR'S OFFICE:

The Contractor shall have an office(s) near the site(s), and shall during office hours on all working days have a clerk or some other authorized person always present at such office, upon whom a notice may be served. Service of any notice left with such clerk or authorized person shall be deemed good, served upon the Contractor.

CONTRACTOR'S STAFF:

The Contractor shall employ for the execution of work only such persons as are skilled and experienced in all activities required for the completion of the Works, from reconnaissance, design, manufacturing, execution and testing to commissioning. The Engineer in Charge shall be at liberty to object to and require the Contractor to remove from the Work any person who in the opinion of the Engineer in Charge misconducts himself or is incompetent or negligent in the proper performance of his duties. Such person shall not again be employed without permission of the Engineer in Charge.

The Contractor shall employ labour in sufficient number to maintain the required rate of progress and quality to ensure workmanship of the degree specified in the Contract.

SITE BOOKS:

Within seven days of the receipt of the order to take up work, the contractor shall supply at his own cost, a work order book having machine numbered pages in duplicate, to the Engineer in charge or his representative. This book shall be kept at the site of work under the custody of the client's representative. Directions or instructions to be issued to the contractor from the inspecting officers of the client or by Engineer in charge of the work or his superior officer shall be entered therein with the dated signature (except when such directions or instructions are given by separate letters). The contractor or his authorized representative shall regularly note these entries in the work order Book and also record therein the action taken or being taken by him in compliance thereon. The contractor or his authorized representative may take away for his own record, the duplicate pages of the work order Book, which will be carbon copies of the original pages, after putting up his signature. The work order Book shall not be removed from the site of work except with the written permission of the Engineer in charge.

DESIGN AND DRAWINGS

GENERAL DESIGN OBLIGATIONS:

The Contractor shall be deemed to have scrutinized, prior to submission of bid, the JDA's requirements (including design criteria & drawings & calculations, if any) for their correctness, accuracy, structural safety and soundness. The Contractor shall be responsible for the correctness, accuracy of all designs and for safety & soundness of all structures constructed under this contract.

The JDA shall not be responsible for any error, in accuracy or permission of any kind in the JDA's requirements as originally included in the contract. Any data or information received by the Contract, from the JDA or otherwise, shall not relieve the Contractor from his responsibility for the design and execution of the works.

The details of materials indicated in the tender document are the minimum requirement, and no reduction/alteration shall be permissible unless the Engineer-in-charge is satisfied that such changes are necessary.

CONTRACTOR'S DOCUMENTS & SUBMISSION PROCEDURE FOR DETAILED DESIGN & EXECUTION DRAWINGS:

The Contractor's Documents shall comprise the technical documents specified in the JDAs requirements, Documents Required to satisfy all regulatory approvals and "As Built Documents" and Operation & Maintenance Manuals. The Contractor's Documents shall be written in the language for communications defined in contract.

If errors, omissions, ambiguity, inconsistencies, inadequacies or other defects are found in the Contractors Documents, these and the works shall be corrected at the Contractor's cost, notwithstanding any consent for approval under this clause.

Hydraulics of plant /GA drawings/ etc. are given in the tender document. However the contractor may check to ensure soundness of the designs & successful completion of the project. The contractor is required to carry out the soil investigation for important structure and to submit the detailed structural designs and execution drawings (wherever required) all civil, mechanical and electrical engineering works. He will also submit the detailed system and working drawings as well as performance curves and data for all hydraulic, mechanical, electro-mechanical and electrical equipment.

If any changes are desired by him in the given designs & drawings, such changes, duly done in the drawings with a detailed note justifying the proposed changes, shall be submitted for approval. No work shall be commenced on site on the basis of designs & drawings not approved by EIC and/or those not accepted by the contractor.

The drawings shall be sufficient in details and the scale has to be chosen accordingly in co-ordination with the engineer in charge.

APPROVAL PROCEDURES:

As soon as practicable after acceptance of his tender and in any case before starting work on site, the Contractor shall submit for the Engineer's approval a detailed programme of work in the form of a PERT / CPM Network and a bar chart together with a description of his proposed methods of working. The programme shall take into account, the importance of completing the various parts of the works in accordance with Clause for time for completion of the Contract

The submission of designs, working drawings and documents etc., done as per the requirement of the tender documents to the competent authority or his authorized representative. The JDA shall progressively review them for an approval within 15 days. The period of review will be counted after all quarries are replied satisfactorily. The schedule should be such so as not to obstruct the actual construction work.

The following shall be the procedure for submission and approval of design, execution drawings & contractor's documents:

The Contractor shall submit three copies of design/drawings/contractor's documents to the Engineer in Charge along with the relevant IS codes / manuals and soft copy of design. Calculations of design in soft copy shall be on excel sheet with stepwise explanation of

formulas, various assumptions, calculations etc. to arrive at results of design. In the soft copy of submissions formulas & calculations shall not be kept hidden. Without such submission no design & drawing will be accepted. All the submitted papers are to be signed by the Contractor or his authorized representatives.

The Engineer in Charge will review the submissions and if found fit for approval, will approve them and return one copy to the Contractor within 15 days duly signed in token of approval.

In case the design/drawings etc. are not found fit for approval, the Engineer in Charge will mark the comments on them and return two copies to the Contractor within 15 days and the same shall be repeated till the submissions are finally approved as per scope of work & specifications. The contractor in such cases shall submit the revised and corrected submissions within 15 days to the receipt of comments from Engineer-In-Charge.

On request of the Engineer in Charge, the Contractor shall depute the design engineer responsible for the particular submission to discuss with the Engineer in Charge or his Representative.

On receipt of approved submissions, the Contractor shall submit four (4) additional copies of the approved submissions (designs, drawings, data sheets etc.) to the Engineer-In-Charge for reference and records.

No designs / drawings with corrections made after taking the prints will be accepted.

The approval along with alterations in drawings/designs by the Engineer in Charge shall not relieve the Contractor of his responsibility in terms of the Contract for soundness of the designs. The Contractor shall be responsible for the structural safety of all the components of the Work.

DISCREPANCIES BETWEEN DRAWINGS AND SPECIFICATIONS

In case of discrepancies between drawings and specifications or data sheets arising from the meaning, dimensions or quality of the materials and equipment for the due and proper execution of the Work, the discrepancy shall be explained by the Engineer-in-Charge. His explanation shall be the final decision and the Contractor shall execute the Work accordingly without any extra payment.

CONTRACTOR'S UNDERTAKING

The design, the Contractor’s Documents, the execution and the completed works shall comply with the relevant standards, building, construction and environmental laws, law as applicable to the product being produced from the works, and other standards specified in the Volume II “Scope of Work & Technical Specifications” applicable to the works, or defined by the applicable laws.

All these laws, in respect of the works shall be, the laws prevailing at the time of letter of invitation. References in the contract to published standards shall be understood to be references to the edition applicable on the date of supply / execution as the case may be.

Whenever there are contradictory provisions in applicable Indian Standards, the most stringent of the provisions shall apply unless specifically mentioned otherwise.

SUPPLY OF MATERIAL

All material required for the execution of the work, testing, commissioning, trial run, operation, routine and preventive maintenance and repairs/replacement/, if any necessitated, during the entire Operation and Maintenance period shall be arranged by the Contractor himself including all required chemicals for treatment of Sewerage etc. except electric charges to be paid to electric company (former electricity board) during O&M period. No material will be supplied by JDA.

SAMPLES:

The contractor shall submit samples to the Engineer-In-Charge at his cost, for their inspection prior to dispatch for review in accordance with the procedure laid down in Contractor's Documents described in relevant sub-clause. Inspection and testing of pumps, motors, bulk meters, valves, control panels asper direction and requirement of EICetc. shall be done in the factory before dispatch of the material.

The JDA's Personnel or authorized representative shall at all reasonable times:

e) have full access to all parts of the site and to all places from which natural materials are being obtained, and
f) during production, an effective and construction (at the site and, to the extent specified in the contract, elsewhere), be entitled to examine, inspect, measure and test the materials and workmanship, and to take the progress of manufacture of equipment and production and manufacture of materials.

The Contractor shall give the JDA's personnel full opportunity to carry out these activities, including providing access the facilities, promises and safety equipment. No such activities shall relieve the Contractor from any obligation or responsibility.

The JDA may opt for third party inspection also in addition to above.

Equipment of similar kind to be used in the contract shall be of same make unless specifically approved by the Engineer-in-Charge. Unless specific approval of the Engineer-in-Charge is obtained, all equipment of one kind, to be used in the project, shall be offered for inspection in one lot. If such equipment are offered in different piece meal lots, the cost of inspection of material in smaller lots will be recovered from the contractor, and the delay caused to the project on this ground, shall solely be attributed to the account of the contractor.

The cost of samples including transportation's as well as of the testing shall be borne by the contractor for the followings:

(a) The collection & supply of the samples and carrying out of such tests is provided for or clearly intended in the contract, will be carried out either at site of work or manufacturer's place or at laboratories at a place approved by the Engineer in charge.

(b) The collection & supply of the samples and the carrying out of such tests if not provided for or clearly intended in the contract but on testing, the material is found defective and has to be rejected.

Testing

(i) The Contractor shall provide all apparatus, assistance, documents and other information, electricity, equipment, fuel, consumables, estimates, labour, materials, and suitably qualified and experienced staff in relation to supply of material and are necessary to carry out the specified test efficiently. The Contractor shall agree, with the JDA/third party, the time and place for the specified testing of any equipment, materials and other parts of the works.
(ii) The JDA may, vary the location or details of specified test, or instruct the Contractor to carry out additional tests. If these varied or additional tests show that the tested equipment, materials or other workmanship is not in accordance with the contract than cost of testing to carry out in this variation shall be borne by the contractor, notwithstanding other provisions of the contract.
(iii) Engineer-In-Charge (client) or its representative shall have the right to inspect and / or to test the Goods for confirm their conformity to the Contract. The Technical Specifications shall specify what inspections and tests the Purchaser requires and where they are to be conducted. If not specified or notwithstanding any mention, the contractor shall submit the inspection plan of all major bought-out items for approval with EIC specifying the stages of inspection as per manufacturer's quality plan and shall arrange to carry out the inspection along with EIC or its representative at manufacturer's works as per the approved plan. The EIC Purchaser shall notify the Contractor in writing of the identifying of any representatives retained for these purposes. All the expenses viz. lodging & boarding, transportation, all facilities as required shall be borne by the successful tenderer.
(iv) The testing of materials and work where necessary shall be carried out in

Signature of Contractor

accordance with the most recent standards or Tentative Standard Methods of Bureau of Indian Standards institution current on the date fixed for opening of the tender. If no such standard exists for a particular test, the standard method as laid down by the British Standard Institution or by American Association of State Highway officials or the American Society or other suitable organization for testing of materials, will be used at the discretion of the Engineer in charge. He may also adopt any other suitable method at his discretion.

(v) The Contractor shall promptly forward duly certified reports of the tests to the JDA. When the specified test has been passed.

(vi) The contractor shall establish a small laboratory at site where routine testing of materials of concrete, asphalt etc. can be done to the extent feasible. He shall indicate in his tender the scope of laboratory that he intends to establish on work site. The charges for the same shall be born by the contractor.

The testing of material during construction activities on time to time basis shall also be carried out from the approved laboratory/ Testing Station as per the schedule decided by the Engineer-In-Charge and at the cost of contractor.

(vii) Process equipment. Inspection charges shall be borne by the contractor. In addition to the above Engineer-In-Charge or his representative may inspect any/ all the bought out items as per the requirement at manufacturers place for which travelling, lodging and boarding charges shall be borne by the contractor.

(viii) The third party agency shall be any one of the following

(a) M/s CEIL
(b) M/s RITES
(c) M/s SGS
or "by any other" as approved by Engineer-In-Charge

(ix) Contractor shall have to produce test certificates for all procurement of cement and steel.

COST OF INSPECTION AND TESTING.

For equipment (s) and material (s) required for execution of the work, The arrangement for Inspection and expenses shall be borne by the contractor.

REJECTION

If as a result of an examination, inspection, measurement or testing, any equipment, materials, workmanship is found to be defective or otherwise not in accordance with the contract, the EIC may reject the equipment, materials, designs or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make the items good to ensure that the rejected items comply with the contract specification.

If the rejection and re-testing cause the JDA to incur additional costs, the Contractor shall pay these costs to the JDA.

APPROVAL OF MATERIAL AND EQUIPMENT

The fact that the Contractor has agreed to provide the material prescribed in the Tender Documents does not release him to ask for the final approval of the equipment and material to be used for the Work. The specifications and drawings of each item to be supplied shall be individually scrutinized and the Engineer in Charge shall verify its conformity with the technical specifications and the standards.

Prior to ordering any material and equipment such as pipes, specials, measuring equipment's, mechanical and electro-mechanical equipment, electrical/instrumentation equipment, material for civil works and interior decoration, paints, etc. the contractor has to supply the detailed specification, drawings, performance curves and data, operation instructions, samples etc., to the Engineer in Charge. If the Contractor has any doubts about the required specifications as prescribed in the Contract, he has to clarify them with the Engineer in Charge.

The procedure for the submission of documents, verification, re-submission if necessary and approval of these items is the same described in relevant clause, If equipment or material which the Contractor submitted first is refused in the approval process he has to

submit documents of such equipment which corresponds to the specifications of the tender documents and which is likely to be approved.

Only after approval of the material and equipment, the Contractor can place the order or start the manufacturing or purchasing procedures.

Four weeks prior to packing and shipping the Contractor must inform the Engineer in Charge when the material/equipment is ready for inspection and testing. At this date, the Contractor shall supply the results of all manufacturers' own tests made during or after manufacturing and his own quality control certificates. The Engineer in charge will decide whether he or his representative will inspect and test the material/ equipment or whether he will approve it on the basis of the supplied documentation.

The Engineer in charge will provide an authorization for packing and shipment after inspection and/or approval of the material/equipment.

If the Contractor packs and ships material/ equipment without approval or authorization of the Engineer-in-Charge, it can be refused if it is not matching with the specifications of the Contract. All costs resulting from this are to be borne by the Contractor. The Contractor has then to provide the material/ equipment, which is matching with the Contract.

COMPLETION OF THE WORK

TIME FOR COMPLETION

The whole of the Work, including mobilization, reconnaissance, investigations, design, manufacturing, transportation, construction, installation & testing, commissioning & trial runs, and demobilization has to be completed within a period of 12 months calculated from the commencement date, which is 10 days after the written order to commence the Work. The duration of the performance trial run and tests is included in the completion period, defined in Clause 2 of General Conditions of Contract. The operation & maintenance period of 3 years shall commence, as per the provisions of related clause. The contractor shall submit a detailed time schedule for all the activities to be completed under the contract. If required this schedule shall be updated in each monthly meeting. However, this time schedule shall not bear any implications on the provisions of clause 2 of General Conditions of Contract.

COMPLETION OF WORK AND FULLY COMMISSIONING

(i) Immediately after the physical completion, the work of testing and commissioning the entire system on design conditions as per the procedure of test given in Volume II "Scope of Work & Technical Specifications" shall be taken up. Once the entire system has been successfully tested and commissioned as per the conditions of contract, the trial run period shall commence. After successful completion of the trial run period of three month, and removal of all visible defects to the satisfaction of Engineer-in-Charge, the work shall be treated as "Completed".

Unless otherwise provided in the contract, after the successful completion of the testing for the entire system, the Engineer-in-charge shall issue a certificate of "Completion of Work". The date of Certificate notifying "Completion of Work" will be used for the final payment as per clause 6 and 7 of General Conditions of Contract. From this date of certificate for "Completion of Work", the Operation & Maintenance period shall commence.

(ii) In case Raw Sewage is not made available by the Employer than completion period as defined in 11.2.(i) shall be extended appropriately.

DEFECTS LIABILITY PERIOD

The defect liability period shall be of 12 months, from the date of issue of the certificate for Completion of works. The Contractor shall operate & be responsible for satisfactory performance & maintenance of the STP under all design and operation conditions for the duration of the defects liability period, except for damage due to unprecedented natural calamities. During the defect liability period the contract has to provide for additional training of the JDA staff and have to carry out the operational, maintenance and repair activities.

Constructional defect such as defects due to premature use of materials, works not executed in accordance with the Contract, hidden faults in material and equipment not discovered during inspection and testing, fault in design, manufacturing, erection and in construction shall be pointed out by the EIC and shall have to be rectified by the contractor during this period. The cost for repair material, spare arts, transport, repairs, tests and repair staff shall have to be borne by the contractor. If the Contractor fails to rectify the defect within a period of 15 days after aforesaid notice, the Engineer in Charge may forfeit the security deposit or an amount thereof required for the rectification through a third party without prejudice to any other right the JDA may have against the Contractor in respect of his failure to remedy such defects.

AS-BUILT DRAWINGS

The submission of the as-built drawings for the equipment is the precondition for the final payment. The final drawings shall be submitted in one reproducible set and 5 copies on linen bound in an album of an approved size. The contractor shall submit all the completion drawings and approved design calculations on CD ROM / DVD in two copies with proper directory structure.

The contractor shall prepare, and keep up to date, a complete set of "as built" records of the execution of the works, showing the exact as built locations, sizes and details of the works as executed. The records shall be kept on the site and shall be used exclusively for the purpose of this sub clause. Two copies shall be supplied to the JDA before the commencement of the tests on completion.

In addition, the contractor shall carryout the Video graphy, still photographs prior to start of work, during construction period and up to completion of the work up to the satisfaction of EIC. The prepared album of photograph/ video cassette shall be submitted to EIC along with the As built drawings.

The contractor shall supply to the JDA as built drawings of the works, showing all works as executed, and submit them to the JDA for review under sub clause [Contractors Documents]. The Contractor shall obtain the consent of the JDA as to their size, the references system, and other relevant details.

Prior to the issue of Completion of works certificate, the contractor shall provide to the JDA the specified numbers and types of copies of the relevant as built drawings, in accordance with the JDA's requirements. The Completion of works shall not be considered until the JDA has received the As Built Drawings.

OPERATION AND MAINTENANCE MANUALS

Prior to the commencement of the tests on completion, the contractor shall supply to the JDA provisional operation & maintenance manuals in sufficient detail as specified in Vol-II 'Scope of work & Technical Specifications', of the tender document.

The works shall not be considered to be completed for the purposes of completion of works until the JDA has received final operation & maintenance manuals in such detail.

PROGRESS OF WORK

All components of works shall ensure a logical sequence of execution, construction, supply, installation, testing, and commissioning. If any supply / construction of a material / unit is made, not in conformity to the logical sequencing of the work component, no payments will be entitled against such supplies, construction and installations.

There has to be a continuous chain of work to ensure that works carried / material supplied by the contractor are carried out/ installed promptly and those carried / installed are sequentially tested in the field without any delay.

It will be the responsibility of contractor to maintain simultaneous pro-rata progress of works.

DOCUMENTS REQUIRED FOR PAYMENT:

The contractor shall submit the following documents in duplicate along with the invoice/bill as directed by EIC.

- ✓ Purchase invoice indicating details of equipments, material manufactured, supplied and installed or work carried out, supply value of such material or equipment or value of such work carried out and amount claimed as and when ask by EIC.
- ✓ Inspection reports/ test reports/ reports certifying completion of activity with acceptable results as per JDA or any other agency representing JDA.
- ✓ Report/certificate of inspections /tests carried out by the supplier of the contractor or by the contractor himself. As required by EIC.
- ✓ Any other such details/documents as may be reasonably specified by the Engineer-in-Charge from time to time during execution of the contract.
- ✓ Certificates, as prescribed, regarding payment of Sales Tax, duties etc. leviable on supplies made as and when ask by eic.
- ✓ Colour photographs/Videography of the work executed during the period for which the invoice has been raised.
- ✓ Other documents required by the Engineer-in-charge.

PAYMENT TERMS

The terms of payment have been as detailed in Volume -IV of the tender document. Payment of running bill shall generally be released once in a month. The contractor shall submit all the bills on the printed forms at the office of the Engineer-in-Charge.

If any extra item crops up during the progress of works, the same shall be carried out by the contractor, after approval of Engineer-in-charge and he shall be paid at the rate fixed by the Engineer-in-charge as per the rate analysis based on current market rates or current BSR whichever is less.

All payments shall be subjected to the following limitations:

SEQUENCE OF EVENT IN CASE OF SUPPLY OF MATERIAL:

Sequence of events shall be decided in the monthly review meetings, and material requirement for subsequent 3 months shall be decided and made part of the monthly reports. Payment for supply of items in consonance with the agreed sequencing of material will only be made, so that material does not remain unutilized for more than 3 months, for which payment of supply has been made.

Payment of material and equipment shall be done for the price quoted for respective items in the Volume IV "Schedule of Prices" of the tender document and as provision given herein after.

DEDUCTIONS

STATUTORY DEDUCTIONS :

The JDA is required to make statutory deductions at source from all running bills and final bill as in force through relevant statutes in force from time to time at the rates prescribed therein.

OTHER DEDUCTIONS**:**

Any other deductions to recover any reduction in rates or any other JDA's claims accrued as per the contract or in respect to any other liabilities arising, shall be deducted from subsequent interim payments or final payments or from the securities with the JDA.

NON APPLICABLE CLAUSES OF GENERAL CONDITIONS OF CONTRACT

The clauses of General conditions of contract bearing nos. 5A, 10, 10B, 10C, 12, 12A, 24, 25, 30, 37,45, 47 and table for schedule of material to be supplied by the deptt. If

available, (referred to in clause 10) of General Conditions of contract shall not be applicable.

No payment in respect of price variation shall be applicable under this contract.

TAXES AND DUTIES

All taxes, duties, levies applicable by any act of the Government of India and/or State of Rajasthan and/or of the Local bodies on the company or its personnel, during the period of work in progress shall be of the Contractor.

All goods manufactured/procured and supplied by the contractor and the work executed under this contract, responsibility of payment of sales tax, surcharge, octroi and any other tax and levies in force, responsibility of payment of all such taxes, duties, levies shall be of the contractor.

In respect of goods and materials procured by the Contractor, for use in works under the contract, Sales Tax will be paid by the Contractor himself. But in respect of all such goods manufactured and supplied by the Contractor and works executed under the contract, the responsibility of payment of sales tax if any is of the Engineer-in-charge as per the statutory provisions, than the sales tax for such cases shall be paid by the Engineer in Charge on behalf of the contractor and the amount so paid shall be deducted from the intermediate payments of the contractor.

PERFORMANCE GUARANTEE OF EQUIPMENT

The bidder shall guarantee that the performance of each pump set, motor, electrical; mechanical; electro-magnetic, automation & instrumentation equipments shall comply with the requirements given in the specifications. He shall also guarantee that the equipments will operate satisfactorily at the time of commissioning and shall be at the desired level of efficiencies during O & M period and also at the time of handing over.

JDA'S RIGHT TO RECTIFY

The JDA retains the right to rectify, at the cost of Contractor, to perform any of these material or work obligations on default of the Contractor.

MAKES OF EQUIPMENT

The Equipment(s) used by the bidder for the project shall be one of the makes as given in the Volume –II of the tender document .The other makes of equipments/material to be used shall be got approved from EIC.

TIME SCHEDULE FOR CONTRACT ACTIVITIES

For completion of the job in the prescribed time it is essential to maintain a timely and logical sequencing of the contract activities. In view of the above the contractor shall submit a plan for approval of JDA.

To adhere to the execution schedule approved by the JDA, the contractor shall also deploy the required T&P as directed by Engineer in Charge. The time schedule so provided and approved by competent authority shall have no bearing on clause 2 of General Conditions of Contract.

INSURANCE

The contractor shall have to provide a minimum insurance of man power and equipments. This insurance cover should start from the date of starting of work and should be valid up to end of execution period. The responsibility of timely payment of the premium as well as that of lodging claims as and when situation arises will be that of contractor.

ACCIDENT OR INJURY TO CONTRACTOR'S EMPLOYEES

The JDA shall not be liable for, or in respect of any damages or compensation payable by law in respect of, or in consequence of any accident or injury to any person in the employment of the contractor (other than accident or injury as may be attributable to the JDA or its employees) & the contractor shall indemnify the JDA against all such damages and compensations and against all actions, suits, claims, cost or expenses arising there from. The contractor shall ensure against such liabilities and shall continue such insurance during the whole of the time that any persons are employed by him on the works.

NIGHT WORK:

Subject to any provisions to the contrary contained in the contract, no work shall be carried out after office hours without the written permission of the Engineer-in-charge except when the work is unavoidable or absolutely necessary, for saving life or property or for the safety of the work, in which case, the contractor shall immediately inform the Engineer-in-charge or his Representative, provided always that the provision of this clause shall not be applicable in the case of any work which it is customary to carry out by double or rotary shifts in which case sufficient advance notice shall be given of the intention to work at night to the Engineer-in-charge. After making all requisite arrangements and management of areas, materials and equipment's, required under any emergency etc. Overtime to supervisory staff of the client in such cases shall have to be however borne by the contractor.

The contractor shall also carry on work after office hours if so required by the Engineer-in-charge, subject to obtaining approval in writing, for expediting the progress on the works or for any other reasons of technical safety.

Whenever any work is required to be carried out at night in the interest of structural safety or any other reason with express approval of the Engineer-in-charge or his representative authorized to supervise, adequate lighting and other arrangement shall be made in advance by the contractor for proper execution and supervision of such work. The contractor shall not be however entitled to any extra payments for night work.

TRESPASS:

The contractor shall at all times be responsible for any damages due to trespass committed by his agents and work people in carrying out the work, unless authorized by the Engineer-in-charge in writing in which case, all repair work shall be done by the contractor at his own cost to restore the original condition.

PERMITS, LICENSES, PRIORITIES, CERTIFICATES, ETC.:

The contractor shall make his own arrangements at his own cost, if required.

(a) To obtain permits, licenses, quota certificates, foreign exchange etc. for any materials or items of work etc. if required by him.
(b) To obtain rail and other priorities for transport of his plants, tools equipments, stores, machinery, materials, labour staff etc.
(c) To arrange with civil supply authorities for release of controlled goods if so, for his labour and staff.

The client will not undertake to arrange for these but will render reasonable help within its competence without accepting any responsibility for delay if any.

SAFETY MEASURES AND SERVICES

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SAFETY OF ALL WORKMEN AND OTHER PERSONS ENTERING OR IN THE WORKS AND SHALL TAKE ALL MEASURES NECESSARY TO ENSURE THEIR SAFETY TO THE APPROVAL OF THE ENGINEER'S REPRESENTATIVE. REFERENCE IN THESE RESPECTS SHALL ALSO BE MADE TO THE CONDITIONS OF CONTRACT AND SAFETY PROVISIONS BUT IN PARTICULAR, SUCH MEASURES SHALL INCLUDE THE FOLLOWING:

a) Provision of proper safety and emergency regulations' fire, gas and electric shock precautions, stretchers and first-aid box together with rescue facilities generally for each place of working :

b) Provision of efficient safety helmets for all personnel including the Engineer's Representative and each of his staff and any authorized visitors to site;
c) Safe control of water including provision of ample standby generating and pumping plant;
d) Provision and maintenance of suitable lighting to provide adequate illumination of works with appropriate spares and standby equipment;
e) Provision and maintenance of safe, sound mechanical equipment, each item of plant having an up-to-date testing certificates ;
f) Provision and maintenance of safe, sound, ropes, slings, pulleys and other lifting tackle, each appliance having an up-to-date testing certificate where appropriate;

Provision of notices 1.25 m x 1.5 m size written in bold letters in English, and Hindi to be erected on existing footpaths and at points of access likely to be used by the pubic, which shall warn the public of the Works. These notices shall be in addition to any statutory requirements demanded of the Contractor.

THE CONTRACTOR SHALL SUBMIT FOR THE APPROVAL OF THE ENGINEER'S REPRESENTATIVE DETAILED PROPOSALS UNDER (A) ABOVE. WHEN THE REGULATIONS HAVE BEEN APPROVED AND BEFORE THE WORK STARTED, THE CONTRACTOR SHALL DISTRIBUTE COPIES IN ENGLISH OR IN OTHER LANGUAGES AS APPROPRIATE TO ALL HIS EMPLOYEES AND TO THE ENGINEER'S REPRESENTATIVE.

THE CONTRACTOR SHALL ENSURE THAT ALL HIS EMPLOYEE ARE FULLY CONVERSANT WITH THE REGULATION, EMERGENCY AND RESCUE PROCEDURES, ETC. AND THE CONTRACTOR SHALL ENFORCE THE RULE THAT ANY EMPLOYEE COMMITTING A SERIOUS BREACH OF SUCH A REGULATIONS SHALL BE INSTANTLY DISMISSED AND SHALL NOT BE RE-EMPLOYED.
CONTRACTOR SHALL PROVIDE AND MAINTAIN AT HIS OWN EXPENSES ALL LIGHTS, GUARDS, FENCING AND NECESSARY WATCHMEN WHEN AND WHERE NECESSARY OR ADD AS REQUIRED BY OWNER / ENGINEER FOR THE PROTECTION OF THE WORKS OR FOR THE SAFETY AND CONVENIENCE OF THOSE EMPLOYED ON THE WORKS AND THE PUBLIC. CONTRACTOR SHALL ALSO PROVIDE AT HIS COST TRAFFIC BARRICADES, MEN FOR DIVERTING AND CONTROLLING TRAFFIC, NECESSARY SIGN BOARDS FOR DIVERSION OF TRAFFIC. IN THE EVENT OF FAILURE ON THE PART OF CONTRACTOR, OWNER MAN WITH OR WITHOUT NOTICE TO CONTRACTOR PUT UP A FENCE OR IMPROVE A FENCE ALREADY PUT UP OR PROVIDE AND/OR IMPROVE THE LIGHTING OR ADOPT SUCH OTHER MEASURES AS HE MAY DEEM NECESSARY, AND ALL THE COST OF SUCH WORK AND PROCEDURES AS MAY BE ADOPTED BY OWNER / ENGINEER SHALL BE BORNE BY CONTRACTOR. MAINTENANCE OF ADEQUATE WARNING AND GENERAL LIGHTING AT NIGHTS AT PLACE OF WORK IS ESSENTIAL.

ACCIDENT LIABILITIES:

The contractor shall be responsible for all liabilities under workman compensation act, as under:

(a) On occurrence of accident, resulting in death of workman employed by the contractor or which is so serious as is likely to result in death of such workman who meet with accident, the contractor shall within 24 hours of incidence, will intimate in writing to Engineer in charge of such incidence. The contractor shall indemnify client, against all losses/damages sustained by the client resulting directly or indirectly from his failure to give such intimation to client including penalties/fines if any, payable by client as a consequence of client's failure to give notice under workmans compensation act or otherwise to confirm the provision of this act in regard to such accidents.

(b) In case when such compensations as above becomes payable under workman's compensation act, whether by contractor or by client as principal employer, it shall be lawful for the Engineer in charge to retain out of money due and payable to the contractor, such sum or sums of money as may in the opinion of the Engineer in charge be sufficient to meet such a liability, the opinion of the Engineer in charge shall be final in regard to all matters arising under this clause.

The Contractor shall have to maintain account of steel, cement and other materials that may be brought by him on site. This account shall be regularly maintained and kept open

for inspection by JDA staff. Watering of all the items shall be done as per instructions. Mixing of concrete shall be done by concrete mixer machine. Arrangements of bringing vibrator for R.C.C. work if required shall have to be made by the Contractor.

The R.C.C. or specified work shall not be done on Sunday and holiday except in emergency or when technical requirements are such that continuity of work should be maintained and that too will be with prior permission of the competent authority

Security Deposit @ 10 % from each Running account bill shall be deducted, which3 shall be released as under.

At the end of First Year of O&M:	30% of total Security Deposit amount
At the end of Second Year of O&M:	30% of total Security Deposit amount
At the end of Third Year of O&M:	40% of total Security Deposit amount

Octroi exemption passes shall not be given for any material required for this work.

Contractor will be fully responsible for compliance of the various provisions under Contract Labor Act, 1970 and the Rules frames there under. The Contractor should obtain necessary permissions, license & registrations from labour commissioner, as per labour law.

The bidder shall note that if the information required to be furnished by him either at the stage of prequalification or at the stage of bidding are not provided in time and/or if it is deliberately concealed and such information has come to the notice of JDA at any stage prior to award of Work and whether or not negatively affecting bidders competency the JDA reserve the right to out rightly reject the bid though he is pre-qualified in the absence of such information.

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APPENDIX–(A)

SAFETY PROVISIONS

1. Suitable scaffolds shall be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used, an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than ¼ to 1 (¼ horizontal and 1 vertical).
2. Scaffolding or staging more than 3.25 metres above the ground or floor, swung or suspended from an overhead support, or erected with stationery support, shall have a guard rail properly attached, bolted, braced, and otherwise secured at least 1 metre high above the floor or platform of such scaffolding or stating and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or stating shall be so fastened as to prevent it from swaying form the building or structure.
3. Working platforms, gangways, and stairways shall be so constructed that they do not sag unduly or unequally, and if height of a platform or gangway or stairway is more than 3.25 metres above ground level or floor level, it shall be closely boarded, have adequate width and be suitably fenced as described in 2 above.
4. Every opening in floor of a building or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of 1 metre.
5. Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 3 metres in length. Width between side rails in a rung ladder shall in no case be less than 30 cm for ladder upto and including 3 metres in length. For longer ladders, this width shall be increased by at least 6 mm for each additional 30 cm of length. Uniform step spacing shall not exceed 30 cm.
6. Adequate precautions shall be taken to prevent danger from electrical equipment. No material on any of the sites shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Contractor shall provide all necessary fencing and lights to protect public from accidents and shall be bound to bear expenses of defense of every suit, action or other proceedings at law that may brought by any person for injury sustained owing to neglect of the above precautions and to pay all damages and costs which may be awarded in any suit, action or proceedings to any such person or which may with the consent of the JDA be paid to compromise any claim by any such person.
7. Excavation and Trenching: All trenches, 1.5 metres or more in depth, shall at all time be supplied with at least one ladder for each 30 metres in length or fraction thereof. Ladder shall be extended from bottom of trench to at least 1 metre above surface of the ground. Sides of a trench which is 1.5 metres or more in depth shall be stepped back to give suitable slope, or securely held by timber bracing, so as to avoid the danger of sides collapsing. Excavated material shall not be placed within 1.5 metres of edge of trench or half of depth of trench, whichever is more. Cutting shall be done from top to bottom. Under no circumstance shall undermining or undercutting be done.
8. Demolition: Before any demolition work is commenced and also during the process of the work:

    (a) All roads and open area adjacent to the work site shall either be closed or suitably protected.
    (b) No electric cable or apparatus which is liable to be a source of danger over a cable or apparatus used by operator shall remain electrically charged.
    (c) All practical steps shall be taken to prevent danger to persons employed, from risk or fire or explosion, or flooding. No floor, roof, or other part of a building shall be so over-loaded with debris or materials as to render it unsafe.

9. All necessary personal safety equipment as considered adequate by the Engineer shall be available for use of persons employed on the site and maintained in a condition suitable for immediate use, and the Contractor shall take adequate steps to ensure proper use of equipment by those concerned.

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(a) Workers employed on mixing asphaltic materials, cement and lime mortars/concrete shall be provided with protective footwear, hand gloves and goggles.

(b) Those engaged in handling any material which is injurious to eyes shall be provided with protective goggles.

(c) Those engaged in welding works shall be provided with welder's protective eye-shields.

(d) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

(e) When workers are employed in sewers and manholes, which are in use, the Contractor shall ensure that manhole covers are opened and manholes are ventilated at least for an hour before workers are allowed to get into them. Manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to public.

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

i. No paint containing lead or lead products shall be used except in the form of paste or ready made paint.

ii. Suitable face masks shall be supplied for use by workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scraped.

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

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

11. Use of hoisting machines and tackle including their attachments, anchorage, and supports shall conform to the following:

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

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

13. Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years shall be in charge of any hoisting machine including any scaffold winch or give signals to operator.

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

15. In case of departmental machine, safe working load shall be notified by the Engineer. As regards Contractor's machine, the Contractor shall notify safe working load of each machine to the Engineer whenever he brings it to site of work and get it verified by the Engineer.

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

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

18. These safety provisions shall be brought to the notice of all concerned by display on a

Signature of Contractor

notice board at a prominent place at the work spot. Persons responsible for ensuring compliance with the Safety Provisions shall be named therein by the Contractor.

19. To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the Contractor shall be open to inspection by the Engineer or his representative and the Inspecting Officers.
20. Notwithstanding the above provisions, the Contractor is not exempted from the operation of any other Act or Rule in force.

SPECIAL CONDITIONS OF CONTRACT-PART (B)

FOR OPERATION & MAINTENANCE

1. DEFINITIONS:

The following definitions shall apply for this Condition of contract for operation and maintenance of Sewage Treatment Plant.

1.1 Facility

Shall mean the entire plant to be designed and constructed in accordance with the provisions of Technical Specifications and including any additions, modifications, alterations, replacement and repairs as may be made thereto from time to time.

1.2 Adverse operation periods

The period during which conditions in clause 5.2 are present.

1.3 Alternative consumption norms

Consumption norms for Power, fuel, chemical and other consumables for the period during which alternative output standard prevail

1.4 Alternative output standards

Mutually acceptable output standards for the treated sewage from the treatment facility those are determined after discussion by the parties

1.5 Billing period

Billing Period means each calendar month, except that (1) the first billing period shall begin on the date of issue of completion certificate or any other date as notified by Engineer-In-Charge and shall continue till the last day of the month in which the date issue of Completion certificate occurs; and (2) the last Billing period shall end on the last day of the operation and maintenance period.
Any computation made on the basis of a billing period shall be adjusted on a pro rata basis to take into account any billing period of less than the actual number of days in the month to which such billing period relates.

1.6 Employer/Owner/Client

The "employer" means **Jaipur Development Authority (JDA)**.

1.7 Clearances

Any consent, license, approval, permit, ruling, exemption or other authorization of whatsoever nature which is required to be granted by any competent Authority to undertake, implement, operate and maintain the facility.

1.8 Competent Authority

Any agency, legislative, judicial or executive authority, department, ministry, public or statutory person, whether autonomous or not, of the Government of India or Govt. of Rajasthan or any other sub-division or instrumentality thereof

1.9 Construction Period / Period for Completion of Work

Time of 12 (Twelve) months or the date of Issue of Completion Certificate /Completion Certificate, whichever is later, to complete the entire construction works including monsoon from the date of issue of issue of notice / Letter of Acceptance / Intent to proceed with the work which is also including One Month successful trial run of the entire Sewage Treatment System at the site.

1.10 Contract Date

Shall mean the date stated in the Contract Agreement

1.11 Contractor

As in the Contract Agreement

1.12 Date of Issue of Completion Certificate

As defined in clause 11 of Special Condition of Contract Part-A.

1.13 Design Requirements

As per this tender specifications

1.14 Fixed Payments

The fixed payment to the Contractor to be made as per Schedule (furnished in Volume IV, Price Proposal) which shall include the cost of remedying of any defects during the defects liability period in accordance with the provisions of this contract.

1.15 Good Industry Practice / Good Engineering Practice

In respect of the Contractor, its subcontractors, and all other such third party agents of the Contractor, practice methods, techniques and standards, as changed from time to time, that are generally accepted for use in international sewage treatment facility construction, development, operations and maintenance taking into account conditions in India.

1.16 Maximum Liquidated Damages

The maximum Liquidated Damages payable by the Contractor shall be 10 % of the contract amount.

1.17 Output Standards

Refers to performance standards as intended in this tender specifications with which the facility has been taken over by the Employer at the time of issue of Completion Certificate to the contractor.

1.18 Nominal Flow

As per designed output of the Facility.

1.19 Operation and Maintenance Completion Certificate

"O&M Completion Certificate" shall mean the certificate issued by the Employer on the fulfillment of all the obligations of the contractor under these conditions.

1.20 Operations and Maintenance Period (O&M Period)

The period commencing on the Date of issue of work Completion Certificate and ending on the Termination Date.

1.21 Operations and Maintenance Manual

A comprehensive and regularly updated manual, which shall include and address the Treatment processes, maintenance, emergency, repair and replacement, preventive maintenance, corrosion protection, staffing, training and other plans required by the Technical Specifications.

1.22 Operations and Maintenance Services

All Services which are the responsibility of the Contractor and are laid out in this tender specifications for operation and maintenance including those obligations listed in Volume II – Technical Specifications.

1.23 Raw Sewage

Incoming sewage to the facility / works supplied by employer for treatment purposes having characteristics as per this tender specifications / Conditions of Contract.

1.24 Termination Date

Three (3) years from the date of issue of Completion Certificate up to the date on which the contract is terminated according to Clause 8.

1.25 Treated Sewage

Sewage processed and treated in the Facility to meet the Required Output Standards as per these tender specifications at the designated Off Take Point for final disposal, as required.

1.26 Utility

Utility means any and all utility services and installations whatsoever (including gas, Water, sewer, electricity, telephone cable and telecommunications), and all piping, wiring, conduit, and other fixtures of every kind whatsoever related thereto or used in connection therewith.

1.27 Variable Payments

The Payment shall be made as per BOQ.

2. THE CONTRACT:

2.1 Term

The terms and conditions of this section will be in effect during the Operations & Maintenance Period unless expressly specified otherwise.

2.2 Expiry of Operations & Maintenance Period / Term

On expiry of the Operations & Maintenance Period, the Contractor shall return the Facility in an operational condition failing which the Owner shall recover Liquidated Damages from the Contractor as per **ANNEXURE-21** (furnished at the end of this section).

3. SCOPE OF WORK / ALLOCATIONS OF RESPONSIBILITIES:

3.1 During the Pre-operations stage (Within the Time for completion / Construction Period)
Without limiting the Contractor's obligations during the Operations & Maintenance Period, the Contractor shall

a) Identify and acquire all Clearances required for the operation of the facility and for the fulfillment of its obligations under the Conditions of Contract.

b) Assist the Owner in identifying the Clearances that are to be acquired

necessarily by the Owner for the fulfillment of the obligations of the Contractor under this Conditions of Contract.

c) Prepare and submit to the Owner for approval, the Operations & Maintenance Manual for duration of the Operations & Maintenance Period.

d) Obtain and maintain the insurance identified in. Clause

3.2 Operations stage

During the O&M Period the Contractor shall -

a) Be responsible for providing Operation & Maintenance Services.

b) Be responsible for the security of the Facility and comply with applicable laws and/or statutory requirements as may be applicable in the land from time to time.

c) Plan, manage, coordinate and execute the treatment of sewage as per the instructions given by the Owner.

d) Be responsible for the routine maintenance of the facility as well as any capital replacement that may be required from time to time to either enhance the performance of the facility or to meet the agreed specifications mentioned in the Operations and Maintenance Manual and pursuant to Clause of this Conditions of Contract for Operation and Maintenance

3.3 Releases

3.3.1 Release of Raw Sewage

The Contractor shall carry on its activities in the Facility in such manner that raw sewage will not be released, leak or spill onto the Site or elsewhere. The Contractor shall bear the cost of correcting any adverse consequences resulting from any such release, leakage or spillage, and shall make and file any reports with respect thereto required under this Conditions of Contract for Operation and Maintenance and Applicable Law.

3.3.2 Release of Hazardous Substances or Hazardous Waste

The Contractor, after first notifying the Owner, shall be responsible for fulfilling all notification or reporting requirements associated with any release of any substance into the environment from the Facility or the Site as required by Applicable Law or by any Legal Entitlement including, but not limited to, the notification or reporting of releases of Hazardous Substances or Hazardous Waste. The Contractor shall prepare a memorandum evidencing such notification or reporting and provide copies thereof to the Owner, along with any documents provided to the relevant regulatory agency regarding such release.

3.4 Disposal of Residue (Screenings, grit, sludge etc. from treatment facilities)

3.4.1 Residue Management

1) The Contractor shall make all necessary arrangements with the owner or operator thereof for the disposal of all Residues during the Term of this Conditions of Contract for Operation and Maintenance at the Residue Disposal Site identified by Employer, the location of which and approx. max. distance from plant is approximately within **5.0 Km radius** of treatment plant as specified elsewhere also as part of these tender specifications. The Contractor shall dispose off residue at the Facility in an enclosed in accordance with the Technical Specifications, so as not to

create, nuisance, odour or degradation of the surrounding environment.

2) The Contractor shall operate the Facility and treat Raw Sewage so as to minimize the production of Residue and comply with the Required Output Standards. The Contractor shall segregate, collect and store all Residues from treatment operations. The Contractor shall transport all Residues to a Residue Disposal Facility after washing the same, when required in a safe and environmentally sound manner and in accordance with Applicable Law.

3) Except as otherwise provided in this sub clause, all cost and expense of Residue disposal shall be borne by the Contractor, and no Uncontrollable Circumstance [or Force Majeure shall entitle the Contractor to any relief or additional compensation hereunder.

4) In the event that the Residue, without Contractor's Fault, is deemed to be a Hazardous Substance or Hazardous Waste (i.e. due to quality of raw sewage), the Contractor shall be entitled to recover from the Owner, subject to Cost Substantiation, the difference between the cost and expense of disposing of the Residue as a Hazardous Substance or Hazardous Waste and the cost and expense of disposing the Residue if it were not a Hazardous Substance or Hazardous Waste.

3.4.2 On-Site Disposal or Residue

The parties acknowledge that the Contractor may dispose of Residue at a disposal location located outside the Site. The use of such disposal location for such purposes shall be subject to all of the requirements for a Residue Disposal Facility hereunder.

3.4.3 Transportation Operations

In the event of a spill, leak or loss of Residue during transit, the Contractor shall immediately arrange for the cleanup and transportation of the material to a Residue Disposal Facility at the Contractor's sole cost and expense, pay any resulting fines, assessments, penalties or damages resulting there from, and indemnify, defend and hold harmless the Owner in accordance with the procedures provided in this Conditions of Contract for Operation and Maintenance and from all Loss-and-Expense resulting thereof.

3.4.4 Residue Disposal Facility Information

The Contractor shall keep and maintain such logs, records, manifests, bills of lading or other documents as the Owner may deem to be necessary or appropriate to comply with Legal Entitlements and to monitor and confirm compliance by the Contractor with the requirements of this section, and shall collect and promptly provide the Owner with a copy of all weights and measures, data and information relating to Residue quantities generated and disposed of hereunder.

3.5 Owner's right to rectify

The Owner retains the right, at the cost of Contractor, to perform any of these material obligations on default of the Contractor,

3.6 Responsibilities of the Owner

During the O&M Period, the Owner will provide

a) Free of charge Raw Sewage.

b) Power supply to the Facility as per the requirement of the Contractor indicated by him during the bidding process / as per Guaranteed Power Consumption (refers Guarantee Statements, Vol. III).

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4 PAYMENTS

4.1.1 a) The contractor will pay for any potable water supply supplied by the owner (subject to availability).

b) The contractor has to make his own arrangement to receive, store and distribute water within the facility.

4.1.2 Electricity and Fuel Charges

(i) The energy charges shall be paid by the owner. However, the actual energy consumption for the preceding month shall be compared with the energy consumption guaranteed by the contractor as part of this tender condition. Penalty towards excess energy consumption for non-maintenance of power factor, shall be recovered from the O&M bill of the current month claimed by the contractor:

a) In case of contractor not able to maintain power factor of 0.9 or more during any particular month, the difference in amount based on power calculated on actual p.f. (below 0.9) and power based on 0.9 p.f. shall be invoked through bidder's O&M bill of the following month. Any surcharge/penalty raised by Electric Company due to low power factor shall be payable by the contractor

4.1.5 Disputed Payment

If there is any dispute in the whole or part of any invoice submitted by the contractor, the employer shall pay such amount of the invoice in question, which is not in dispute and shall be entitled to withhold the balance pending resolution of the dispute. Any or all amount so withheld, but subsequently found to be properly payable following the resolution of such dispute, shall not carry any interest.

4.1.6 Currency of Payment

The currency of payment shall be in Indian Rupees only.

4.1.7 Taxes

The contractor shall be responsible for paying all taxes assessed as due and enforced from time to time payable by the contractor associated with the carrying out of the services. The employer shall be entitled to withhold from payment to the contractor any amount it is required by law to so withhold.

4.2 Liquidated Damages

4.2.1 For the quantity of treated sewage

If the pumped sewage quantity parameters do not meet the output standards, then liquidated damages shall be payable as per **Annexure** (furnished at the end of this section).

4.2.2 The treated sewage quantity levels shall be calculated on the basic average over the relevant period of 24 hours.

4.2.3 Limit on Liquidated Damages

Notwithstanding the above, the liquidated damages payable by the contractor shall not exceed the Maximum Liquidated Damages.

4.2.4 It is understood that liquidated damages are not a penalty but represents a reasonable estimate of fair compensation which are payable without proof of actual damage for a failure to meet the stipulated conditions which otherwise is impracticable or extremely difficult to fix the actual damages resulting from failure of the contractor to meet such output standards.

4.2.5 Silt / Sludge / Screening / Grit removal

If the contractor fails to remove silt / sludge / screening / grit etc. in the treatment plant from the date of receipt of letter from the employer, then the silt/sludge/screenings/grit shall be removed by the employer by engaging other agencies and the cost will be recovered from the contractor.

5. OPERATIONS:

5.1 Variability of Output

5.1.1 Variation in Treated Sewage Quantity required by Owner

1) Throughout the Operations & Maintenance Period, the Owner has the right to demand Treated Sewage in accordance herewith and to convey Raw Sewage to the Facility in order to enable the Contractor to meet such Treated Sewage discharges. The Owner shall not be liable to damages or otherwise for any failure to discharge Treated Sewage or to supply Raw Sewage, or for the quantity or quality of Raw Sewage conveyed to the Facility for treatment.

2) The Contractor shall have the obligation to discharge treated sewage in quantities upto the Nominal Flow in accordance with the terms and conditions of this Contract for Operation and Maintenance and the schedules to this Conditions of Contract for Operation and Maintenance. Failure to comply with such obligations shall attract the levy of liquidated damages for the violation of stipulated treatment standards by the Contractor.

3) If the quantity of treated sewage from the facility can be increased in the existing system without impacting the annual fixed costs to the contractor, the contractor shall comply with such requirements.

4) For a sustained requirement of higher throughput from the Facility for a period beyond 2 months, the Contractor may be required to frame and submit a proposal for revising the periodic payments made by the Owner that shall be implemented if mutually acceptable.

5) For a sustained requirement of lower throughput from the Facility by the Owner for a period beyond 2 months, the Owner may frame and submit a proposal for revising the periodic payments made by the Owner that shall be implemented if mutually acceptable.

5.1.2 Variation in Treated Sewage Quality

1) Throughout the Operations & Maintenance Period, the Contractor shall, at its own cost and expense, ensure that the Treated Sewage output from the Facility shall meet the Required Output Standards. Failure to ensure such conformance shall invoke payment of Liquidated Damages along with the notices to be complied as well as the penalty imposed etc. or any action by the statutory controlling authorities shall be borne by the contractor.

5.2 Planned Outage

The contractor shall maintain the Output Standards at all times during the O&M period irrespective of any planned maintenance that may be undertaken by him.

5.3 Personnel

(i) The Contractor shall appoint, on or before the date of issue of Completion Certificate, a properly qualified, competent and experienced person to act as the Contractor's Representative, which appointment shall be subject to the approval of the Owner and such approval shall not be unreasonably withheld or delayed.

(ii) The Contractor's Representative shall be authorized and empowered to act for and on behalf of the Contractor on all matters relating to the rights and obligations of the Contractor during the O&M Period. In all such matters, the Contractor shall be bound by the written communications, directions, requests and decisions given or made by the Contractor's Representative. The Contractor's Representative shall not be entitled to amend this Contract on behalf of the Contractor.

(iii) The Contractor's Representative will direct and manage the Contractor's resources and have full responsibility for the operation, maintenance and administration of the Facility alongwith the strict adherence to the stipulated discharge standards for final disposal of the treated sewage.

(iv) The Owner shall appoint, on or before the date of issue of Completion Certificate, an Owner's Representative and notify the Contractor of such appointment.

(v) The Owner's Representative shall have authority to act on behalf of the Owner in relation to all matters concerning the scope of work during the O&M Period , save to the extent of any limitation on such authority of which the Owner has given the Contractor notice. In no event shall the Owner's Representative have any authority to relieve the Contractor of any obligation or liability or to amend this Contract.

(vi) The Contractor shall identify, interview and hire sufficient number of qualified and trained (and if required, licensed) personnel to perform its obligations during the O&M Period as per these tender specifications / O&M specifications (Vol. II, Technical Specifications for O&M).

(vii) All Contractors' personnel employed at the plant at any time during the O&M Period will be provided by the Contractor. The Owner is not liable for personnel in any way and cannot be held responsible in the event of litigation of any sort between the Contractor and members of plant personnel or their representatives or non performance of obligations due to any strike or other industrial action by the Contractor's workmen (including those of its subcontractors, suppliers etc).

(viii) The Contractor undertakes to comply with applicable legislation and the code of labour law on matters of health, hygiene and safety, and shall assume responsibility for works required in the event of any change in applicable regulations and shall also require its subcontractors to comply with this clause.

(ix) The minimum personnel required are mentioned in the Chapter in Volume II, Technical Specifications for O&M.

(x) The Contractor undertakes to provide the training that may be necessary from time to time to all the personnel employed in the facility, at its own cost and responsibility.

(xi) The Contractor further undertakes to train 2 persons nominated every year by the Owner in order to able to effectively carry on the operation & maintenance of the facility during a period of emergency/Force Majeure when the obligations of the Contractor have been temporarily suspended,

(xii) The Contractor also undertakes to provide training to the personnel nominated by Owner to take over the operation & maintenance of the facility at the time of termination/forced termination of this Conditions of Contract for Operation and Maintenance.

5.5 Maintenance/Repairs

5.5.1 Ordinary routine Maintenance, Repairs and Replacements

(i) The contractor at its own cost and expenses shall maintain the Facility in good working order and repair and in a neat orderly condition, including

the cleanup of litter and debris on a daily basis or more frequently, if required, shall maintain a spare parts inventory necessary to performance maintenance required as per the operation and maintenance manual, and shall maintain the aesthetic quality of the Facility as originally constructed and in accordance with the technical specifications, with due allowance for reasonable wear and tear and depreciation.

(ii) The contactor shall provide or make provisions for all labour, materials, and equipment which are necessary for the normal operation and maintenance of the Facility and shall conduct the required predictive and preventive maintenance of the Facility consistent with the operation and maintenance manual. The contractor shall maintain maintenance logs in accordance with the preventive maintenance plan set forth in the operations and maintenance manual.

5.5.2 Major maintenance, Repairs and Replacements

(i) The contractor shall be responsible for providing all Major Maintenance, Repairs and replacement of the machinery, equipment, structures and improvements constituting the facility during the Operation & Maintenance period. No such Major Maintenance, Repair or Replacement shall constitute a Facility Modification for which the Owner shall be financially responsible hereunder.

(ii) The contractor shall submit a periodic statement outlining the scheduled maintenance, repairs and replacements, whether routine or major or otherwise, and the actual status of the maintenance, repairs and replacements carried out by the contractor up to that date, in order to prove compliance with the provisions of this conditions of contract and the Operations and Maintenance manual.

(iii) The Owner and the Owner’s representative shall have the right to conduct inspections at the Owner’s sole expense and risk at any time in order to assure that the Facility is being properly operated and maintained, repaired and replaced in accordance with this Conditions of Contract for Operation and Maintenance.

(iv) The Contractor shall at least semi-annually and at least once during each period when Major Maintenance, Repair and Replacement activities required hereunder are being carried out by the Contractor, at the Owner's request, conduct a day-long "Walk-through" of each component of the Facility in which the Contractor shall demonstrate to the Owner's inspectors that all Major Maintenance, Repair and Replacement activities required hereunder are in fact being carried out by the Contractor.

(v) The Major Maintenance, Repair and Replacement plan set forth in the Operations and Maintenance Manual shall contain the basic principles under which the Contractor shall carry out its Major Maintenance, Repair and Replacement program required by this Conditions of Contract. Such plan shall also contain a detailed listing of Major maintenance repair and replacement activities which would be required to be performed by the Company over the Term of this Conditions of Contract for Operation and Maintenance in order to achieve the standard of overall Facility over its expected useful life. The Contractor shall make and complete all Major Maintenance, Repairs and Replacements to the Facility that are necessary to achieve such standard of repair and replacement by performing all such listed activities within the timeframe indicated in the Operations & Maintenance Manual.

(vi) The parties acknowledge that, in light of the long term nature of the Conditions of Contract for Operation and Maintenance and the practical limitations on predicting with specificity the useful life of any particular asset, it may be appropriate from time to time to alter such Major Maintenance, Repair and Replacement plan. Such alterations to the plan shall be made via updates to the appropriate sections of the Operations and Maintenance Manual. No such alteration shall be made unless the Contractor demonstrates to the satisfaction of the Owner that the sum of all Major Maintenance, Repair and Replacement services performed to date by the Contractor, and all Major Maintenance, Repair and Replacement services to be performed under any such alteration, shall result in a standard of overall Facility maintenance and repair which is equal to or better than the standard represented by the activities to be performed under the Operations and Maintenance Manual. The Contractor shall co-operate with the Owner in identifying any such

alterations which may be desirable in order to anticipate or address the technological obsolescence of any component, system or process of the Facility, and in proposing alterations for the Owner's approval.

5.6 Owner's rights:

5.6.1 Inspection

(i) The Owner may periodically check the operation as well maintenance of the Facility or designate an organization of its choice to carry out inspections of the Facility to satisfy itself that the Contractor is performing its obligations with due diligence, at its own cost.

(ii) Any assistance required for such inspection of the Facility shall be provided by the Contractor at its own cost.

5.6.2 Technical Audit

The Owner has the right to conduct a technical audit of the Facility and to perform any analysis or inspection it deems necessary. Before any such inspection, the Owner shall give a prior written notice of one day to the Contractor. The Contractor shall at the Contractor's sole cost and expense provide all assistance the Owner requires to complete these inspections. Such audits may cover all or any of the obligations of the Contractor, including without limitation,

a) Verification of the system capacity save for normal wear and tear during the O&M Period

b) Verification of the performance standards and useful life of the individual assets of the Facility, save for normal wear and tear during the O&M Period

c) Verification of the capacity of the Facility to meet Output Standards during the residual life of the Facility saves for normal deterioration expected during such residual life

d) Sampling, testing and verification of the Output Standards for treated Sewage, Sewage losses

5.6.3 Facility / Plant Visits

(i) At the end of each three-month period, or at the initiative of the Owner, a visit shall be organized so that both Parties can check the condition of the installations at the Facility.

(ii) A report shall be drawn up to record the opinions of both Parties. The Owner reserves the right to call in equipment manufacturers or specialized technicians for these visits.

(iii) These visits shall provide an opportunity for examining maintenance programs and operating procedures and improvements requiring additional investments.

5.7 Other Contracts

(i) The Contractor shall not delegate its responsibilities hereunder nor subcontract any part of the services to be provided by him hereunder without the prior written consent of the Owner. If the Contractor subcontracts its responsibilities hereunder or subcontracts any part of the services to be provided by him hereunder with the consent of the Owner, the Contractor shall not be relieved from any liability or obligation under this Contract and the Contractor shall continue to be responsible for the act, defaults or negligence of any sub- contractor as fully as if it were the acts,

defaults or negligence of the Contractor, its officers, employees or agents.

(ii) The period of validity of any contractual commitment for provision of services or material or personnel to the Facility or any subcontract entered into by the Contractor with any party shall not extend beyond the Termination Date.

(iii) All such contractual commitments to be entered into by the Contractor should be freely assignable to the Owner or to any other contractor during the O&M period.

(iv) The Contractor cannot create a charge on any assets of the Owner or the assets purchased under the Contract.

6. Emergencies

6.1 Contractor Action

In the event of emergency endangering life or property, the Contractor shall take such action as may be reasonable and necessary, at the own cost and expense, to prevent, avoid or mitigate injury, damage or loss and shall, as soon as possible, report any such incidents, including the Contractor's response thereof, to Owner's Representative.

6.2 Personnel and Expenditure

The Contractor shall utilize its personnel to take such action as may be reasonable and necessary in the event of an emergency. Notwithstanding anything to the contrary in this Conditions of Contract for Operation and Maintenance, the Contractor may incur any expenditure or take any other measure, which the Contractor deems to be necessary (in accordance with Good Industry Practices) in the case of emergencies affecting the Facilities or the operation of the Facilities to counteract the effects where the Contractor considers immediate action is required to safeguard lives or property (and provided that any communication with the news media made by the Contractor shall provide only enough information to satisfy immediate public concern).

6.3 Notification

In the event of an emergency the Contractor shall forthwith notify the Owner's Representative of the emergency, the expenditures made and the actions taken. The Contractor shall discuss without delay the further actions which should be taken as a result of that emergency.

7. FORCE MAJEURE

7.1 Definition

(i) "Force Majeure" ("FM") shall mean any event or circumstances or combination of events or circumstances (and their consequences) such as political or natural calamities/disaster occurring on or after the date of issue of Completion Certificate that materially adversely affect(s) the performance of the Employer's and/or the Contractor's (Affected Party) rights or obligations under this contract provided that such events and/or circumstances

a) are beyond the reasonable control, directly or indirectly, of the Affected Party (it being understood that if a causing event is within reasonable control of an Affected Party, the direct consequences shall also be deemed to be within such Party's reasonable control); or

b) Could not have been avoided, overcome or remedied if the Affected Party has taken reasonable care or has acted in accordance with Good Industry Practices.

(ii) "Reasonable care" includes any acts or activities that protect the Facility from a

casualty event which are reasonable in the light of the likelihood of such event, the probable effect of such event should it occur, and the likely efficacy of the protection measures.

(iii) The following conditions shall not, however, constitute a Force Majeure event
a) Late delivery of plant, machinery, equipment, materials, spares parts or consumables for the Facility.

b) A delay in performance of any of the Contractor's sub-contractors.

(iv) Notwithstanding anything contained in this Section, insufficiency of funds shall not constitute a Force Majeure event.

8 Termination by Employer

The Employer may terminate the O & M Contract by notice on:
(a) the dissolution or insolvency of the Contractor, pursuant to an order of a court or the bankruptcy of the Contractor; or
(b) if 45 days having passed since the Contractor is in material breach of his obligations under these Conditions, or
(c) sustained inability (for a continuous period of two weeks) to meet the minimum output standards.
(d) if the cumulative liquidated damages in a year exceed the Maximum Liquidated Damages.
(e) if the Contractor ceases to carry on its business; or
(f) abandonment;
(g) the subsisting Force Majeure event as provided in Clause 7 above.

9 INDEMNIFICATION

9.1 Loss or Damage to Facilities

The Contractor shall at its own expense make good any physical loss or damage to the Facilities occasioned by it in the course of the performance of its obligations under these Conditions if and to the extent such loss or damage is caused by the negligence, willful default or breach of statutory duty or failure to follow Good Industry Practices by the Contractor.

9.2 Other Loss or Damage

9.2.1 The Contractor shall indemnify, defend and hold harmless the Employer against any and all liabilities, losses, damages and claims of whatever kind and nature, including all related costs and expenses incurred in connection therewith, in respect of personal injury to or death of third parties or any employee of the Employer or in respect of loss of or damage to any third party property or property belonging to employee of the Employer by:

(i) any breach by the Contractor of its obligations hereunder; and

(ii) any negligence, willful default or breach of statutory duty on the part of Contractor, or its subcontractors or their respective agents or employees.

9.2.2 The Contractor shall indemnify, defend and hold harmless the Employer against any and all liabilities, losses, damages and claims of whatever kind and nature, including all related costs and expenses incurred in connection therewith, in respect of personal injury to or death of any person employed by the contractor or its subcontractors in connection with the performance of the Contractor's obligations hereunder except to the extent that such death or injury is caused by the acts or omissions of the Employer or their employees.

ANNEXURE-01

TENDER LETTER

(Ref : Clause-4.1 of ITB)

To

The Director (Engineering)
JDA – Jaipur
Rajasthan

Subject:Tender for Design, Construction, Erection, Commissioning, Trial Run of 1 MLD STP at Smriti Van (Jhalana), on Turnkey basis based on SBR technology with PLC, SCADA Systems, Allied works, and O & M for 3 years at Jaipur City.

Ref :- Your NIT **03 /2016-17** dated : **12.08.2016**

Dear Sir,

1. Having carefully examined all the parts of the tender documents and the addenda (if any) for the execution of the above mentioned works, having obtained all requisite information affecting this tender, having visited the site and being aware of all conditions and difficulties likely to affect the execution of the contract, we, the undersigned, hereby offer to execute the single responsibility turn-key job on lump-sum basis as described in the Tender Documents and to hand over the whole of the said works in conformity with the drawings, conditions of contract, technical conditions and scope of work, for the sum indicated in the financial offer and such other sum as may be ascertained in accordance with the Contract.

2. We declare that we have read and understood and that we accept all clauses, conditions, descriptions, drawings of the tender documents volume I to volume II, and subsequent addenda (if any) without any change, reservations and conditions. If any change, reservation or condition has been made in our tender we herewith withdraw it.
3. We undertake, if our tender is accepted, to commence the work within 10 days of the work order and to complete the work in the stipulated time for completion.
4. If our tender is accepted we will provide a security deposit in the required form in the sums as stipulated in the tender documents.
5. Unless and until the formal agreement is prepared and signed, this tender, together with your written acceptance thereof shall constitute a binding contract between us.

6. We agree to abide by this tender for the period of 120 days from the date of opening of the pre-qualification bids and it shall remain binding upon us and may be accepted by you at any time before or after the expiry of that period, and not to make any modifications in its terms and conditions which are not acceptable to you.
7. Together with the tender we submit the earnest money of Rs [1] ..... as [2] ..... Dated this ..... day ..... 2016 [3] ..... in the capacity of [4] ..... duly authorized to sign the tender for and on behalf of [5] .....

Name:

Address:

Telephone: Telefax: Telex:

Signature of the authorized representative .....

[1] Amount of Earnest Money
[2] Indicate the form in which it is provided.
[3] Name of the authorized Representative of the firm
[4] Designation
[5] Name of firm

Signature of Contractor

ANNEXURE-02

MEMORANDUM OF WORKS IN BRIEF

(Ref clause 4.4 of ITB)

Name of Work	:	**Tender for Design, Construction, Erection, Commissioning, Trial Run of 1 MLD STP at Smriti Van (Jhalana), on Turnkey basis based on SBR technology with PLC, SCADA Systems, Allied works, and O & M for 3 years at Jaipur City.**
Estimated Cost	:	**Rs. 331.00 Lacs**
Earnest Money (Bid Security)	:	**Rs. 1,65,500.00/-** for bidders registered with JDA and **Rs. 6,62,000.00/-** for the bidders not registered with JDA
Validity Period of Tender offered	:	**120 days** from the date of opening of the Tender.
Security Deposit	:	The security deposit shall be deposited as per clause-01 of General condition of Contract.
Time allowed for completion of the work from the date of written order to commence	:	**12 months**
a) Date of sale of tender document	:	From 24.08.2016 to 23.09.2016 upto 6.00 P.M
b) Pre-bid meeting	:	N/A
c) Date on or before which the tender must be uploaded	:	Dt 23.09.2016 upto 6.00 P.M
d) Mode of submitting the filled up tender	:	a) Online through e-procurement
e) Mode of quoting rate in Schedule of quantities (in Financial bid)	:	**Lump sum price In figures as well as in words in financial bid/proposal (Envelope B) only. The tenderer should not mention his price in pre-qualification technical proposal (Envelope A) or in his forwarding letter as that will lead to outright rejection of the tender.**
Execution of work	:	Work shall start immediately as directed by Engineer-in-charge.

Signature of Contractor :

Name :

Company's Seal :

Date :

ANNEXURE-03

Declaration – Under the official Secrets Act

(Ref clause 4.5 of ITB)

"I/We hereby declare that I/We shall treat the tender documents, drawings and other records, connected with the work, as secret confidential documents and shall not communicate information derived there from to any person other than a person to whom I/We am/are authorized to communicate the same or use the information in any manner prejudicial to the safety of the same".

I/We understand that failure to observe the secrecy of the tenders will render the tender, liable to summary rejection.

Signature of Contractor :

Name :

Company's Seal :

Date :

Signature of Contractor

ANNEXURE– 04

ELIGIBILITY CRITERIA FOR TECHNICAL REQUIREMENT

(Ref. Clause no. 9 of ITB)

One STP/STP Capacity of which should not be less than 1.0MLD or two STP each of minimum 0.5 MLD capacity each during past five years of STP for one year as on date of receipt of Pre-qualification document.

Sr. No.	Name of the Project/Client	Capacity of STP & type of treatment process	Word Order amount (Rs. In Lakhs)	Work order no. and Date	Stipulated date of commencement of work	Stipulated date of completion of work	Actual date of completion of work	Completion cost of project (Rs. In Lacs)	Whether Project Under Litigation (Yes/No) & reasons thereof
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***

***** Attach certificate issued by an officer not below the rank of Executive Engineer or equivalent of a Government / Semi-Government / Autonomous organization.

Note :-

i. *Experience certificate as referred above should include work order no. and date, amount, date of start, actual date of completion, completion cost of project, year of commissioning. Bidder may also provide details of various components of STP completed by him. Bidder shall also enclose copy of work order for construction of STP.*
ii. *Experience certificate submitted by firm as joint-venture, shall not be considered*

Signature of Contractor :
Name :
Company's Seal :
Date :

ANNEXURE-05

FINANCIAL RESOURECES AND CAPABILITY

[Reference Clause – 9 of ITB]

1. Name of Bidder
2. Total financial turnover achieved by the bidder in the last five financial years:

S.No.	Year	Turnover
(1)	2011-12	
(2)	2012-13	
(3)	2013-14	
(5)	2014-15	
(6)	2015-16	

Note:- Balance sheets and profit & loss accounts is to be enclosed by the bidder which is considered by him as per criteria – (a).

3. Total financial turnover projected in the current financial year.
4. Has the bidder ever been debarred from tendering for Central Government / State Government / any Government undertaking?

   Yes / No, if yes give details.

5. Has bidder ever been declared insolvent?

   Yes / No, if yes give details.

6. Name (s) and Address of Branch / (s) for bidder's Bankers.

I / We hereby certify that the above information is correct to the best of my / our knowledge and belief.

Signature of Bidder

(With Seal wherever applicable)

Date:

ANNEXURE-06

[Reference Clause – 9 of ITB]

DETAILS OF EXISTING COMMITMENTS & ON GOING WORKS TO BE COMPLETED

S. No.	Name of Works (with agreement No. & Date)	Client	Cost of Works as per Work Order	Stipulated date of Commencement	Stipulated date of Completion	Value of balance work on date of tender	Likely date of completion of balance work	Page No.

Signature of Bidder

ANNEXURE-07

[Reference Clause – 9 of ITB]

DETAILS OF MAXIMUM VALUE CIVIL ENGINEERING WORKS EXECUTED IN ANY ON YEAR DURING THE LAST FIVE YEARS TAKING INTO ACCOUNT THE COMPLETED AS WELL AS WORKS IN PROGRESS

S. No.	Name of Works (with agreement No. & Date)	Client	Place (district / state)	Financial Year	Cost of Works as per Work Order	Stipulated date of Commencement	Stipulated date of Completion	Value of work done during the year	Page No.

Signature of Bidder

ANNEXURE-08

QUALIFICATION INFORMATION

(ref. Clause no. 12.2 of ITB)

(To be submitted on Rs. 100/- Stamp paper duly attested Notary Public)

The information to be filled in by the bidder in the following pages will be used for the purposes of Technical evaluation as provided in clause 11 of the Instruction to 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)

Signature of Contractor :

Name :

Company's Seal :

Date :

ANNEXURE-09

POWER OF ATTORNEY OF THE REPRESENTATIVE OF A FIRM

(Ref. Clause no. 12.2 of ITB)

A. Power of Attorney for Authorized Representative*

The firm M/s……..authorize the following Representative to sign and submit the tender document, negotiate terms and conditions for the contract, to sign the contract, to deal with the JDA, to issue and receive correspondence related to all matters of the tender for

Tender for Design, Construction, Erection, Commissioning, Trial Run of 1 MLD STP at Smriti Van (Jhalana), on Turnkey basis based on SBR technology with PLC, SCADA Systems, Allied works, and O & M for 3 years at Jaipur City.

We/M/s._____under take the responsibility due to any act of the representative appointed hear by.

FOR PARTNERSHIP FIRM'S

S,No.	Name of the all partner	Signature of Partner with Seal
1.		
2.		
3.		
4.	Name and Designation of the person Authorized.	
5.	Attested Signature of the Authorized Representative.	

FOR LIMITED FIRM'S

Attested Signature of the Authorized Representative.	
Firm	
Address	
Telephone No.	
Fax No.	
Telex No.	
Authority by which the powers is delegated	
Attested Signature of the Authorized Representative.	
Name and Designation of person attesting the signatures.	

- **To be prepared on *Stamp Paper of Rs. 100/- duly attested by Notary Public*.**

Signature of Contractor :

Name :

Company's Seal :

Date :

ANNEXURE-10

Key Technical personnel & Project Manager Competence and qualification

(Experience in Year)

(Ref. Clause no. 19.1 (xv) of ITB)

Team	Name of person	Qualification	Experience in Years (In Required status)
Project Manager			
Environmental Engineer (Design Engineer)			
Civil Engineer (Construction Engineer)			
Mechanical Engineer			
Electrical Engineer			
Instrument Engineer			
Procurement Engineer			

Note: **Please give required details in curriculum vitae for each team members**

Signature of Contractor :

Name :

Company's Seal :

Date :

Form of Agreement **ANNEXURE-12**

Ref. clause 44.1(a)

THIS Agreement made the _____ day of _____2016 between the ----------, Jaipur on behalf of the Jaipur Development Commissioner of the one part and _____ of _____ (hereinafter called Contractor) of the other part.

WHEREAS the JDA is desirous for execution of **"Tender for Design, Construction, Erection, Commissioning, Trial Run of 1 MLD STP at Smriti Van (Jhalana), on Turnkey basis based on SBR technology with PLC, SCADA Systems, Allied works, and O & M for 3 years at Jaipur City".**

WHEREAS the JDA has accepted a tender by the Contractor for the execution, completion and maintenance of such work,

NOW THIS AGREEMENT WITNESSES as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the conditions of Contract hereinafter referred to.
2. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz.:

(i). Form of agreement
(ii). Letter of award and any pre-award correspondence between JDA and the Tenderer
(iii). Tender documents contained in;

Volume I	:	Instructions to bidders & conditions of contract
Volume I	:	Scope of Work and Technical specifications
	:	Forms of Proposals, Schedules & Drawings
Vol-III	:	Schedule of Prices
All addenda issued		

(iv). The Tender Offer

3. The signed and initialed Tender Documents shall be deemed to form and be read and construed as part of this Agreement.

4.In consideration of the payments to be made by the JDA to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the JDA to provide, execute, and to complete the work, remedy the defects, commission the work and maintain it in conformity in all respects with the provisions of the Contract**.**

The JDA hereby covenants to pay the Contractor in consideration of the provisions, execution, completion of the works, remedying of the defects therein and maintenance of the work the Contract Price or that sum as may become payable under the conditions of the Contract at the times and in the manner prescribed by the Contract.

The following are the salient data of the agreement:

Contract sum	Rs _____
Execution Part	***Rs _____***
Operation and Maintenance Part	***Rs _____***

Time for completion:

Execution Part	***12 months***
Operation and Maintenance Part	***3 Years***

IN WITNESS thereof the parties to these present have hereto set and subscribed their respective hands the day, month and year first above written.

SIGNED for and on behalf of JDA

Executive Engineer (PHE-I), JDA, Jaipur	Witness

SIGNED for and on behalf of the Contractor

Authorized representative	Witness

ANNEXURE – 13

WATER SUPPLY AND ELECTRICITY
(Refer Clause 7.8 (b) of Special Condition of Contract-A)

1.0 WATER SUPPLY

Contractor shall make his own arrangement for Water supply at his own cost and nothing extra shall be paid by the JDA. This applies to water required for construction as well as testing purpose also. The Contractor can, however, construct a tube-well or a pipeline at his convenience on nearby JDA land if available with prior approval of JDA. Contractor will be responsible for all costs of tube well, pumping, laying of necessary pipe lines, installation of meter, storage, maintenance and ultimate removal of the same.

Bidder, if proposes to use Ground Water for construction at site, the same may be used if found potable. He shall arrange to carry out necessary test in approved laboratory on his own to ascertain water quality and that it is potable and obtains prior permission of JDA to use the same.

However if Water pipeline is available nearby then the contractor may take water connection making all arrangement for getting water by laying pipe line installing drawal point – maintenance and subsequent removal at his own cost, All the maintenance and water charges connection charges shall be borne by contractor

2.0 ELECTRICITY

Contractor will have to make all arrangements for obtaining power connection, the installation, operation, maintenance and subsequent removal of temporary supply of electricity. JDA shall issue only authorization letter to Contractor for obtaining power connection, and, yet if power is not available in time, the work shall not be postponed and the Contractor shall have to arrange for diesel generating set (s) at his own cost.

Signature of Contractor :

Name :

Company's Seal :

Date :

ANNEXURE – 14

CEMENT AND STEEL

(Refer Clause 10.2 (ix) of Special Condition of Contract-A)

Cement and Steel required for this work as well as for manufacture of pipes shall be procured by Contractor. Contractor will not be paid for any transport, handling and storage expenses separately and he should quote for the works accordingly.

Test certificate for cement and steel shall be obtained and submitted by contractor. Contractor shall have to produce test certificates for all procurement of cement and steel.

Cement/OPC/PPC/SRC shall be of Ambuja, Binani, L & T, Lotus, ACC, JK, Birla or other make approved by engineer-in-charge.

TMT reinforcement steel shall be of Tata, SAIL,Jindal or any other approved make approved by EIC.

Signature of Contractor :

Name :

Company's Seal :

Date :

ANNEXURE – 15

Liquidated Damages

(Refer Clause 2.2.1 of Special Condition of Contract-B)

(For non-conformance in meeting the Output Standards for Treated Sewage set as per this tender specifications)

Event triggering the recovery of Liquidated Damages	**During the O&M Period**	
	Liquidated Damages	**Frequency**
As per clause6.D of SCOPE OF WORK-Operation and maintenance of STP	As per clause6.D of SCOPE OF WORK-Operation and maintenance of STP	As per clause6.D of SCOPE OF WORK-Operation and maintenance of STP

Signature of Contractor :

Name :

Company's Seal :

Date :

ANNEXURE-16

[Reference Clause 3(i)]

Signed
Photograph of
Applicant

To be given on Non-Judicial stamp

Paper of Rs. 10/- only,

AFFIDAVIT

I/We…… Proprietor/ Partner/ Authorized signatory of M/s …… under take the oath that the information furnished by me/us in schedule I to VII of the assessment Bid for …… is correct to the best of my/our knowledge and nothing has been concealed by me. I acknowledge that if in future any information furnished by me is found incorrect I will be solely responsible and shall be punished as per the law and also any benefits in any form obtained by me shall be recoverable.

……

Proprietor/ Partner/ Authorized signatory

M/s …….

…….

Annexure-17

[Reference Clause – 19.1 (xii) of ITB]

DETAILS OF LITIGATION OR ARBITRATION CONTRACTS

S. No.	Name of Works (with agreement No. & Date)	Client	Work Order Amount	Disputed Amount Claimed in Litigation / Arbitration	Date of Raising Disputed Amount	Actual Award Amount, if the case is Decided	Cause of Litigation & matter in Dispute

Signature of Bidder

Signature of Contractor

Annexure-18

[Reference Clause – 19.1 (xiii) of ITB]

BID CAPACITY

Name of Bidder:- _____

1.	**A = Maximum value of civil Engineer works** **Executed in any one year during the last five years** **(Up dated to present price level)**	**_____ Lacs**	**Certified details enclosed at** **Page No. _____**
2.	**N = Number of years prescribed for completion of the work for which bids are invited**	----------	
3.	**B = Value, at present price level of existing** **Commitments and on going works to be** **Completed during the next N Period**	**_____ Lacs**	**Certified details enclosed at** **Page No. _____**

Bid Capacity = A x N x 3 – B

= _____Lacs

Signature of Bidder

Signature of Contractor

Scope of Work and Technical Specification

Volume-II

Scope Of Work & General Specifications

General Requirements

1. PREAMBLE

JAIPUR JDA AREA

1.1 Jaipur is located at 25°58 North latitude & 75°09 East longitude. Jaipur is 265 kms from Delhi and 250 kms from Agra**.** It is well connected with road, railway and Air.

1.2 The climate in the area is marked by the extreme conditions.

Climate of the town is typical of Desert with large variation in temperature during day and night. Maximum temperature during summer hours between 40ºC to 43ºC and minimum temperature fluctuates between 04o to 16o C during winter season.

1.3 The soil strata of Jaipur in general consists of sandy soil to SOIL mixed with kankar.

.

1.5 **Location, Capacity and Land Availability:**

JDA has earmarked a pieces of land for the proposed STP,s and associated works.

S.No	Location / Zone	Capacity(MLD)	Available land only for STP Works (Apprx.)
1	Smriti Van, Jhalana	1 MLD (STP)	900 Sqm

Allied works to be done with STPs for reuse in horticulture works.

1. Smriti Van

i) RCC clear water tank : 200KL capacity.

ii) RCC, OHSR : 500 KL capacity of 20 mtr staging.

iii) P/L/J of DI (K-7) pipe line for distribution of treated sewage : 900 Mtr of 150 mm diameter.
(Including earthwork and specials and valves)

iv) P/L/J of HDPE, PE 100 grade pipe line : 1.5 KM of 160 mm diameter
1.0 KM of 110 mm diameter

(Including earthwork and specials and valves)

1.0 SCOPE OF CONTRACT

The scope of work will be in general but not limited to Design, Detailed Engineering, civil, mechanical, electrical, instrumentation, interconnecting pipe works, testing, trail runs, commissioning and guaranteeing and operation and maintenance (including spares) of STPs as mentioned above as per detailed technical specifications and data sheet. The scope also includes geotechnical survey of plot to derive soil bearing capacity, strata classification and details of water table etc. The following shall be included in scope of work.

LOCATION OF PLANT:

The proposed sewage treatment plant is to be constructed as given above in the table.

The design of the proposed STP is based on the Cyclic Activated Sludge Process (SBR Technology), well established process and also approved by Indian Institute of Technology for treatment of municipal domestic sewage. The tenderers are to adopt the same nomenclature used for various treatment units in their design report as used in the tender documents.

The tenderer is required to fill up/complete the datasheets presented in Technical Bid as a part of tender submission. Any bid without filled in the datasheet shall be considered as non responsive and will be summarily rejected.

The bidder is advised to depute a suitable representative to visit and examine the site of works and its surroundings for fully understanding of the job and ascertain the difficulties that may be encountered during execution of the works and for obtaining for himself, on his own responsibility, all information that may be necessary for preparing the bid and entering into the Contract. The cost of visiting the site shall be entirely at bidder's own expense.

The bidder and any of its personnel will be granted permission by the Employer to enter upon its premises and lands for the purpose of such inspection.

Bidder has to collect the required data like soil investigation report, bore log data, topography, NGL, HFL and Discharge level of the final treated water etc at his own expenses if required. Drawings enclosed in this tender are indicative only. Bidder has to submit the actual hydraulic drawings, plant layout, piping & instrumentation diagram based on technically & commercially viable option based on the Cyclic Activated Sludge Process/SBR technology for biological treatment of sewage. Alternative process proposals will not be accepted.

The Scope of Work includes but not limited to the following Units:

- Primary Treatment Units comprising Inlet Chamber, Coarse Bar Screen Chamber.
- Biological Treatment Units based on Cyclic Activated Sludge Process/Sequential Batch Reactor (SBR) technology.
- Disinfection (Chlorination) Units comprising Chlorination Tank and chlorine dosing pump of suitable capacity/arrangement as well as Treated Effluent Disposal Pipe / Channel.
- Sludge Dewatering Units comprising of centrifuge system.
- Administrative Building including PLC/SCADA cum MCC & Control Building with required furniture with suitable capacity of air condition and attached lath-bath.
- Required Landscaping & leveling.
- Allied works for horticulture purpose as per scope of work ,D.I. K-7,upvc,hdpe pipeline and R.C.C. OHSR and Treated water tank.

The tenderers are requested to adopt the same nomenclature used for various treatment units in their design report as used in the Tender documents. The Tenderer is required to fill up/complete the datasheets presented in Technical Bid as a part of Tender submission. Any Bid without filled in the datasheet shall be considered as non responsive and will be summarily rejected.

2.0 SCOPE OF WORK:

2.1 BRIEF SCOPE OF WORK

The Contractor shall ensure the technical feasibility of his Offer submitted after visiting the Site. It must be clearly understood that as the Contract is a "Turnkey Contract", the Contractor shall design and execute every such Item(s) of Work(s) which are considered required or necessary for the satisfactory completion and functioning of the entire Plant including Operation & Maintenance of the plant even if such Item(s) of Work(s) are not specified in the Bid documents, but are essential to complete the Plant.

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

- Providing, supplying and installing 2nos. (1 W + 1 S) non clog submersible pumping machineries at raw sewage pumping station along with all required valves and specials with supplying, jointing, lowering suitable dia., suitable CI.pipe from sump up to the Inlet Chamber of proposed STPs.
- Providing & installing ONE ultra sonic type flow measuring system to measure the sewage flow to the proposed STP and after treatment shall be measured by SCADA during decanding for reuse.
- Treated water from CWR(treated water Tank) shall be pumped to proposed RCC OHSR for further horticulture purpose use. Providing,laying & jointing of distribution pipelines-D.I. K-7,upvc,HDPE for reuse purpose.

- **Note: Rising main shall be designed for peak flow of the proposed STPs.**
- Design, Construction, Supplying, Erection, Testing and Commissioning of Sewage Treatment Plant (STP) including but not be limited to the following works:
- Topographical and Geotechnical Survey including Subsoil Investigation for Water Table and Safe Allowable Bearing Capacity. The Contractor through a reputed and specialist

firm approved by Executive Engineer for confirmation of Geotechnical data shall carry out subsoil Investigation.

- Site Development including but not be limited to the following works:
- Cutting of unwanted Tress, Plants, Bushes and Shrubs etc. and removing the same form Site. **However, the Employer shall arrange necessary approval for the same.**
- Demolishing the existing Structures and removing the debris from Site.
- Shifting of Pipe Lines, Cables and Poles etc. if required.
- Level dressing of the undulated portion of the proposed STP site.
- Levelling and grading to improve the aesthetics and to facilitate the vehicular movement.
- Arranging Construction Power & Water.
- Construction of temporary Labour Shelters nearby Site.
- Preparation of Process, Hydraulic, Civil, Mechanical, Piping, Electrical and Instrumentation Design and Drawings including Construction, Architectural and As-built Drawings.
- Construction of Civil Engineering Works for all the Process Units, Buildings and Plant Drains etc. as detailed in Civil Specifications. Layout shall be made in such way that all Process Units and Buildings are interconnected and can be accessed from one Point.
- Hydraulic testing of all water retaining structures after applying the epoxy painting.
- Providing Plinth Protection along the periphery of all the Process Units & Buildings shall be provided as detailed in Civil Specifications.
- Providing Internal and External Plaster to Buildings as detailed in Civil Specifications.
- Providing Internal Black Anti Corrosive Bitumastic Paint and External Water Proof Cement Paint to all Process Units.
- Providing Internal Acrylic Washable Paint and External Acrylic Smooth Exterior Paint to all Buildings.
- Providing Rolling Shutters, Doors and Windows & Ventilators in all Buildings.
- Providing External Epoxy Paint to all Steels Works made of MS or GI.
- Providing GI Hand Railing along all the Stairs and Walkways of all Process Units
- Testing of parameters for raw and treated sewage as mentioned in Clause.
- Supply, Erection, Testing & Commissioning of all the Mechanical Equipment as detailed in Mechanical Specifications.
- Obtaining incoming Power Supply from State Electricity Authority from nearby Source to the STP Site. **However, necessary Deposits shall be arranged by the contractor and shall be reimbursed to the contractor.**
- Supply, erection, testing & commissioning of all the Piping, Gates & & Valves as detailed in Mechanical Specifications.
- Supply, Erection, Testing & Commissioning of all the Electrical Equipments including HT/LT Equipments as detailed in Electrical Specifications.
- Supply, Erection, Testing & Commissioning of all the Instrumentation Equipments as detailed in Electrical Specifications.
- PLC/PC/SCADA based Automation System for STP as detailed in Specifications.
- Supply, Erection, Testing & Commissioning of Safety Equipments at required locations including Safety Showers, Sand Buckets, Fire Extinguishers, Fire Alarms etc.
- Planting of Trees and Plants / Landscaping.
- Trial Run of the constructed & hydraulically tested Plant along for a period of Three (3) months and Operation & Maintenance (O & M) for 36 months after Trial Run as per Tender specifications.
- Supply of all Spares, Tools & Tackles required during Performance Run and O & M Period.
- Repairing & reconditioning of all the Equipments in the concluding year of the Operation & Maintenance Period to such a condition that they are in running condition with regular preventive and recommended maintenance.
- Providing "on the job" training to the Employer's personnel.
- Defects Liability Period of 12 months from the date of successful completion of Performance Run.
- Preparation and submission of As-Built Drawings and Operation & Maintenance Manuals for Mechanical, Electrical & Instrumentation Items.
- **Operation and maintenance of sewage treatment plant after successfully commissioning for a period of three years.**

Suitable wire mesh fencing for the STP land as directed /approved by Engineer – In-Charge.

Vehicle: The contractor shall provide I vehicle with pol (SUV-6 seater) for supervision to be done by JDA (as approved by engineer in charge) upto completion of project/work.

2.1.1

Providing qualified and experienced consultant exclusively to JDA who will assist them for checking and approval of design and drawing and also for

execution of work. The scope of work of consultant shall be defined in volume 01. The contractor shall submit a panel of consultants after award of the job and JDA shall select appropriate consultant from the panel. Payment of consultants' fees would be the responsibility of contractor, which shall be maximum up to 1.0% of price quoted for STP. However, being a principal employer, JDA shall have right to ensure timely payment to consultant by the contractor for which successful bidders shall submit proof of payments to JDA while raising the bill.

The consultant shall have experience of designing and detailed engineering of minimum 2 nos. of sewage treatment plants up to 5 MLD capacities in last 15 years. He should also have an experience of three years in operation and maintenance of sewage treatment plant of 2.0 MLD or more in last 15 years. He should have the following technical personnel for the design / approval of the engineering/ drawing.

- ✓ **Process engineer / Environmental Engineer : The Engineer shall be post graduate in the environmental engineering with min. 10 years of experience in the design of sewage / water / waste water treatment plants.**
- ✓ **Structural Engineer: The Engineer shall be post graduate in the structural engineering with minimum 10 years of experience in the design of sewage / water / waste water treatment plants.**
- ✓ **Mechanical Engineer: The Engineer shall be post graduate in the mechanical engineering with minimum 10 years of experience in the design of sewage / water / waste water treatment plants.**
- ✓ **Electrical/Electronics/ instrumentation Engineer : The engineer shall be graduate in the electrical / instrumentation engineering with minimum 10 years of experience in the design/ execution of sewage / water / waste water treatment plants.**

- **In addition to the above, the consultants must have average receipt of consultancy fees as Rs.10 lacs during last three years ending March 2015.**

Any other Items which have not been specifically mentioned in specifications but are necessary for construction of the Plant as per good engineering practice, safety norms and successful operation and guaranteed performance of the entire Plant shall be deemed to be included within Scope of Work and shall be provided by the Contractor without any extra cost to the Employer.

The Bidders are advised to visit the STP site before quoting for the proposed STP. JDA is reserved the right for physical verification for the credentials provided by the bidder if required. In such case all the expenses shall be borne by the bidder. The designs and drawings of OHSR(Overhead Service Reservoir) are required to be approved from MNIT,Jaipur/MBM, Jodhpur at contractor's cost and in conformation with CPHEEO specifications and Indian Standards, before submitting them to JDA.

The above works shall be completed within 9 months from the commencement date followed by 3 months trial run including monsoon period and O & M for 36 months.

2.2 PROPOSED TREATMENT SCHEME

2.2.1 Raw Sewage Pumping Station

Sewage/drain generated shall be received in wet well of raw sewage pumping station at STP site. It is proposed to install total 2 nos. (1 W + 1 S) non clog submersible type of pumps to pump average flow of raw sewage in to the proposed Inlet Chamber of Sewage treatment Plant based on SBR process. It shall be accomplished by providing suitable Dia pipeline as per scope of work.

2.2.2 Inlet Chamber

Raw Sewage from STPs Sewage Pumping Station shall be received into the Inlet Chamber from where it will be taken into downstream Fine Bar Screen Chamber. The function of the Inlet Chamber is to reduce the incoming velocity. It shall be of adequate

size to meet the requirements of workability inside it. It shall be water tight to prevent seepage of the sewage outside.

2.2.A Coarse Screen Channels

Two units of coarse screen channel designed for peak flow shall be provided along with CI sluice gates at upstream ends to regulate the flow.

Adequate RCC Platform shall be provided at the upper level to enable operation. Railings shall be provided around the entire periphery of the platform. The entire structure shall be min in M30 grade concrete and as per IS 3370. RCC Staircase, 900 mm wide, shall be provided for access from the ground level to the top of the Unit & to the operating platform.

Particulars	**1 MLD STP**
Average Flow	1 MLD
Peak Factor	1.0
Number of Units	2 No. (1 Working + 1 Standby)
Approach Velocity at Average Flow (m/sec)	0.30
Velocity through Screen at Average Flow (m/sec)	0.6 maximum
Velocity through Screen at Peak Flow (m/sec)	0.9 to 1.2 maximum
Min Freeboard	0.50
MOC	SS – 304
Flat bar size	6mm x 50mm
Clear spacing of flat bars	40 mm

2.2.3 Fine bar screen chamber

Fine bar Screens Channels shall be provided upstream of fine bar Screens should be capable to screen out most of the small floating materials above 6 mm size. The screenings shall be dropped on the Conveyor Belt installed at the top of the Fine Screens Channels. The screening material as collected will drop automatically into wheel Barrows for its disposal.

2.2.4a Grit Removal Unit

One no. manual & one no. mechanical Grit Chamber of peak flow capacity shall be provided after Fine Screen Channels. It shall have the following:

1. One tapered Inlet Channel running along one side with Deflectors for entry of sewage into the Grit Chamber. The minimum SWD shall be 0.9 m.
2. One tapered Outlet Channel for collecting the de-gritted sewage which shall overflow over a weir into the Outlet Channel.
3. One sloping Grit Classifying Channel into which the collected grit shall be classified.
4. The grit from Classifier shall be collected in a wheeled Trolley.
5. A grit Scraping Mechanism.
6. Adjustable Influent Deflectors.
7. Reciprocating Rake Mechanism to remove the grit.
8. Organic Return Pumps

CI Sluice Gates shall be provided at the entrance of the Grit Chamber. To enable easy operation of the Gates, RCC Platform with GI Railing shall be provided at the upper level. The entire construction shall be in M25 grade concrete and as per IS 3370.

Particulars	As per scope
Average Flow	As per scope
Peak Factor	1.0
Peak flow	As per scope
Number of Units	2 No. (1W+1S)
Type	100% peak flow capacity
Size of grit particle	0.15 mm
Specific gravity of grit	2.65
Maximum Surface Overflow Rate	960 m3/m2/day
Freeboards	0.5m
Side Water Depth	0.9 m

2.2.5 Sequential Batch Reactor (SBR) Units

- Primarily treated sewage shall be fed into the Sequential Batch Reactor (SBR) Process Basins for biological treatment to remove BOD, COD, Suspended Solids, Biological Nitrogen and Phosphorous.
- Sequential Batch Reactor (SBR) shall work in Cyclic / Batch mode in single step. It shall perform biological Organic Removal, Nitrification, De-nitrification and Biological Phosphorous Removal and shall be capable of simultaneous sludge stabilization. The oxygen required shall be supplied through fixed type Fine Bubble Diffused Aeration System with auto control of oxygen level in the Basins. The system shall have a SVI <120 for higher settling rates and should be designed in such a way that growth of filamentous bacteria is restricted. The complete operation including Filling of Sewage, Aeration, Sludge Recirculation, Decanting and Wasting of Excess Sludge shall be controlled by PLC. Treated sewage from Sequential Batch Reactor (SBR) Units shall be collected in Chlorination Tank for its disinfection.

2.2.6 Chlorination Units

- Treated sewage from Sequential Batch Reactor (SBR) Units shall be collected in a Chlorination Tank where disinfectant will be added for disinfection at suitable dosing rate. Baffle walls shall be provided in the Tank to facilitate hydraulic mixing of treated sewage. Adequate reaction time shall be provided to ensure proper disinfection of treated sewage.

Chlorinated sewage from Chlorination Tank shall be discharged to the CWR and shall be pumped to proposed OHSR. From proposed SR treated effluent shall be used through proposed pipe line network for horticulture work.

Sludge Sump and Pump House

Sludge Sump (if required) shall be provided to collect the excess sludge from SBR Process Basins.

Sludge Sump shall be constructed as per IS 3370.

Above/Adjacent to Sludge Sump, there shall be a Pump House as per process requirement if required. This shall be RCC frame and brick masonry structure. Minimum height of the Pump House shall be 3.0 m from the plinth level. It shall be provided with Rolling Shutter, Doors and Windows as per technical specifications. Hoist of suitable size shall be provided in the Pump House to lift the pump assembly.

Pump House shall be plastered inside and outside as per Tender specifications painted with approved color and make as directed by Engineer.

Number of Units	:	1
Free Board	:	0.5 m
Retention time	:	4 hrs

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

Sludge Pumps

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

Type	:	Screw
Liquid	:	Bio Sludge of 1-2% solids consistency
Specific Gravity	:	1.05
Solid Size	:	65 mm (Maximum)
Temperature	:	Min. 20° C
Efficiency	:	More than 30%
Installation	:	Fixed
Quantity	:	2 Nos. (1W + 1S)

Stainless steel air line of 20 mm dia shall be provided from Air blower of Aeration tank.

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

- **Centrifuge**

The dewatering of the sludge will be carried out in Centrifuge. The Centrifuges shall be housed in an encloser/elevated platform such that the dewatered sludge falls directly on to the trolley/Cart to be taken for disposal.

A Polyelectrolyte dosing system comprising of tanks, Agitators and Pumps has to be provided to dose Dewatering Polyelectrolyte at the Centrifuge inlet to aid sludge dewatering.

2.3 DETAILED SCOPE OF WORK

2.3.1 Design Basis:

Sr. No.	Design Parameters	Capacity
1	Average Flow	As per scope
2	Peak Factor	1.0
3	Peak Flow	As per scope

2.3.2 Raw Sewage Quality:

An abstract of Raw Sewage Characteristics is indicated in the following Table:

Sr. No.	Parameters	Values	UOM
		For all STP,s	
1	Biochemical Oxygen Demand (BOD)	200-250	mg/l
2	Chemical Oxygen Demand (COD)	400-500	mg/l
3	Total Suspended Solids (TSS)	250-300	mg/l
4	Total Kjeldahl Nitrogen (TKN)	45	mg/l
5	Total Phosphorous (TP)	5	mg/l
6	pH	6 to 8.5	----

The waste water reaching at Smriti Van Pond is a mixture of raw sewage & drain from Jawahar Nallah & Jhalana Nallah.

The Bidder shall carry out the sampling tests of raw sewage by themselves to ascertain the raw sewage quality for treatment process. The Employer will not be responsible for the above and no relaxation will be given to the guarantee conditions of desired treated effluent quality. For design purposes the lower parameters than the above mentioned parameter will not be allowed.

2.3.3 Treated Sewage Quality:

The Contractor shall design the process in such a way that the treated effluent quality attains the following limits or even better:

Sr. No.	Parameters	Values
1	Biochemical Oxygen Demand	10 or less mg/l
2	Chemical Oxygen Demand (COD)	50 or less mg/l
3	Total Suspended Solids (TSS)	10 or less mg/l
4	Nitrate Nitrogen NO3-N (as N)	10 or less mg/l
5	Total Phosphorous (TP)	1 or less mg/l
6	Feacal Coliform	100 or less MPN/100 ml
7	pH	7.0 to 8.0

Since Nutrients (Nitrogen and Phosphorous) if present in the treated sewage discharging into a Water Body encourage an abnormal increase in the growth (blooms) of Algae called Eutrophication, which causes foul smells and odors as well as depletion of oxygen in the Water Body. So it is imperative that Nitrogen and Phosphorous also need to be removed before the treated sewage is discharged and Total Nitrogen (as N) ≤ 10 mg/l and Total Phosphorous (as P) ≤ 1 mg/l shall be ensured at the Outlet of Sequential Batch Reactors. **Bidder must have to adopt the proven /successful SBR technology who is meeting the standard of treated sewage as above in Indian conditions for at least last two years.**

2.3.4 Technical Specifications

1.0 Raw Sewage Pumping Station

Sewage trap from existing sewer/drain shall be received in the sump of raw sewage pumping station. The entire construction shall be in **M 30** grade reinforced cement concrete and as per IS 3370. RCC Staircase, minimum 1.00 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway. It is proposed to install total 2 nos. (1 W + 1 S) non clog submersible type of pumps to pump required quantity as per scope, of raw sewage in to the proposed Inlet Chamber of Sewage treatment Plant based on SBR process. It shall be accomplished by providing Suitable dia pipeline as per scope of work. One no. of ultra sonic type of flow meter shall be installed for measuring the incoming flow to the proposed STP.

- Design Flow : As per scope
- Peak Factor : 1.0
- Detention time : 30 min at peak flow
- No. of pumps & Capacity : (1 No. Working +1 No. standby) as per design

- Type of pumps : Submersible type non-clog design
- Head : 20 m
- Solid passage size through pumps : 100 mm max.
- Insulation : Class F
- Protection : IP-68

2.0 Primary Treatment Units

Primary Treatment Units comprising Inlet Chamber,coarse bar screen channel,grit removal unit, Fine Bar Screen Channels. The Inlet Chamber, Coarse Bar Screen Channels shall be designed for Peak Flow.

2.1 Inlet Chamber

Inlet Chamber will receive raw sewage from Raw Sewage Pumping Station. It shall be designed for Peak Flow. The entire construction shall be in **M 30** grade reinforced cement concrete and as per IS 3370. RCC Staircase, minimum 1.00 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway.

- Average Flow : As per scope
- Peak Factor : 1.0
- Peak flow : As per scope
- Number of Units : 1 No.
- Hydraulic Retention Time : 60 Sec
- Free Board : 0.50 m min.

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope.

2.2 Mechanical & Manual Fine Screen Channels

One Mechanical Fine Screens (Working) and one Manual Fine Screen (Standby) shall be provided in Fine Screen Channels. Each Fine Screen Channel shall be designed for Peak Flow. The entire construction shall be in **M 30** grade reinforced cement concrete and as per IS 3370. RCC Staircase, minimum 1.20 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway. The clear opening shall be 6 mm for Mechanical Fine Screen and 10 mm for Manual Fine Screen. The Mechanical and Manual Screens shall be made of SS 304 flats. Conveyor Belt and Chute arrangement shall be provided to take the screenings. Screenings dropped from Chute shall be collected in a wheel Burrow. Manually operated Gates shall be provided at to regulate the flow.

- Average Flow : As per scope
- Peak Factor : 1.0

- Number of Units : 1 Mechanical + 1 Manual each of Peak Flow capacity.
- Approach Velocity at Average Flow : 0.30 m/s
- Velocity through Screen at Average Flow : 0.60 m/s max.
- Velocity through Screen at Peak Flow : 1.20 m/s max.
- Free Board : 0.30 m min.
- Wheel Barrow : 1 No. min.

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope.

3. Sequential Batch Reactor (SBR) Units

3.1 Process Design

- Sequential Batch Reactor (SBR) Units shall be installed and equipped for average flow as defined in scope of work.
- The SBR Process shall have following independent steps without overlapping each other:
  - ¾ Fill & Aeration
  - ¾ Settling (Sedimentation/Clarification)
  - ¾ Decanting (Draw)
- Since it is Batch Process, Filling during Settling or Decanting will not be acceptable.
- The complete biological system shall be designed for handling peak flow.
- Suitable Nos. of SBR Basins with adequate volume shall be provided. In addition, 0.50 m Free Board shall be provided to each Basin. Maximum Liquid Depth of each Basin shall be restricted up to 5.50 m.
- The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370. RCC Platform/Walkway, minimum 1.20 m wide with Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.20 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway. Plinth protection along periphery shall be provided as per technical specifications.
- The system should work on a gravity influent condition.
- The system should be designed for maximum F/M ratio between 0.1 - 0.18 Kg BOD/Kg MLSS day.
- MLSS maintained in the Basin should range from 2500 to 4000 mg/l.
- Cycle times shall be selected adequately by the Bidder considering min. 12 hrs/day Basin of aeration and not exceeding decanting of 2.40 m liquid depth at any time with preferred cycle times containing max. 50% not aerated portion.
- The excess sludge produced shall be fully digested. Sludge production (including percipients) rate shall be about 0.60 – 1.20 Kg / Kg of BOD removed. A minimum aerated SRT of 10 days shall be maintained to ensure digested sludge.

3.2 Decanting Device

The Decanting Device shall be Moving Weir Arm Device of SS 304 with top mounted Gear Box, Electric Drive, Scum Guard, Downcomers, Collection Pipe, Bearings.

- The following types of decanter assemblies are not acceptable:
  - ¾ Rope Driven Decanters.
  - ¾ GRP Products.
  - ¾ Valve Arrangement.
- The maximum design travel rate shall be 60 mm/min with proven hydraulic discharge capacity of the decanter proportional to the selected Basin area.
- There should be maximum one (1) Decanter per Basin.
- The hydraulic design based on design flow rate as given above shall not exceed flow speed of 1.30 m/s.
- Flexible rubber hose kind of decanter sealing is not acceptable.
- Each Decanter shall be inclusive of local control boxes with manual operation selection and function buttons and communication to main PLC by DH485 or Ethernet.

3.2.1 Aeration System

The aeration facility shall be installed for average flow as per scope of work.

Only Fine Bubble Type, EPDM / PU Membrane Diffusers shall be acceptable with minimum Membrane Diffusers to Floor Coverage Area of 5%. Combination of aeration techniques using Aerators/Submersible Mixers etc. is not acceptable. Diffusers shall be submerged, fine bubble / fine pore, high transfer efficiency, low maintenance and non-buoyant type. Diffusers shall be panel / tubular type. In case tubular type Diffusers are used, only top half surface area of the Diffuser shall be considered for supply of air. Material of construction for entire under water system including accessories shall be of non corrosive. Complete Diffuser as a unit shall be assembled at the manufacturing factory level. The grid supports shall of adjustable type made of SS 304.

The Air Blower Arrangement shall be capable of handling Total Water Level and Bottom Water Level operation conditions controlled by process sensors such as DO, Temperature and Level.

Each set of Air Blowers shall have dedicated standby. Minimum one working Air Blower in each set shall operate via VFD while others may be operating at a fixed constant speed on soft starter configuration.

The Air Blowers shall be positive displacement (Roots) type and head for Air Blowers shall be decided on the basis of S.O.R. of Diffusers and maximum Liquid Depth in Basin duly considering the losses governing point of delivery (Diffusers) and the Air Blowers. Air Blowers shall be complete with Motor and accessories like Base Frame, Anti Vibratory Pad, Reactive Silencer, Non Return Valve, Air Filter etc. as per requirements. Further, Air Blowers shall have acoustic enclosure to ensure that the noise level at 2.00 m from Air Blowers is below 85 db. The Air Blower House shall have Rolling Shutter, Windows, Exhaust Fans, Safety Equipments with sufficient Ventilation, Lighting and Working Space. It shall be equipped with sufficient capacity Electrical Hoist with Travelling Trolley (Min. 3 Ton or 1.5 times the weight of Air Blower whichever is more) to facilitate removal of Air Blower / other Accessory for repairs.

The operation of Aeration System shall include PLC based control. The operation and speed of Air Blowers shall be automatically adjusted using parameters like Oxygen Uptake Rate, Dissolved Oxygen and Temperature and Liquid Level in the Basin such that the DO is supplied as per demand and power utilisation for operation of Air Blowers is optimised.

The main Air Header/Ring Main shall be in MS as per relevant IS Code, painted with corrosion resistant paint as per Manufacture's recommendations. The Air Header/Ring Main shall be supported on saddles at suitable intervals or shall be protected against external corrosion in case laid below ground. The Sub-header shall have Auto Valves to facilitate switch over of Aeration Cycle from one Basin to other by PLC. The Sub-header shall supply air to Diffuser Grids at various locations through vertical Air Supply Pipes. These Air Supply Pipes above water level shall be in MS, painted with corrosion resistant paint and below water shall be in SS 304. All under water Lateral Pipes shall be of UPVC. Junctions between horizontal Sub- header and vertical Air Supply Pipes shall be suitably protected against corrosion due to dissimilar materials.

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope.

3.3 Return Sludge and Excess Sludge Pumps

Dedicated Return Sludge and Excess Sludge Pumps shall be provided in each SBR Basin. The Pumps shall be of submersible / horizontal centrifugal type suitable for handling biological sludge of 0.8 – 2% solids consistency. Capacity and Heads shall be decided based on process requirements. Each Basin shall be provided with suitable lifting arrangements to facilitate lifting of these Pumps if required for maintenance.

a. Return Sludge Pumps

- Capacity and Head : As per requirements

- Type : Submersible / Horizontal Centrifugal
- Liquid : Bio-sludge of 0.8 – 2% solids consistency
- Specific gravity : 1.05
- Solid size : 40 mm (Maximum)
- Temperature : Min. 10° C
- Efficiency : more than 50%
- Quantity : 1 No. per Basin + 1 No. Store Standby

b. Excess Sludge Pumps

- Capacity and Head : As per requirements
- Type : Submersible / Horizontal Centrifugal
- Liquid : Bio-sludge of 0.8 – 2% solids consistency
- Specific gravity : 1.05
- Solid size : 40 mm (Maximum)
- Temperature : Min. 10° C
- Efficiency : more than 50%
- Quantity : 1 No. per Basin + 1 No. Store Standby

3.4 Automation and Control

PLC based Automation System with application software based on Rockwell or equivalent to control SBR System including all Gates, Air Blowers, Pumps, Valves and Decanters as per Bidder's/Technology Provider's own design including I/Os with 20 % Spares and UPS.

HMI Panel shall comprise latest Personal Computer with 22" LCD Monitor, Multi Media Kit, Printer, Internet Connection, RS-View, RS-Links (Gateway Version), Process and Operator Software with dynamic Flow Charts, Pictures, Screens, Alarms, Historical Trends, Reports etc.

SCADA based Automation System to monitor the following parameters continuously in each SBR Basins:

- ¾ Fill Volume
- ¾ Discharge Volume
- ¾ Temperature
- ¾ DO Level
- ¾ Oxygen Uptake Rate
- ¾ Air Blower Speed
- ¾ Decanter Speed

4. Disinfection (Chlorination) Units

Disinfection (Chlorination) Units including Chlorination Tank shall be designed for Average Flow.

Treated sewage from SBR Basins shall be taken to Chlorination Tank by RCC Channel/RCC Pipe of Class NP3.

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope.

4.1 Chlorination System

Sodium hypochlorite solution will be used as disinfectant suitable dosing pumps along with all the necessary arrangements shall be provided by the contractor.

- Design Flow : As per scope
- Type : As approved by EIC
- Chlorine Dosing : 5 ppm minimum
- Dosing/Feeding pumps : 2 Nos. (1Working + 1Standby)

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope.

4.1 A Clear water tank(Treated water Tank) and OHSR filling pumps (1 working and 1 standby),Type and duty condition as per design and approved by engineer in charge.

5.0 Mechanical Dewatering Unit

5.1.1A Specification of Multi-Diskplate Screw Press type centrifuge

Multi-Diskplate Screw Press shall have a flow control tank to fix sludge flow and a water level adjuster to return the excess amount of sludge when necessary. Multi-Diskplate Screw Press shall have a flocculation tank(s) to mix sludge with polymer to separate solids and liquid. Sludge feed pump and polymer feed pump shall be interlocked with the equipment. The main body of Multi-Diskplate Screw Press shall have a drum being composed of accumulated rings and a screw going through inside the drum. Solids and liquid shall be separated by the pressure caused by the screw. Filtrated water shall be discharged from the first part of the drum, from the gaps between the accumulated rings. The accumulated rings shall be sorted into two types; moving rings and fixed rings. The internal diameter of the moving rings shall be smaller than the diameter of the screw so that the screw shall push the internal edges of the moving rings. The moving rings move continuously in the gaps between the fixed rings when the screw rotates, which shall clean the gaps and prevent clogging. The separated solids shall be discharged from the end of the drum. Multi-Diskplate Screw Press shall dewater directly thin sludge with its concentration at 0.2% at minimum, discharge sludge cake with its solids content at 15% at minimum and catch 90% solids fed. The main material of Multi-Diskplate Screw Press shall be SS304. The noise caused by Multi-Diskplate Screw Press shall be 65dB and the vibration caused by Multi-Diskplate shall be 50dB.

Centrifuge shall be installed over a 50 mm thick concrete platform with 1:1.5:3 CC over 100 mm thick 1:4:8 CC. A shed over the platform shall be provided with CGI roof shelting.

OR

5.1.1B **The Mechanical Dewatering Unit shall be Solid Bowl Centrifuge designed so as to give a 100% trouble free operation at all times.**

- The Dewatering System shall be so located that the dewatered sludge can be loaded into Trolleys / Drums / Bins directly. Preferably the Dewatering Unit shall be so located that the dewatered sludge falls into the Containers/ Bins without requirement of another Material Handling Unit.

- The dewatered sludge shall be truckable & be suitable for disposal by open body Truck and shall have minimum solid concentration of 20% or more (measured as dry solids w/w basis).

  The Centrifuge Building shall be G (Stilt) + 1 type RCC Frame Brick Masonry structure required as per requirement. The First Floor shall house Centrifuges. The configuration shall be such that the wet cake discharge shall be discharged through single central Chute to the parked Trailer/Lorry below.

The Centrifuge shall be solid bowl type of co-current/counter current design. The Centrifuge shall have sufficient clarifying length so that separation of solids is effective. The Centrifuge and its Accessories shall be mounted on a common base frame so that entire assembly can be installed on an elevated structure.

Suitable drive with V-Belt arrangement and Turbo Coupling shall be provided along with Overload Protection Device. Centrifuge shall have SS 304 wetted parts.

Differential Speed and Bowl Speed shall be adjusted by changing the Pulleys. Differential speed may be adjustable by use of epicyclical gear. The Bowl shall be protected with flexible connections so that vibrations are not transmitted to other Equipments. The base frame shall be MS epoxy painted and provided with Anti Vibration Pads. All steps necessary to prevent transmission of structure borne noise shall be taken. The drive Motor shall be of 1450 RPM. The noise level shall be 85 dB (A) measured at 1 m distance under dry run. The vibration level shall be below 50 micron measured at pillow blocks under dry run condition. Adequate sound proofing shall be carried out for housing the Centrifuges to ensure that the noise level at 5 m distance from the enclosure is less than 75 dB (A).

An Electrical Hoist with Trolley shall be provided above for maintenance purpose.

Number of Centrifuges : 2 Nos. (1 Working + 1 Standby)

Type : Horizontal

Capacity : As per design

Mixing arrangement of Polyelectrolyte and Sludge : Online mixing

Sludge cake consistency : not less than 20%

OR

The drum thickener belt-type filter press mono-block machine is a comprehensive sludge thickening and dewatering equipment c/w integral sludge conditioner, drum thickener and belt-type filter press machine.

5.1.1C Working Principle

i) Sludge Thickner

Normally the sludge is further concentrated by a gravity thickener to about 3% solid content before being pumped to the belt press for dewatering.

ii) **Sludge Conditioning**

Polymer is injected into the thickened sludge in order to make larger flocs of sludge. The type of polymer to be used depends on the nature of the sludge.

iii) **Rotary thickener**

The conditioned sludge is first fed to the rotary thickener of the belt press. The purpose of the rotary thickener is to remove excessive free water quickly to facilitate the further thickening of the sludge.

iv) **Gravity Dewatering Zone**

After existing the rotary thickener sludge will reach the gravity dewatering zone, which allows initial dewatering by gravity.

v) **Wedge Pressure Zone**

After the gravity dewatering zone, sludge is gradually carried into wedgs press dewatering zone and pressed into wedge-shape between two belts.

vi) **High Pressure Dewatering Zone**

The partially dewatered sludge then enters into the high pressure dewatering zone, where a number of S-type rollers from the sludge cake by applying high pressure between the belts.

vii) **Sludge Cake**

The dewatered sludge normally has a water content of between 68-86%, depending on the type and nature of the sludge.

viii) **Pneumatic System**

Sludge thickening and dewatering machine is equipped with a pneumatic system (excluding air compressor). The system can regulate the tension and correct the off-tracking of the belt. The tension and offset are controlled by two separate tubing systems, with individual air pressure reading and adjustment for each system.

The tension of the belt is constant and will not change with the feed-in sludge. Pneumatic system can show the belt tension. All the appurtenant components of pneumatic system such as pressure gauge, reducing valve and isolation valves are made of stainless steel for long service life.

ix) **Cleaning system**

Both the upper and lower belt has a set of cleaning device; filtered water is used as wash water. The belt is continuously cleaned by water jet from the cleaning device. A pressure gauge is provided to show the pressure of the flow. Spray nozzles are easy to change.

Model	**For 1 MLD**
Belt effective width (mm)	500
Drum diameter (mm)	400
Belt speed (m/m)	2 – 8
Mixer Rated power (HP)	1/ 4 x 4P
Drum thickener rated power (HP)	1/ 4 x 4P
Belt-type filter press machine rated power (HP)	1/ 2 x 4P
Cleaning water pressure (Bar)	5.0
Cleaning water amount (m^3/h)	3.8

Nominal treatment capacity (m^3/hr)	1-3 m^3/hr (Dry sludge 45 kg/hr)
Size (LWH mm)	2439 x 1047 x 1881
Weight (kg)	1050

Major Performance Parameters

Feed Sludge Characteristics		
1	Feed-in nature	Municipal sludge and industrial sludge
2	Feed-in moisture content	≤ 99.5%
System Performance		
1	Cake moisture content	≤80% (Depend on feed solid concentration)
2	Solid recovery rate	≥98%
3	Noise Level	≤75 db (A)
4	Polymer Dosage	1-3 kg per ton of dry sludge

5.1.1D

The mechanical dewatering unit shall also be of Basket Type Centrifuge designed to STP's based on SBR and to give a 100% trouble free operation at all times. The dewatered sludge shall have minimum solid concentration of 20 % or more (measured as dry solids w/w basis).

Number of Centrifuges : (1 Working) + 1 No. (Standby)

Operating Hours : 12 hrs per day maximum

The centrifuge shall be 3 point suspended Centrifuge vibration of centrifuge are absorbed by heavy duty. Suspension spring mounted in Pendulum with bolts. The centrifuge shall have a dynamically balanced rotating basket for easy removal of filter bag with solid material.

5.2.2 Polyelectrolyte Dosing System

The Polyelectrolyte will be dosed online at the Centrifuge inlet. Minimum dosage of Polyelectrolyte shall be 1.2 - 1.5 kg/T of dry solids in sludge at 0.1% solution strength. There shall be two Polyelectrolyte Dosing Tanks each suitable for minimum 8 hrs of operation. Each Polyelectrolyte Dosing Tanks shall be equipped with slow speed Mixer (100 RPM) to prepare Polyelectrolyte solution. The solution will be fed using positive displacement type Dosing Pumps. There shall be dedicated Dosing Pumps to each Centrifuge with one common standby. The pumps shall be interlocked with Centrifuges so that it can only be running in auto when Centrifuge is on and should shut down when Centrifuge stops.

6.0 Plant Utilities

6.1 Schedule of Finishes

Sr. No.	Unit	Flooring	Doors	Windows / Ventilators
1	SBR Air Blower House, & Tool Room, Chlorinator House, Sludge Pump Houses, Electrical HT Substation,	IPS Flooring with Abrasion Resistant Additives of approved make	MS Rolling Shutter (See Through Type) of approved make	Aluminum of approved make
2	Centrifuge Platform	Anti Skid Tile Flooring of approved make	---	---
3	Toilet Blocks	Coloured Glazed	UPVC of approved make	UPVC of approved make

6.2 Treated Sewage Disposal

Treated sewage collected in to the chlorination tank shall have to be used for gardening purpose. Bidder has to supply, joining, lowering D.I. K 7 pipe line of suitable dia from Chlorination tank to the proposed Treated water tank, OHSR as per scope of work for further horticulture work. The scope of work include providing and fixing of suitable duty condition CWR and OHSR filling pumps as approved by engineer in charge with electro mechanical work.

6.3 Disposal of Plant Residuals Treated Effluent

Plant Residuals (Screenings, Grit and Dewatered Sludge) and treated effluent shall be the property of the Employer. However, the Contractor shall be responsible for disposal of Plant Residuals within 5 Km from Site as directed by EIC. Treated sewage shall be discharged into nearby proposed Underground tank. The Contractor may sell off the Dewatered Sludge but at the discretion of the Employer.

6.4 Landscaping

Landscaping involves beautification of Sewage Treatment Plant site by cultivating lands, plants and trees of environmental value and suitably modifying the appearance of STP site. It shall add scenic value to the STP site to obtain maximum visual impact.

Contractor has to develop proper landscaping in the STP site from professional landscaper approved by OWNER. Area for future expansion shall also be considered for landscaping.

Plantation

Plantations are to be done all along the boundary wall just to provide a barrier. Big trees should be planted 3m apart from each other within a 5m wide. Space adjustment should be done taking the site condition into consideration. Cubical pit of 60cm should be proposed and should be filled with good soil mixed with 2 go 4 baskets of 5 kg each of well decomposed manure. The ground should be well prepared in between by digging it about half metre deep with removing all stones and weeds. The trees should be planted at suitable distances so that when they mature and reach their maximum growth.

7.0 Interconnecting Piping and Valves

All interconnecting Piping, Gates, Valves, Specials and other appurtenances, auxiliaries and accessories required as per Process Design and Scope of Work. In case of Rising Mains, thrust blocks shall be provided wherever required. In case of buried Pipes, warning tapes shall be provided of the appropriate colours. The material of construction for major interconnecting Piping shall be as follows:

S. No.	From	To	Material and class
1	Rising Main from Raw Sewage Transfer Pumps	Inlet Chamber	CI DF

2	SBR Air Blowers: Delivery Piping	Common Header	MS Epoxy Painted
3	SBR Air Blowers: Delivery Piping	Horizontal Sub-header SBR Basins	MS Epoxy Painted
4	SBR Air Blowers: Delivery Piping	Vertical Down comers SBR Basins	SS 304
5	Air Grid in SBR Basins		UPVC George Fischer make / Equivalent
6	Air Grid in Selector Compartments		SS 304
7	SBR Basins: Outlet Chambers	Chlorination Tank	RCC Channel or RCC Class NP3
8	Chlorination Tank: Outlet Channel	CWR	Doubled Flanged DI Class (K-7)
9	Air Grid in all Sludge Sumps		HDPE/UPVC
10	All Sludge Piping		Doubled Flanged DI Class K-9

Note: All piping shall be designed by considering the peak flow.

8.0 Electrical & Instrumentation Works

It shall be the Contractor's responsibility to obtain adequate incoming LT / HT power from State Electricity Authority based on the maximum demand load. The Employer will reimburse the charges for obtaining the above connection whereas necessary Liaoning for the same shall be done by the Contractor in consultation with Executive Engineer.

Adequate nos. of Transformers with 10% overload shall be provided. These shall be oil filled, air cooled and step down Transformers. They shall be supplied with all accessories and mounting as per IS 2062 and shall also have Dial Thermometer, Bucholz Relay, Rollers and Explosion Vent. Each Transformer shall be provided with off load tap changer for ± 2.5%. The windings shall be of connections as per vector group DY II. The efficiency of the Transformer at 100%, 75% and 50% loading should also be indicated separately. The Transformer should be filled with oil and tested as per I.E. Rules & Regulations. Suitable cable boxes for H.T. and bus ducting for L.T. side be provided.

- The entire Plant shall be operated on 415 V, 3-Phase, 50 Hz, 4-Wire system.
- The Contractor's Scope of Work shall include the following:
- Obtaining incoming LT/HT Power from State Electricity Authority including necessary liasonoing, documentation etc. complete.
- LT / HT Cable with Termination Kit from "Source" to the Electrical LT / HT Substation located at the Sewage Treatment Plant.
- HT Substation including 2-Pole Structure, Metering Kiosk, HT Panel, Transformers, Power Control Centre etc. complete.
- Motor Control Centres.
- Cabling including HT cable, Power, Control and Instrumentation Cables.
- Earthling for Electrical equipments as well as Instruments.
- Internal Lighting in Buildings.
- External Lighting.
- Local Push Button Stations near respective Drives (as per requirement).
- Any other item / accessories required for successful completion of the project.
- The Contractor shall design/execute the System as per standard specifications, I.E. Rules and Regulations, requirements of State Electricity Board and other local Authorities and actual site conditions.

Also, the Contractor shall provide adequate automation for fully automatic operation of the entire Sewage Treatment Plant including Primary Treatment Units, Biological Treatment Units based on SBR technology, Chlorination Units and Sludge Dewatering Units through a Programmable Logic Centre (PLC) and Supervisory Control and Data Acquisition (SCADA) with Man-Machine Interface (MMI). Provision shall also be made to operate each Unit of the Plant manually, if required.

9. PLC/PC/SCADA BASED AUTOMATION SYSTEM FOR PLANT

The entire Sewage Treatment Plant including Primary Treatment Units, Biological Treatment Units based on SBR technology, Disinfection (Chlorination) Units and Sludge Dewatering Units shall be designed for fully automatic operation through a Programmable Logic Centre (PLC) and Supervisory Control and Data Acquisition (SCADA) with Man-Machine Interface (MMI). Provision shall also be made to operate each Unit of the Plant manually, if required.

Salient features of the proposed System shall be as follows:

- Dynamic display of all Units, Equipments and Drives shall be available on SCADA Screen.
- Auto/Manual operation of each Drive shall be made by selecting a Soft Switch on SCADA Screen.
- In Auto mode, each Drive shall operate based on pre set sequence and interlock.
- In Manual mode, each drive shall be operated in Local/Remote mode by selecting a Soft Switch on SCADA Screen. In Local mode, each Drive shall be operated from the Local Push Button Station (LPBS) located nearby. In Remote mode, operation from LPBS shall be disabled and each Drive shall be operated manually from PLC. Also Working/Standby selection of Drives shall be done by selecting a Soft Switch on SCADA screen.
- Run/Trip indication of all Drives shall be displayed on SCADA screen.
- Open/Close indication of all Auto Gates and Auto Valves shall be displayed on SCADA Screen.
- Annunciation & Alarm facility shall be available in PLC/SCADA. In the event of a Fault, the symbol representing the Equipment/Drive shall continue flashing on SCADA Screen with Equipment/Drive description appearing at bottom of the SCADA Screen and electric Hooter shall continue blowing until the Fault Alarm is acknowledged.
- Data logging of Running Hours of each Drive, Alarm and Historical Trends of monitored Parameters etc shall be envisaged in SCADA.

DESIGN CRITERIA FOR STRUCTURAL DESIGN

1) INTRODUCTION

This document forms the engineering design basis for structural design. The content of these documents is to form the guidelines for engineering design of Structures and to provide information about other disciplines concerned.

This is technical specification summarizes the concept and relevant IS codes (Latest Revision) to be followed for buildings and water retaining structures.

2) GEO-TECHNICAL INVESTIGATION

The bidder will be responsible for the of geo-technical exploratory survey to obtain accurate information about soil condition,SBC at the site.

3) BASIC ENGINEERING DATA: DATUM AND SITE LEVELS.

Plinth height (Minimum above FGL) 0.5 m or as approved by engineer in charge.

4) LIST OF DESIGN CODES AND STANDARDS

All designs shall be based on the latest International or Indian Standard (IS) Specifications or Codes of Practice. The design standards adopted shall follow the best engineering practice in the field based on any other international standard or specialist literature subject to such standard reference or extract of such literature in the English language being supplied to and approved by the Employer's Representative. In case of any variation or contradiction between the provision of the IS Standards or Code and the specifications given with the submitted tender document, the provision given in the Specification shall be followed.

Design of various structures shall be carried out as per Technical specification and relevant IS Codes (Latest Version).

(i) Foundation Engineering

IS 1080 Design and construction of shallow foundation on soils.

IS 6403 Determination of bearing capacity on shallow foundations. IS 8009 Part I & Part II Calculation of settlement of foundations.

IS 2974 Code of practice for design and construction of machine foundations (part

1 to 4)

IS: 13301 Guidelines for vibration isolation for machine foundations

(ii) Loading standard codes and Design Aids:

IS 456 - 2000 Code of Practice for plain and reinforced concrete

IS 875 - 1987 Code of Practice for design loads for buildings and structures

Part I – dead loads.

Part- II – Live loads.

Part III – Wind loads

Part V- Special Loads and Load combinations

IS 3370 Code of Practice for concrete structures for the storage of liquids

Part-I - General Requirement (2009)

Part- II - Reinforces concrete structures (2009)

Part-III - Pre-stressed concrete structures (1967)

Part-IV - Design tables (1967)

IS 1893 - 2002 Criteria for earthquake resistant design of structures

IS 4326 Earthquake design and construction of buildings - Code of Practice.

IS 13920 Ductile detailing of Reinforced Concrete Structures subjected to Seismic forces.

IS 1911 Schedule of unit weights of building materials

(iii) Reinforcement

IS 1786 High strength deformed steel bars

IS 2502 Bending and fixing of bars for concrete reinforcement

IS 5525 Recommendation for detailing of reinforcement in concrete works

(iv) Brickwork and Hollow block

IS – 1077 Common burnt clay building bricks

IS -2212 Brick work

IS -2185 Cement Concrete Block. Part- I, Part-II - Hollow cement concrete blocks.

(v) Cement and Fine & Coarse Aggregates:

IS-455 Portland slag cement

IS-1489 Part 1 Portland Pozzolana Cement (PPC) fly ash based

IS-1489 Part 2 PPC Calcined clay based

IS-8112 43 grade Ordinary Portland Cement

IS-12269 53 grade ordinary Portland cement

IS-383 Coarse and Fine aggregate

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

I.S. 800 Code of Practice for general construction in steel

I.S.806 Code of Practice for use of steel tubes in general building construction

I.S. 807 Code Of Practice For Design, Manufacture, Erection And Testing

Structural Portion Of Cranes And Hosts

I.S. 808 Dimensions for hot rolled steel beam, column channel and angle section

I.S. 813 Scheme of symbols for welding

I.S. 816 Code of Practice for use of metal arc welding for general construction in mild steel

(vii) Miscellaneous

IS:1172 Code of basic requirements for water supply, drainage and sanitation

IS:1742 Code of Practice for building drainage

IS:3067 Code of Practice for general design details and preparatory works for damp proofing and water proofing of buildings

SP:16 Design Aids for reinforced concrete to IS:456

SP:20 Handbook on masonry design and construction

SP:22 Explanatory handbook on codes for earthquake engineering

SP:24 Explanatory handbook on Indian Standard Code of Practice for plain and reinforced concrete

SP:25 Handbook on causes and prevention of cracks in buildings

SP:34 Handbook of concrete reinforcement & detailing (SCIP)

IRC:37 Guidelines for design of flexible pavements

IRC:73 Geometric design of roads

5) METHOD OF ANALYSIS

The analysis for all structures (RCC as well as Steel Structures) has been carried out by STAAD-pro and designs the same for the worst/governing combination as per latest International or Indian Standards.

6) METHOD OF DESIGN

Design shall be done as per following:

- RCC footings: Limit state method of design
- RCC columns: Limit state method of design
- RCC column in pumping station & Water Retaining Structure: working stress method of design
- RCC beams and slabs: Limit state method of design Retaining wall: - Working stress /Limit state method of design RCC water retaining structures: Working stress method of design
- Also provide the seismic design calculation of R.C.C Water retaining structures as per IS 1893 (Part – II, Draft Code).
- Steel Structures: Limit State/Working Stress method of design

7) DESIGN BASES

Foundation shall be designed to carry all the loads from equipment or super structure, which they support in accordance with the relevant codes.

- Net safe bearing capacity of soil: As per geo-technical report

Type of foundation

- For buildings and structures: As per geo-technical report
- Allowable increase in soil bearing capacity in event of storm(wind) 25%, Earthquake
- 25%, factor of safety as per IS 1904 against overturning 1.5, Sliding 1.5, and buoyancy 1.2.

As a general rule following features will be adopted, unless decided otherwise in a specific or exceptional case:

- Top of footing will be horizontal and flat/Trapezoidal as case.
- Minimum depth of footing is considered as per geotechnical report for various locations of the proposed structure.
- Foundation plinth for structural columns and equipment supports shall extend not less than 5 mm from the edge of base plate.
- The clear distance between a standard mild-steel anchor bolt or anchor sleeve and the face of the foundation shall be not less than 75 mm.
- Minimum thickness of lean concrete layer shall be 75 mm and shall extend 75 mm beyond the foundation edge.
- For heavier loads and restricted settlements pile foundation may be considered as an alternative as per IS 2911.
- Where ever columns are very near pedestals of footing are considered combined to take care of unbalance loading. Sufficient reinforcement is provided to take care of unbalancing load. Centre of footing and combined loading is match to nullify eccentricity in load.
- Where stresses due to wind (or seismic) and temperature are combined with those due to other loads, the allowable stresses in concrete and reinforcement steel shall be increased by 33.33% in case of working stress design.

All building shall have a minimum 1.0 m 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.

8) 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 to be considered up to full height of wall and no relief due to soil pressure from the other side to be considered.

(ii) RCC water retaining structures like storage tanks shall be leak proof and designed as uncracked section

(iii) Structure empty condition (i.e., empty of liquid, any material, etc.): full earth pressure with saturation and surcharge pressure wherever applicable, to be considered.

(iv) Partition wall between dry sump and wet sump: to be designed for full liquid depth up to full height of wall.

(v) Partition wall between two compartments: to be designed as one compartment empty and the other full for both the directions.

(vi) Structures shall be designed for uplift in empty conditions with no live load with the water table indicated in the geotechnical report or high flood level, whichever is maximum. No reduction factor for the uplift forces shall be considered. Use of pressure relief valves to reduce uplift pressure due to ground water table shall not be allowed.

(vii) Walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilization and dynamic water loads.

(viii) 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 and due to other loads shall be1.5.

(ix) Soil bearing capacity is to be considered as per soil investigation report.

9) DESIGN LIFE

The design life of all structures and buildings shall be 60 years.

10) DESIGNED LOADING

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, Equipment load, Piping Anchor and Restraint loads, Crane, Monorail & Elevator loads, Earth Pressure load, Hydrostatic Pressure load, stresses due to temperature changes, shrinkage and creep in materials, dynamic loads, impact load and other specific loads.

a) Dead Load

This shall comprise all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipment and other items of machinery.

I. Material Densities

(i)	Weight of water	:	10.00 kN/m^3
(ii)	Weight of soil	:	As per field test results
(iii)	Weight of plain 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	:	24.00 N/m^2 per mm thickness
(viii)	Weight of Filling in Sunk Slab etc.	:	10 KN/m3
(Ix)	Weight of ceiling plaster 6/8 mm thick	:	20 KN/m3
(x)	Light weight concrete with aggregates as Perlite etc.	:	10 kN/m3
(xi)	Rubble Masonry	:	22.00 kN/m3
(xii)	Electrical Panel Load, Instrumentation Panel Load, Battery backup Load etc.		As per Actual Panel Loads

II. Dead Loads

Note: Openings (doors, windows, ventilators etc.) in the masonry are ignored.

III. Slabs

Floor Finished on working floors – 1.0 KN/m2

Floor Finished on Terrace – 1.0 KN/m2

Filling in sunk slabs: weight density X thickness of filling

Self weight: - Weight density X thickness of slab

IV. Beams

Self weight: - Weight density X width X total depth

Brick masonry: - Weight density X wall thickness X wall height

b) Live Load

Live loads shall be in general as per I.S. 875. However, the following minimum loads shall be considered in the design of structures:

(i)	Live load on roofs (accessible) (Non-accessible)	: 1.50 kN/m^2
(ii)	Live load on floors supporting	
	Equipment such as pumps, blowers,	
	Compressors, valves, etc or	
	as required by equipment supplier whichever is greater.	: 10.00 kN/m^2
(iii)	Live load on all other floors Walkways, stairways and platforms.	: 5.00 kN/m^2
(iii)	Live load on all residential floors	: 3 KN/m2
(iv)	Live load on Toilets	: 2.5 KN/m2

Live load reduction shall be in accordance with the provisions of IS: 875 and IS: 1893 in case of seismic analysis.

In the absence of any suitable provisions for live loads in I.S. Codes or as given above for any particular type of floor or structure, assumptions made must receive the approval of owner/PMC 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.

c) Wind Load

Wind loads shall be as per I.S. 875.

In design of structures, wind force on equipments supported on frame including all fixtures, piping, staircases, ladders, handrails etc. shall also be considered.

d) Earthquake Load

This shall be computed as per I.S. 1893. An importance factor appropriate to the type of

structure shall be considered for design of all the structures.

For all structures and buildings Response Spectrum Method of design shall be used. The importance factor for all buildings and structures shall be taken as 1.5

e) Dynamic Load

Dynamic loads due to working of items such as pumps, blowers, compressors, switch gears, travelling cranes, etc. shall be considered in the design of structures as per manufacturer's data.

f) Earth Pressure Load

Earth pressure for all underground structures shall be calculated using coefficients of earth pressure at rest or coefficient of active earth pressure (whichever is applicable)

In addition to earth pressure a minimum surcharge load of 20 kN/sqm shall also be considered for the design of all underground structures or railway load (in case the railway track is located nearby) which ever is critical.

The underground structures shall be subjected to sub surface water pressure. Calculations shall be based on the weight of the soil plus full hydrostatic pressure. The full upward pressure of water below base raft shall be taken over the entire area.

g) Hydrostatic Pressure Load

Ground water level for calculation of shall be considered as indicted in the geotechnical report or high flood level whichever is maximum / at Finished Ground Level.

h) Impact Factor

Loads for cranes, hoists and elevators shall be taken as per IS: 875(Part 2). The minimum impact factors to be used in design shall be as follows:

i. Crane Loads

a. For vertical force, an impact factor of 25% of the maximum static loads.

b. A lateral crane surge of 10% of the weight of the crab plus lifted load applied at the top of crane rail acting on any one crane track rail. For frame analysis, this force shall be applied on one side of the frame at a time in either direction.

c. A longitudinal surge of 5% of the maximum static wheel loads of the crane applied at the top of the rail.

ii. Monorail Loads

a. Impact factor of 10% of lifted load of hoist for monorail and support design b. Impact factor of 25% of lifted load for electrical pulley and support design.

i) Temperature Load

Expansion and contraction due to changes of temperature of materials of a structure shall be considered and adequate provisions shall be made for the effects produced (as per provision in relevant IS codes). Suitable expansion joints shall be provided in the longitudinal direction wherever necessary. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.

Analysis shall be carried out for ambient temperature variation. The temperature variation shall be considered as 2/3 of average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum temperature during the coldest month of the year and mean of daily maximum temperature during the hottest month of the year. The structure shall be designed to withstand thermal stresses due to 50% of the temperature variation.

Coefficient of thermal expansion of steel shall be taken as per IS: 800. Coefficient of thermal expansion for concrete shall be taken as per IS: 456.

j) Vibration Loads

- Vibration Loads shall mean the vibration forces caused by heavy vibrating equipment or machinery and dynamic forces caused by fluids in the normal operation.
- Frames, structures and foundations for machinery or equipment causing vibration shall be designed to limit vibrations to an acceptable level.
- It shall be designed such that whether they are independent or part of the building, it shall not only safely carry the loads for such items but also prevent resonance. Natural frequencies of frames, structures and foundations must differ by more than 20% from that of the machinery under operating conditions.
- While carrying out dynamic analysis of foundations/structures supporting dynamically loaded equipments, the loads indicated by vendor in his documents shall be used. However, in the absence of such data, the following loads shall be assumed as the equivalent static loads when the dynamic analysis is not carried out.

1. Rotating (Centrifugal) type

(a) Vertical direction: 0.5 times the weight of equipment or machinery

(b) Horizontal direction:

(i) Along direction of Rotation (Perpendicular to center line of shaft) 0.25 times the weight of equipment or machinery

(ii) Along direction of shaft axis 0.1 times the weight of equipment or machinery

2. Reciprocating type

(a) Vertical direction: 0.5 times the weight of equipment or machinery

(b) Horizontal direction:

(i) Along direction of reciprocating 0.25 times the weight of Motion equipment or machinery

(ii) Along direction perpendicular 0.1 times the weight of reciprocating motion equipment or machinery

These horizontal loads shall be considered to be acting at shaft centreline.

k) Load Combination

Load combination for checking of bearing capacity of soil and design of steel structures

(working stress)

DL + 1.0 LL

DL +/- 1.0 WL (1.0 EQ)

DL + 1.0 LL +/- 1.0 WL (1.0 EQ)

Load combination for design of RCC structures and Steel Structures (Limit state)

1.5DL + 1.5 LL

1.5DL +/- 1.5WL (1.5 EQ)

0.9DL + 1.5 WL/EQ shall be used for stability against overturning is critical.

1.2DL + 1.2 LL +/ 1.2 WL (1.2EQ)

Load combination for water retaining structures

1.0DL + 1.0 Water Load

1.0DL + 1.0 uplift

1.0DL + 1.0LL

Appropriate factor of live load shall be taken as per IS 1893 for seismic load calculation. The load combinations giving the most critical conditions on foundations, structures or individual members shall be taken in to account.

11) Minimum Cover to main Reinforcement

The minimum clear cover to reinforcement in all R.C.C structures shall be as per IS:

456/IS: 3370 (Part –II), except as mentioned for following:

The following minimum clear cover shall be provided for RCC works.

Slab (roof & floors, Canopies, 20 mm Chajjas, waist slab in stair etc.)

Beams, lintels 25 mm

Grade beams 25 mm

Columns, pedestals 40 mm

Dry pits / retaining walls

i. Face in contact with earth 50 mm

ii. Free face 50 mm Water / Liquid retaining structures

i. Face in contact with liquid 60 mm

ii. Away from liquid but in contact 50 mmwith earth

Footing

i. Sides and top 50 mm ii. Bottom 60 mm

Increased cover thickness may be provided when surfaces of concrete members are exposed to the action of harmful chemicals (as in case of concrete in contact with earth faces contaminated with such chemicals, acid vapour, saline atmosphere, sulphurous smoke (as in case of steam operated railways) etc. and such increase of cover may be between 15 mm and 40 mm beyond the figures given above as may be specified by the engineer-in-charge.

Concrete cover blocks of different and necessary sizes and shall use as and when required for providing the adequate and specified cover to the reinforcement. Such cover blocks shall be made so in advance and properly cured to take the load of reinforcement. Cement mortar blocks in CM (1:1) shall be used for making cover blocks.

a)	**Minimum diameter of bar**	
	Main steel in foundation	: 10 mm
	Main steel in column	: 12 mm
	Main steel in beam	: 10 mm
	Main steel in slab Stirrups & Ties	: 10 mm
	Main steel in wall & Wall footing	: 8 mm
	Main steel for water retaining structure	: 10 mm

Minimum thickness of PCC

1) For all RCC building foundation : 75 mm Thick –M 15 And Trenches etc

2) For Brick masonry wall foundation : 100 mm Thick – M 15

3) For all water retaining structures : 100 mm Thick –M 15

b) Minimum percentage of steel

1) For buildings : As per IS 456-2000 or other relevant codes/as per tender specifications

2) For liquid retaining structure : As per IS 3370: 2009 (Part-2) or other relevant codes/as per tender specifications (For thickness more than or equal to 150 mm in wall, reinforcement shall be provided on both faces)

12) MINIMUM THICKNESS OF STRUCTURAL MEMBERS

The following min. thickness shall be used for different reinforced concrete members irrespective of design thickness.

CIVIL MEMBER	THICKNESS (mm)
Walls for liquid retaining structures	225
Walls of launders	150
Base slab of launders	150
Roof slabs for liquid retaining structures	125
Bottom slabs for liquid retaining structures	225
Floor slabs including roof slabs, walkways canopy slabs	100

Walls of cables/pipe trenches, underground pits etc	125
Column footings	300
Parapets, chajja	100
Precast trench cover	75
Beam	230 (width) 300 (depth)

13) SPACING OF REINFORCEMENT

Minimum distance between two parallel main reinforcement bars shall placed as per relevant Indian Standards (Latest Revision).

In locations where reinforcement is congested, grouping of bars by touching one another may be permitted provided the requirements of minimum horizontal distance as specified above are complained with and provided further that development length is adequately increased.

14) MATERIAL SPECIFICATION

Footings- M25 (Fck -25 N/mm^2) - for buildings & columns

Beams, slabs, chajjas, Lintel etc. – M25 (Fck – 20 N/mm^2) Raft foundation – M-30 for water retaining structure

Water retaining structure – M 30 (Fck – 30- N/mm^2) PCC for column footings – As per tender specification

PCC for wall footings and plinth beams for water retaining structures – M 15

PCC for wall footings and plinth beams for water non-retaining structures – M 15

Reinforced steel TMT confirming to IS 1786 – Fe- 415 (Fy 415 N/mm^2) Reinforcing steel Mild steel (M.S) bars – Fe 250 (Fy 250 N/mm^2)

15) JOINTS

Movement joints such as expansion joints, complete contraction joints, partial contraction joints and sliding joints shall be provided and designed to suit the structure as per relevant IS specification. However, contraction joints shall be provided at specified locations spaced not more than 7.5 m in both right angle directions for all walls and rafts.

Expansion joints of suitable gap at suitable intervals not more than 30 m shall be provided in all walls, floors and roof slabs of water 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. Alternatively contractor can use G.I. Sheets of 18 gauge and 200 mm wide.

Expansion joints for non-liquid retaining structures shall be provided as per IS 3414. Expansion joint if required shall be furnished in detail drawings.

16) NOMINAL STRIPING TIME (Based on IS 456)

In case when the cube strength at seven days are found to be low or in the cases when other cements are used, stripping time and removal of props may have to be extended.

In normal circumstances, (generally where temperatures are above 20° C) and where ordinary Portland cement is used, forms may generally be removed after expiry of following periods:

	Type of Formwork	**Minimum periodbefore striking formwork**
a)	Vertical formwork to columns, walls, beams,	18-24 days
b)	Soffit formwork to slabs (Props to be re-fixed immediately after removal of formwork)	3 days
c)	Soffit formwork to beams (Props to be re-fixed immediately after removal of formwork)	7 days
d)	Props to slabs: i) Spanning up to 4.5 mt. ii) Spanning over 4.5 mt.	7 days
e)	Props to beams and arches: i) Spanning up to 6 mt. ii) Spanning over 6 mt.	14 days

17) CURING OF DIFFERENT ITEMS:

During construction, curing shall be carried out especially from 7.00 AM to &. 7.0 P.M even on holidays with proper manpower, necessary pumps and pipe lines, connections etc.

Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by poundings or by covering with a layer of sacking, canvas, Hessians or similar material and kept constantly wet for at least seven days from the date of placing concrete in case of OPC and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 14 days for concrete exposed to dry and hot weather conditions and where mineral admixtures or blended cements are used. For the concrete containing PPC or Portland slag cement, period of curing may be increased.

For, other items the curing shall be done as follows or as directed by the engineer-in-charge.

a) Brickwork- at least for 10 days

b) Plaster work – at least for 7 days

c) Sand faced plaster – at least for 15 days

d) Tiles or stone flooring and dado – at least for 10 days.

18) Special Consideration for Steel Structures a. Steel Stairs

All steel staircase shall normally clear width (back to back of stringer) of 1000 mm and maximum inclination with horizontal of 35°75′. However, in case of space restriction, minimum clear width up to 750 mm and slope up to 45° may be provided with prior approval. The vertical height between successive landings shall not exceed 2.75m. Channels (min. MC150) shall be provided as stair stringers. Treads shall be minimum 250 mm wide made of chequerred plate / grating, with suitable nosing, and spaced equally so as to restrict the rise to maximum 180 mm.

b. Steel Ladders

Ladders shall be provided to platforms, walkways, instruments and equipments that do not require frequent access. Ladders shall preferably be vertical and its angle with vertical shall not exceed 5°. Ladders shall be minimum 450 mm clear width with 20 mm dia. MS rungs spaced at 300 mm (maximum)

Ladders of more than 4.5 m height shall be provided with safety cage. However safety cages to start at 2.5 m above the lower landing level.

c. Platforms and Walkways

All steel platforms above grade shall be constructed with kick plates at edge of platform to prevent tools or materials from falling off. It shall consist of 8 mm thick steel plate projecting 100 mm above the platform surface. Kick plate shall be painted with the same type of coating as the material to which it is attached.

d. Special Consideration for Brick / Stone Masonry

All Masonry works shall be designed in accordance with IS: 1597, IS: 1905, IS: 2212, IS:

4326 and other relevant IS codes as applicable. Structural design of Brick / Block Masonry shall be in accordance with criteria specified by section 4 of National Building Code of India Part IV.

All Masonry walls for buildings shall be raised on plinth beams.

Bricks shall be of minimum compressive strength of 50 kg/sq.cm conforming to IS: 1077. Brick masonry shall generally be in cement mortar 1:6 (1 cement: 6 sand). However, 115 mm thick masonry shall be constructed in cement mortar 1:4 with 2 nos. of 6 mm dia. Reinforcement provided after every fourth layer.

e. Grouting

Non-shrink flowable grout shall be used for under pinning work below base plate of columns. Non-shrink cum plasticizer admixture shall be added in the grout. For grouting of base of machine foundation high strength ready mixed non-shrink flowable grout shall be used.

Crushing strength of the grout shall generally be one grade higher than the base concrete. Minimum grade of grout shall be M 25.

Nominal thickness of grouting shall be at least 50mm for columns and pedestals of major equipment. For secondary posts, stair and ladder base, etc. grouting shall not be less than

25mm thick.

APPENDIX - IV LIST OF APPROVED MAKES

The following is the list of products and name of the approved manufacturer against each product. The contractor shall quote rates for the various items of works considering these products. Any other make of product, not approved below, shall not be allowed for use in this work unless specifically approved separately by the purchaser after establishing its technical suitability, price, availability & effect on price quoted by contractor for the item where this item is being used. However selection of make shall be prerogative of Owner/NDDB.

S. No.	Item Description	List of Approved Manufacturers / Brand / Applications
	Civil Works	
1	Cement	Vikram, ACC, Ultratech, Gujrat Ambuja Cement, Birla Corp. Ltd., J.K., Laxmi Cement
2	Anti-Termite Treatment	NOCIL or Equivalent
3	Steel Reinforcement	SAIL, Rashtriya Ispat Nigam, IISCO, TISCO, Barnala Steel Industries, U.P. Rathi Udyog Ltd., Ghaziabad, Kamdhenu Steel, Usha Martin Steel, Agra.
4	Ironmongery	Subject to prior approval of Engineer

5	Synthetic paint	Asian Paint, Berger, ICI, Nerolac, Shalimar Paints, Jenson & Nicolson Paints.
6	Cement Based Paint	Super Snowcem, Duracem, Accrocem
7	Zinc cromate primers	Shalimar, Asian Paint, Berger, ICI
8	Flush door / Block Board/ Ply	Kitply, Sarda Ply, Kutty, Greenply, Tower, Swastic, GEE-DOORS.
9	Glass	Modiguard, Saint Gobin, Asahi, Atul
10	Water proofing compound admixtures	Choksey, Sika Qualcrete, Degussa, Fosroc, Roffe, Ciro, Impermo, ACCO proof, Overseas Waterproofing Corpn., India, Waterproofing, Hindustan Waterproofing
11	Dash Fasteners	Hilti Fischer
12	Concrete ADmixtures	Sika, Fosroc, STP, CICO
	Sanitory Works	
1	Viterous China Sanitary Ware	Hindware, Parryware, Neycer, Cera, Hindustan
2	Plastic W.C. seats	Commander, Diplomate, Bestilite, Hindware, Parryware, Johnson, Poddar
3	Plastic Flushing Cistern	Commander, Hindware, Parryware, Johnson Poddar
4	G.I. Pipes	Tata, Jindal, Nezone, Prakash
5	G.I. Fittings	HB, Zoloto, K.S. Unik, R Brand
6	C.P. Pillar Cock, Bibcock, Stopcock and other CP Fittings	Essco, Parko, GEM, Jaquar, Kingston, Soma,
7	Brass Bib & Stop Cock	GPS, Sant, L&K
8	Gun Metal Valves	Leaders, Kent, Zoloto
9	Soil, Waste and Rainwater pipes and fittings/Sand Cast Iron Pipes & Fittings	Neco, Anand, Ashutosh Casting, RIF, Big, Neco
10	Unplasticised PVC Pipes	Supreme, Fiolex, Prince, Ori-Plast, Reliance, Manmohan Plastics/Jain Irrigation/Tirupati Structures/Balaji Industries/Chemical Process equipment
11	Self Sustaining Breathing Apparatus	Drager

12	Gas Mask	Drager
13	Water Feed Pumps/Chemical Pumps	Kirlosker/ M&P / Sulzer / KSB
14	Stoneware pipes and gully traps	Perfect, Burn R.K.
15	RCC Pipes	Laxmi, Sood & Sood, Jain & Co., Pragati Concrete Udyog
16	RCC Hume Pipes	Indian Hume Pipe, Pragati Concrete Udyog gupta industries newai, SGG
17	C.I. S/S Pipes	IISCO, Kesoram, Elector Steel
18	PVC HDPE Tank	Sintex, Sheetal (Aquaplast Industries)
19	C.I. Sluice Valves (Fullway, Air Valves, Check, Butterfly and Globe Valve)	Leader, Kirloskar, Upadhyay, SKS, C&R Fouress, Hydraulic & General Engg., Glenfields Kennedy, Orion, Dancal, Indian Valves Co/Fouress/Jash/R&D Multiple/ Intervalve / Durga
20	Water Meters	Capstan, Krant, Anand, Dashmesh
21	Ball Valve with Plastic Float, GM. Forged Brass Valve	Leader, Zoloto
22	CI Manhole Cover and Frame	Neco, RIF, SRIF
23	SFRC Manhole Cover and Frame	KK Manhole & Gratings Pvt. Ltd.,SGG
24	Centrifugal Pumps	Beacon, Kirloskar, KSB Crompton, Mather & Platt
25	Non Clog Centrifugal Pumps	Johnson, Kirloskar, Mather & Plantt, Grundfos
26	Turbine Pump	Jyoti, KSB Worthington
27	Submersible Pump	KSB, Kishore, Kirloskar, Grundfos, Mather & Platt, Aqua
28	Motors & Contractor	Sharita Cutter Hammer, Larsen & Tubro, Kirloskar/ Jyoti/NGEF/Siemens/AEC/Bharat Bijlee/Crompton Greaves / BHEL, GE Power/ New Govt. Electronics Ltd., / Alstom
29	Gate Valves/ Sluice Valves	Kirloskar brother Ltd., Indian Valve Company, Upadhyaya Vaives Manufacturers Pvt. Ltd. Shiv Durga Foress Iron work (p) ltd.
30	Zero Valve	Kirloskar brother Ltd., Indian Valve Company,

		Upadhyaya Vaives Manufacturers Pvt. Ltd. Shiv Durga Foress Iron work (p) ltd.
31	Pressure Release Valve	Kirloskar brother Ltd., Indian Valve Company, Upadhyaya Vaives Manufacturers Pvt. Ltd. Shiv Durga Foress Iron work (p) ltd.
32	Air Valve	Kirloskar brother Ltd., Indian Valve Company, Upadhyaya Vaives Manufacturers Pvt. Ltd. Shiv Durga Foress Iron work (p) ltd.
33	Non-Return Valves	Kirloskar brother Ltd., Indian Valve Company, Upadhyaya Vaives Manufacturers Pvt. Ltd. Shiv Durga Foress Iron work (p) ltd., Fouress/ Advance/ Intervalve/ Durga
34	Sluice Gates	Jash Engineering (P) Ltd., The Indian Valve Co., Oriental Castings, Bharat Industrial Corporation, Shiva Durga Iron Works (P) Ltd., Hydraulic & General Engineers
35	Cast Iron pipes & fittings	The Indian Iron & Steel Company Ltd., Bharat Indl. Corporation. Oriental Castings, Upadhaya Castings Calcutta, Electro Steel Castings, Tata Iron & Steel Co.
36	a) Crane b) Chain Pulley Block	W.H. Brady & Co. Ltd., Hercules Hoist Ltd., Delta Engineering, Works, Sharps Engineering Pvt. Ltd., Avon Cranes, Batilboi, Reva Engg., Hercules Hoists Ltd., W.H. Brady & Co. Ltd., ACE Mfg. Engg. P. Ltd./ Indef/ Morris/Eqv.
37	Hot Cranes	Indef/ ACME Manufactures Engineers / Electromech Engineers / FAFECO, Mumbai / Batliboi Ltd. / SMACO Engineering Ltd.,
38	Mechanical Screens	Triveni / Geomiller / Jash / Napier-Reid.
39	Belt Conveyor	Indiana / Konal Corporation / Voltas / Batliboi / Dynamic
40	Degritter	Geomiller / Triveni / EIMCO – KCP Limited/ Napier-Reid.
41	Exhaust Fan	Bajaj Electrical Ltd., Crompton Greaves Ltd., Jay Engg. Works, Alstom General Electric Company Ltd.
42	415 V Switch Gear Control Gear Components/ Bus	Larsen & Toubro Ltd., Siemens India Limited, Voltas Ltd., English Electric Ltd., Jyoti Ltd., Control

	Dust	and Switchgear, Bhartia Cutler Hammer
43	Gear Box	Radicon – Greaves / Elecon / Flender
44	Electro Magnetic Flow Meters	Endress + Hauser / Krone-Marshall / Fisher Rosemount
45	11 KV Switchgear	Jyoti Ltd., New Government Electric Factory Ltd., Siemens India Ltd, Asian Brown Boveri, Alstom, Kriloskar Electricals Ltd., Cromption Greaves, Voltas Ltd.,
46	Lighting Fixtures	Bajaj Electrical Ltd., Cromption Greaves Ltd., Philips, Wipro Ltd., Klipsal
47	415 V Air circuit Breaker	English Electric Ltd., Larsen & Toubro Ltd., Siemens India Ltd.
48	Motor Strater	BHEL, Penimal Engineering Ind., Meco Instruments (P) Ltd., Enterprising Engineering, Pan Asia, Advance Enciphering
49	Battery	Standard Batteries Ltd., Chloride India Ltd., Exide
50	Voltage & Frequency Stabilizer	Applied Electronics Ltd., Jindal Electric Surya Electric Servocon Logicstat
51	Lightening Unit	National Radio & Electronic Co. Ltd.
52	Instrument Transformers (ST's & PT's)	Mysore Electrical Industries, Automatic Electric Pvt. Ltd., Kappa Electric.
53	Vaccum Pump	Kirloskar Brothers Ltd., SLM Manek Lal Industries Ltd.,
54	Battery Charger	Uptron Powertronics, (Shreetron) Statcom Automatic Electric Ltd., Chabi Kerta State Electricity Corp. APCO
55	Fire Extinguishers	Steelage Industries Kooverji Devshi & Co. Ltd. Vijay fire Protection System Pvt. Ltd.
56	Nuts & Bolts	GKW, TATA
57	Push Button for Non-Flame-Prooflame Proof Weather Proof	Siemens, FCG, Baliga
58	Gas Compressors and Blowers	Kirloskar Pneumatic Co., K.G. Khosla Compressors Ltd., Ingersoll Rand, Chicago Pentatonic (I) Ltd., Kay / Swamelgi, SLM – Maneklal/ Swam/ Usha Engg./ Everest / Ingersoll-Rand/Beta.
59	Exhaust Fans	Bajaj Electrical Ltd./ Crompton Greaves Ltd./ General Electric Company
60	Bus Duct	Best & Crompton Engg. Ltd., Power Gears Pvt. Ltd., Control & Switchgear Zeta Switchgear, Advance Panels & Switch Gear (P) Ltd.,

61	Control System / Instrumentation / PLC / SCADA	AIMIL Limited, Johnson Controls (I) Pvt. Ltd., Tata Honewell, Rockwell Automation, Ge Fanuc, Alstom, Krohne Marshall, Allen Bradley, Siemens.
62	Instrument Control Panels	Industrial Control & Appliances (P) Ltd. / Electric Automation / Jaisum & Hutchison Controls (P) Ltd. / Industrial switch gear & Controls, Allen Bradley, Siemens.
63	PCC / MCC	Advance Panels & Switch Gear Ltd., Vidyut Control, Tricolite, Lasen & Toubro, ,Kryton,Siemens, Jakson Associated, Electrical, Bhartiya Cutter Hammer, Control & Switch Gear, G.E. Power, Jasper Engineering, Allen Bradley, Siemens.
64	Optic Cables	Fibre Delink, Cords, RR Cables, Icon, Aksh
65	Flow Meters	Krohne Marshall, ABB, Schlumburger, Endress Haussr, YBL, Yokogawa, Magnetrol, GE, Thermo Scientific USA
66	Open Channel Flow Meters	JN Marshall / Fisher Rosemount
67	Pressure Switch Pressure Trasmillters	Danfoss, Switzer, Tiebig, Varna Trifag, H. Guru, High Tech. (Orion)
68	Level Switch	Endress Hauser EIP, Nivo Control, ABB, Level, Cone, Magnetrol, Krohne Marshall
69	Electronic Ballast	Philips, Opal, Washlow
70	Micro Processor Relays for Motor Protection	GE, Power Relays, Rockwell Motoral, L&T, Simes
71	Motor Control Panel	ECS / IMPL / Jasper / Kilburn / Weather Proof Subhelec Philicon / CAS.
72	Scrubber	Excellent Engine, Pilani, Enuirotec
73	UPS	Tat Emerson, Mertin Gerin, Mitsubishi
74	Transformer	Crompton Greaves, Kirloskar, Volt Amp. BHEL, RTS ALSTHOM, Bharat Bijlee Ltd., New Government Electric Factory Ltd., Kirlosker Electric Co. Ltd., Voltamp EMCO (NASIK), ETC (Thana), Voltas Ltd., Crompton Greaves, MEI, Rectifiers & Controls, Power Engineers, ECE, Surya Electro Controls
75	Vaccum Circuit Breaker – LT/HT	Siemens, Alsthorn, BHEL ABB Crompton Greaves, L&T GEC, MEI
76	Moulded Case Circuit Breaker & Air Circuit Breaker	GE, MDS, Schnelder, L&T, Syntron, Control & Switch Gear, Siemens
77	Relay	Engiish Electric Ltd., Universal Electric, Easun

		Reyollers Relays, Jyoti, Asian Brown Boveri, Alsthom, GE, L&T, Syntron, Control & Switch Gear, Siemens
78	Main LT Panel, Main & Sub Distribution Boards	CPRI Tested Vendor / GEC, Jyoti, Siemens, Kirloskar Electric, Easun, Crompton Greaves, Powei Tech / Enpro Engineering / Standard, Jasper Engineering
79	Miniature circuit & MCB distribution boards	MDS, Merlin Grin, Elecon / Gerard, L&T, Heger Siemens, Havells,
80	M.C.C.B./ M.C.B.	English Electric, Crompton, L&T, Standard, C & S Ltd. Andrew Yule, HPL.
81	MCB Distribution Board	MDS, Loadstar & Loadkontakt, Standard
82	CTS & PTS	Kappa, Automatic Electric, Control Switchgear
83	HRC Switch Fuse Unit / Fuses	Siemens, General Electric, L&T, Schnelder, Electric control Gears Pvt. Ltd., Crompton Greaves, Control Switch Gear, Standard, HPL
84	AC Power Contactor	Siemens, L&T, General Electric, Schnelder, Havells
85	DC Power Contactor	Bhartia Cutler, Hammer, BHEL
86	Control Switch/Toggle Switch	General Electric, Kaycee, L&T
87	Push Button & Indicating Lights	Siemens, L&T, Bhartia Cutter Hammer, Vaishno, L&T, Siemens, Vaishno,
88	Indicating Lamps	L&T, Siemens, Vaishno
89	Control Transformer	Logicstat, Bhartia Culter Hammer
90	Timer/Time Switches	L&T, Siemens, MDS
91	Hooter, Buzzer, Bell	Unicon, Edison,
92	Terminal Blocks	Elmex, Lupco, Jainco, Phoenix
93	GI Pipes	Tata, Jain Tubes, Jindal, Prakash Tube
94	Cable Glands	Comic, Raychem, Braco, Jainco
95	HT / LT Jointing Kits	Birls-3M, Denson, Raychem, M-seal
96	Cable Lugs	Dowel, Lotus, Jain
97	XLPE Cable 11KV	Nicco, Universal, Polycab, CCI Havells
98	Control Cables	Nicco, Finolex, Universal, Havells, Plaza, Asian Cables, Kalinga, CCI, ICE, Fort Gloster Industries, Omega, Indian Cables Co., Asian Cables Corporation Ltd., Gemscab, Finolex Cable Ltd., Havell's Gradly, Delton Cables.

99	Cables (660V Grade)	Asian, Universal, Gloster / Tropodur, Finolex, Indian Cables, Industrial Cables
100	PVC Condult	AKG, BEC, Kalinga, Plaza
101	PVC Insulated Copper Wires (1100 volts grade)	Finolex, Electron, Polycab, Skytone, Havell's, KEI, Plaza, Kalinga, Philco, Sandeep
102	Wiring Accessories – Piano type switches, sockets, telephone	Ellora Leader, Anchor, Plaza, Precision
103	HPSV Fitting	Crompton, Bajaj, Phillips
104	Fluorescent tube fittings	Crompton, Bajaj, Phillips
105	Ceiling / Exhaust fan, fans air circulators	Usha, Crompton Greaves, Khaitan, Polar, Bajaj, Jay Engg. Works, ALSTOM, General Electronic Co. Ltd. Rallis, Almonard, Orient, Havell's
106	Multimeter	Excrop, Motwane
107	CFL	Phillips, Havell's, IndoAsian
108	MS Pipes	Jindal, Tata, Bhart Tubes
109	Changeover Switch	Havell's, Control & Switchgear, L&T
110	Isolators	L&T, General Electric, Control & Switchgear
111	PCC Poies	Concrete Udyog, Mohan Concrete Udyog
112	Steel Tybular Poles	National Tubing Company, United Engineers, Advance Steel Tubes
113	TPN Switch fuse unit / Switch Disconnecto fuse unit with HRC fuses	Siemens, L&T, GE, C&S, Scheneider, Crompton Greaves, Power Control, Gerard
114	DP / SPN SFU/SDFU with HRC Fuses	Havells, L&T, Crompton Greaves, Siemens
115	All moulded fuse with HRC fuses/Distribution fuse board with HRC Fuses	Siemens, L&T, GE, C&S, havells, Schnelder (MG)
116	Rewirable type porcelain switchgear, fuse fittings	Anchor, GE, Standard, Havells, Indo-Asian
117	Switchgear with HRC fuses	English Electric, Siemens, L&T, Jyoti, System Control
118	Changeover Switch	L&T, Elecon, Gerard, Havells, Indo-Asian

119	PVC 5A and 15A Switches	Anchor, Precision, MK, CPL
120	PVC 5A and 15A Socket	Anchor, Precision, MK, CPL
121	Clock Switch / time Switch	L&T, MDS, Hager, GIC, Indo-Asian
122	Measuring Instrument (Ammeter, Voltmeter, P.F. meter)	Automatic Electric, Industrial Meter (I.M.P) Universal Electric, L&T, Kaycee
123	Instrument meter	Universal Electric Ltd., Automatic electric Ltd., Meco Instruments (P) Ltd., Industrial Motors (P) Ltd., Havells Pvt.
124	On/Off Rotary Switch/ Selector Switch/ Programme Switch0	Siemens, Leader, L&T, Kaycee
125	Lamp Holder or batten	Anchor, Leader, Ellora, Plaza
126	Ammeter/Voltmeter selector switch	Kaycee, L&T, C&S, AE, Siemens
127	Current Transformer	Kappa, L&T, C&S, AE, Siemens
128	APFC Relay	L&T, GEC, Crompton & Greaves
129	Capacitors	GEC, Crompton Greaves, Universal, NGEF, BHEL, Maher (L&T), Gulati, Maohar Brothers, Madhav, Khatau & Junker, Voltas, Escop, Crompton, HIcco, Energy Capacitors.
130	Any Other Item	As decided by Engineer-in-charge
131	Metering equipments like C.T.P.T. and trivectometer	Gyro, IMP, GEE, Universal, Simco, HPL
132	D.O.L. And Star Delta Starter	L.T., LK, Siemens, L&T, Jyoti, System controls
133	D.G. Set Engine	Kirloskar, Ashok Leyland, Cater Pillar, Cummin
134	Alternator	KEC, NGEF, Crompton, Jyoti
135	Gls, / hpsv, hpmv, floure-scent tubes, other type lamps	Philips, Crompton, Bajaj, Mysore Lamps, Sylvania–Hazman, Osram, Wipro
136	Luminaires	Philips, Crompton, Bajaj, Lumes, GEC, Wipro
137	Switches, SFV	Anchor, Radart, Khosla, Vinay, Pointer, MK, CPL
138	Emergency Lights	Prolite, Elite, Istalie

139	PVC power and control cable, flexible, and house wiring cables	Universal, Asian, Finnolex, Torrent, Uniflex, Tropdor, Jhonson, HMT Cale Corporation, Omega
140	Steel Tubular Poles, Caps and brackets	ITC, Rubit, Unifab, B.T.& P.Co.
141	Pumps	Kirloskar Brothers Limited, Mather & Platt. (I) Ltd., Jyoti Limited, Beacon wire Ltd., Worthington India Ltd., Bharat Pumps & Compressors Ltd., KSB Pumps, Grundfose / Kishore/Flow more/Roto/Tushaco.
142	Gravity Feed Type Chlorinators	Banaco/Chlorocontrol/Metito/Precession/Penwalt
143	Free Residual Chlorine Comparator	Glaxo / Lovibond
144	Chlorination Plant Accessories for Connecting Chlorine Tonner Container	Banaco/Chlorocontrol/Metito/Penwalt
145	Electrical Actuators	AUMA/Marshal/Rotark
146	Gates	Jash/Yashwant/Geeta/BIC
147	Diffusers	EDI/OTT/Rehan
148	DO Meters	E & H, Forbes
149	Centrifuge/Energy Saving Drum thickener Belt Filter Press	Humbolt, Alfalevel, Penwalt, Napier-Reid
150	Screw Pumps	Roto, Alpha Helical, Tushoca, Remo
151	Dosing Pumps	Milton Roy, Grundfos, Prominent, Shapotools
152	Nut Bolts SS-304	Kundan
153	Decanter	C-Tech, Premier tech, Napier Reid, Geo-miller
154	SS Piping	Zindal, Lloyds, Zenith.
155	UV disinfection Unit	Alfa Level or Equivalent
156	HDPE Pipes	Hallmark, Vijay Sangir, Sriram Polymers, Finolex
157	Ozonator	Pollucon, Oze Air, Ozonia
Note: Any item whose make is not given or other equivalent make will be subject to approval by the Engineer in Charge before supply.		

SPECIAL TECHNICAL SPECIFICATION FOR ELECTRO-MECHANICAL WORK

(SEWAGE TREATMENT PLANT) (PART –B)

General Requirements

1 Material

All materials incorporated in the Work shall be the most suitable for the service conditions and duty concerned. They shall be new and of reputed make / approved *STP Project for Jaipur* quality, free from imperfections and selected for long life and minimum maintenance.

Non–destructive tests, if called for in the Specification, shall be carried out. All submerged moving parts of the Plant, or shafts and spindles or faces etc. in contact with them shall be of corrosion resistant materials. All parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall maintain their properties without aging due to the passages of time, exposure to light or any other cause. All materials shall conform to the material standards as per BIS or any equivalent standard.

2 Work man ship

Workmanship and general finish shall be of first class quality and in accordance with best workshop practice. All welds shall be as per IS, BS, ASME standards. All tolerances and clearances shall be as per good and sound engineering practices.

Should the Employer's representative not consider any material acceptable, it shall be replaced.

3 Design Features

As far as practicable, all designs shall be as per latest concept and practices. The equipment shall be new, of robust design for a long reliable operating life. These shall be capable of 24 hours per day continuous operation for prolonged period in the climatic and working conditions prevailing at the site and with a minimum of maintenance. Particular attention shall be given to extra temperature and the rating of electrical and mechanical equipment, cooling systems and the choice of lubricants shall be for the temperatures as specified.

Paints used shall be the manufacturers' standard and shall be suitable for duty as described. The equipment shall be designed to provide easy access to and replacement of component parts which are subject to wear without the need to replace whole units. All parts in contact with water shall have a life from new to replacement for 13 YEARS minimum and new to repair of not less than five years.

Design features shall include the protection of equipment against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Equipment shall operate

without undue vibration. Noise reduction measures shall be adopted such that levels of 75 dB (A) at 3 meters are not exceeded. Parts shall be designed to withstand the maximum

stresses under the most severe conditions of normal service. Materials shall have a high resistance to change in their properties due to the passage of time, exposure to light, temperature and any other cause which may have a detrimental effect upon the performance or life of the Plant.

All rotating elements shall be dynamically and statically balanced.

All equipment shall have name plates specifying the makes, model, rating and other pertinent information.

4 Lubrication

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

The Contractor shall furnish a complete schedule of recommended oils and other lubricants. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the Employer's representative for approval.

Lubricants shall be oil and grease. The Contractor shall indicate indigenously available equivalent lubricants, with complete specification. Where the lubricant is grease, preference shall be given to a pressure system which does not require frequent adjustment or recharging. Preferably, life lubricated grease packed bearings shall be used. Where more than one special grease is required, a grease gun for each special type shall be supplied and permanently labelled.

5 Name Plates

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

6 Painting At Manufacturer's Works:

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

Parts may be cleaned but surface defects may not be filled in before testing at the manufacturer's works. Parts subject to hydraulic test shall be tested before any surface treatment. After testing, all surfaces shall be thoroughly cleaned and dried out, if necessary by washing with an approved de-watering fluid prior to surface treatment. Except where the specification provides to the contrary, all painting materials shall be applied in strict accordance with the paint manufacturer's instructions.

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

At Site:

Immediately on arrival at the site, all items of Plant shall be examined for damage to the paint coat applied at the manufacturer's works. Any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.

After erection, such equipment/ items which are not finish painted shall be done so. Items that have been finish painted at the manufacturer's works shall be touched up for any damaged paint work. For finish painting, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be at least 25 microns. The dry

paint film thickness shall be measured by Elcometer or other instruments approved by the Employer's representative. In order to obtain the dry film thickness specified, the Contractor shall ensure that the coverage rate given by the paint manufacturer will enable this thickness to be obtained. Strength of adhesion shall be measured with an adhesion tester and this value shall not be less than 10 kg/cm2. Painted fabricated steel work which is to be stored prior to erection shall be kept clear of the ground and shall be laid out orstacked in an orderly manner that will ensure that no water or dirt can accumulate on the surface. Suitable packing shall be laid between the stacked materials. Where cover is provided, it shall be ventilated.

Acceptable Makes: - Berger/ Shalimar/Asian/Woodlas/Neroalc

7 Galvanising

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

a) Fabricated steel : 460 gms/sq. m

b) Fasteners : 300 gms/ sq. m

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

8 Supports for Pipe Work & Valves

All necessary supports, saddles, slings, fixing bolts & foundation bolts shall be provided to support the pipe work. Valve and other equipment mounted in the pipe work shall be supported independently of the pipes to which they connect.

All valves to be installed in straight lines shall be installed between the flanges with a dismantling joint or SS expansion bellow at one side of the valve. The dismantling joint must allow a minimum clearance of 20 mm. The pressure rating of the dismantling joint / expansion below shall be same as that of the valve.

Mechanical fine Screens

General :

Mechanically operated step Screen completely made of Stainless Steel having 6 mm clear spacing between the bars shall be provided in inlet screen channel for screening out floating materials such as plastic pouches, bags, rags, floating debris, weeds, paper wastes and other floating materials from the raw sewage coming from the pumping station / gravity mains.

The screen shall include discharge chute as required to discharge the screenings on the belt

/ screw conveyor without employing any external mechanism / rake mechanism.

The screen shall be factory assembled & movement tested at plant before dispatch to site &

shall only be installed at the site in factory assembled condition thereby avoiding chances of

misalignments.

Scope:

Design, Supply, Installation, Testing & Commissioning of screening equipment consisting of

following:

Mechanized step screen having 6mm spacing between bars and suitable for installation at

an inclination of 40 degrees in channel.

Level sensing instrument connected to control panel for automatic operation of screen

mechanism and allied accessories.

Local control panel installed near screen.

Belt/screw conveyor to discharge the screened material of the screen to the waste bin.

Specification

Material of construction:

The fixed as well as movable bars, mechanism, support frame, fixings discharge chute shall be manufactured from stainless steel for long life in the aggressive sewage environment. No component of the screen assembly shall be made of carbon steel or any other material, which can get corroded in sewage environment.

Screen Construction

The step screen shall be a complete unit comprising of main frame with an integral mechanism containing movable bars located in between fixed bars without engagement of external mechanism / rake mechanism for pulling out the screened material ensuring minimum movement of the mechanism.

The mechanism comprising of movable bars located between fixed bars shall gradually move the screened material upward in the form of a mat and deliver on the up to the discharge chute.

The fixed as well as movable bars shall contain a series of steps to prevent the screenings

from falling back into the main flow.

The mechanism shall be mechanically operated by Electro-motor or hydraulic system and shall be suitable for automatic operation controlled by a level sensor.

- The screen shall operate automatically when the upstream water level of the screen increases beyond a pre-set limit and it shall stop when the upstream level decreases to a preset low level due to upward travel of screened material. The fine bar screen shall be capable of being tilted out of the sewage flow up to horizontal position for the purpose of cleaning & maintenance. The base of the screen shall be fitted with a specially profiled stainless steel plate to direct any grit that may be present towards the screen and taken out along with other screened material thus reducing the possibility of building up of grit in front of the screen.

Level Controller

The level controller shall be upstream type Ultrasonic level switch.

Electrical Motor

The motor shall be TEFC type with IP 55 protection and shall be suitable for operation on

415V + 10% and frequency of 50Hz + 5%.

Control Panel

The Control Panel shall have IP 55 protection, painted with Epoxy paint and shall be

comprising of

Mushroom Head Emergency stop

Overload relays for motor protection

MCB's, HRC Fuses and Glass Fuses

Circuitry to operate the screen with level sensors.

Selector Switch to operate the screen on JOG mode

Shop Testing

The screen should be completely manufactured and offered for inspection at the plant of the manufacture confirming the above mentioned eligibility criteria. A screen assembled by a vendor and offered for inspection at the plant of a vendor / sub contractor shall not be accepted. The screen shall be subjected to following tests at manufacturer's premises by third party inspection and / or JDA representative(s):

Dimensional Check: The overall dimension of the screen shall be conforming to the approved drawings.

Operational Test: The complete screen including its carriage, rake, drive system and brake motor shall be mechanically operated and tested to verify interference free movement and satisfactory operation.

10 Air blowers for Oxygenation

The blowers shall be provided for providing adequate oxygen into the reactor tank for aeration. The air requirements shall be calculated for summer and winter as well as for mixing power the higher duty shall be installed. The summer sewage temperature shall be taken as 38 degrees C and that in winter at 10 degrees C.

The blowers shall be capable of developing the required total pressure at the rated capacity for continuous operation. The blowers shall be Tri-lobe or Twin lobe type. The blowers shall be provided with suction air filter, silencer, dead weight pressure relief valve and pressure gauge and the air delivered shall be clean, dry and oil free. The blower noise level and velocity of vibration shall be within 85 dB (A) at a distance of 3m respectively. The blower shall be driven by squirrel cage induction motor.

The speed of the blowers shall be below 1500 rpm. The power rating of motor shall be at least 10% above the maximum power requirement by the blower. The blowers shall be mounted at a level necessary to avoid back low or siphoning of sewage into the blower.

Material of construction:

Casing : C I conforming to IS: 210 Gr FG 260

Rotor : Alloy steel

Shaft : Carbon steel C40/EN 24/19

Timing gear : Cast alloy steel

Pulley and gear side plates and cover : CI conforming to IS 210 Gr FG 260

Tests

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

11 Diffused Aeration System

This comprises piping to diffusers and the diffusers.

Type of diffuser system

A fine bubble diffused aeration system shall be applied to aeration tank for oxygenation. The number of diffuser elements can be varied by the bidder depending on the manufacturer selected, subject to the condition that sufficient design calculations are attached along with it and the manufacturer is a standard one having supplied the diffusers to various waste water treatment plants of similar nature.

Diffuser Elements

The diffuser elements shall be of EPDM/PU tubular membrane type and resistant to such ingredients as hydrocarbons, oil and grease. This shall afford a high oxygen transfer rate coupled with a minimal pressure drop besides permitting simple erection onto the horizontal air manifold. They shall have self-cleaning properties while in action. The diffuser unit shall be of corrosion resistant material. The membrane diffusers shall permit connection to the air manifolds of circular or square cross section and the entire lot of diffusers shall be capable of discharging designed flow of air at an average flow (maximum of summer and winter requirement) when installed in the said SBR tanks.

The diffuser grid shall be of fixed type. The headers onto which the diffusers are fixed shall be of standard Imported PVC/UPVC pipe sections of suitable inner bore and shape with custom fixtures of the diffuser elements as directed by the membrane manufacturers. Alternative pipe materials shall be acceptable provided the same are a mandatory part of the diffuser supplier and have been in the supplier's line of supply as original equipment. The headers shall also be procured from the equipment manufacturers who are the suppliers of the membrane diffusers. These headers shall have enough counterweight or alternative arrangement to surmount any buoyancy lift from the floor during air charging.

Air Supply Piping

The air piping from the blower to the basin header (above water) shall be of MS epoxy painted material and pressure rated for the sewage depth plus frictional losses etc. Each air header shall travel downward from the air piping by aligning itself onto the sidewall of the aeration tank and thereafter travel horizontally onto the tank floor. These shall be fixed securely to the concrete surfaces in the horizontal plane and vertical plane so that they are not clamped horizontally onto vertical sides of the walls. The clamping shall be so designed as to permit "in-situ" screw driven fittings. Breaking open concrete surfaces shall not be permitted.

12 Specifications for Epoxy Painting

Zinc rich epoxy primer and epoxy paint of approved quality shall be used for external and internal painting. No primer shall be applied without prior approval from the Employer's Representative. The max of zinc rich epoxy primer shall be prepared at work site not earlier then 15 minutes before applying the same on pipes and special surfaces. One coat of zinc rich epoxy primer of DFT 75 micron shall be applied along with two coats of epoxy paint DFT 40 micron and DFT 30 micron respectively. No thinner shall be added to ready mix paint without previous approval of the Employers' representative and the finishing coats on top of the primer coat shall only be applied after allowing the film to cure for at-least 48hrs. After application of zinc rich epoxy primer the surface should be cleaned by duster and inspected. If during inspection any portion is found rusting the same shall be removed by emery paper and coated with zinc rich epoxy primer. Mixed paint should be used within 3 to 4 hrs. of mixing and fresh mixing shall be done for every new application. Every successive coat of paint shall be given only after 48 hrs. of previous coat. Before applying the next coat the surface should be properly cleaned by duster.

13 Specifications for Decanting Drive

The decanting device shall be rotating moving arm devices of Stainless Steel with top mounted gear box, drive, scum guard, down comers, collection pipe, bearings. The following type of decanter assemblies are not acceptable:

· Rope driven decanters.

· GRP products.

· Valve-arrangement.

- The maximum design travel rate shall be 60 mm/min. with proven hydraulic discharge capacity of the decanter proportional to the selected basin area. Bidders to provide sample graphs of executed projects with such decanting speeds with decanters of min. same size (length)

- There should be Maximum 1 decanter per basin.

- The hydraulic design based on design flow rates as given above shall not exceed flow speeds of 1.3 m/s.

- Flexible rubber hose kind of decanter sealing is not acceptable.

- Each Decanter mechanism shall be inclusive of local control boxes with manual operation selection and function buttons, communication to main PLC by DH485 or Ethernet

14 Submersible Pumps for Return and Excess sludge

Return sludge pumps shall pump the return sludge from the sump to the aeration tank. Pumps shall be submersible type of non –clog design. They shall be suitable for pumping soft solids normally present in raw sewage. Raw sewage pumps with maximum 960 rpm shall be provided. In addition to this, the pumps shall be fitted with a special tearing system on the suction side for tearing soft solid material. The impeller shall be of a non-clog design with smooth passage and desired solid handling capability. Maintenance-free anti- friction bearing, deep grooved permanently greased filled ball bearings shall be provided to take care of all the axial and radial forces at any point of operation. The pump installation design shall be such as to facilitate automatic installation and removal of the pumps without having to enter into the sewage pit. The motor shall be squirrel cage type, suitable for three phase supply continuous duty with class 'F' insulation. Motor shall have integral cable parts and the cable entries shall be sealed. The cables must be leak tight with respect to liquids and firmly attached to the terminal block. The motor shall be designed for non-overloading characteristics. There shall be thermal protection against overheating of the motor winding. The pump design shall ensure that seal does not come directly in contact with the liquid being pumped as well as cooling / lubrication by oil is provided. The moisture sensor of the tripping unit shall be located inside the oil chamber.

The pump unit shall be supplied along with the special duck foot bend, flanged elbow, lifting chain with shackles, enough guide wire / pipe, sufficient tough rubber sheeted water proof cable, as well as stainless steel foundation bolts and nuts. Alternatively pump unit can be with SS wire rope guiding system and pedestal cart integrated with the discharge head.

Reverse Rotation

The pump shall be designed to operate safely in the reverse direction of rotation, due to

wastewater returning through the pump.

Pump Construction

Refer Section – 2.0 Scope of Work of the tender.

Pump Bearings

Pump bearings shall be of the antifriction type. The bearings shall be able to take normal axial thrust loads due to unbalanced hydraulic loads on the impellers plus the weight of all rotating parts of the pumps. Pump bearings shall be designed with a minimum life of 40,000

hours. The bearings shall be grease lubricated for life and shall be maintenance free

Mechanical Seals:

A double mechanical seal of approved type shall be provided to prevent pumped liquid

entering into the motor winding. The seals shall be running in oil bath. The oil bath shall have moisture sensors to sense water leakage. The sensors shall be used for tripping the pump and also for alarm.

Pump Balance:

All rotating parts shall be accurately machined and shall be in rotational balance. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case the amplitude of vibration as measured at any point on the pumping unit shall not exceed the limits set forth in the latest edition of Indian Standards. At the operating speed, the ratio of relative speed to the critical speed of the unit or its components shall be less than 0.8 or more than 1.3.

Lifting chain

Each pump shall be provided with galvanized steel lifting chain of suitable capacity. One end of the chain shall be attached to the pump and the other end fixed near the upper bracket for guide rail / wire rope assembly, by means of GI D shackle. The chain shall have GI rings fixed at an interval of about 1 meter for engaging the hook of the chain pulley block.

Submersible Cable

Each pump shall be provided with submersible cables of equal length for power and control so that the pump positions can be interchanged with each other. The cable shall be terminated in a common weatherproof junction box.

Moisture Sensor

The moisture sensor shall be provided in the oil chamber to detect the failure of the mechanical seal.

Motor

The motor shall be integral part of the pump. The enclosure for motor shall be IP-68. Each phase of the motors shall be provided with thermostat. The motor winding shall be suitable for star delta/soft starter. The motor shall be designed for minimum 10 starts/stops per hour, irrespective of whether it is DOL start or otherwise. For other requirements refer subsection

VI. The motor shall operate satisfactorily at all operating levels in wet well.

Protective Coating:

The pumps shall be epoxy painted.

15 Other Sludge Pumps

These pumps shall be of screw type used for pumping sludge to centrifuge. The pumps shall be designed to operate satisfactorily without detrimental surges, vibration, noise, or dynamic imbalance. Over the required head range, the head-capacity curve of the pump shall have a continuously rising head characteristic with decreasing capacity over the whole range of total head. The pump shall have the maximum efficiency at the specified duty point. The unit shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to sewage returning thro the pump at times when power supply of the motor is interrupted.

All rotating parts shall be statically and dynamically balanced as per ISO standards.

A stationary coupling guard shall be provided for the coupling conforming to all relevant safety codes and regulations. Guards shall be designed for easy installation and removal. They shall be complete with necessary support accessories and fastener.

The pumping unit shall be provided with a common base plate. The base plate shall be of sufficient size and rigidity to maintain the pump and motor in proper alignment and position.

The pump design shall be as per IS 6595 and pump performance shall be as per IS 9137.

The power rating of the pump motor shall be the larger of following

(i) 115 % of power required by the pump at the duty point

(ii) 110 % of maximum power required by the pump from zero discharge to the runoff point total head

Material of Construction & Specifications

Type Screw

MOC Alloy Steel

Base plate CI / MS Epoxy painted

Fastener SS AISI 304.

Pump speed 960 rpm (maximum)

Ball passing size 25 mm minimum

Applicable code

Design IS 6595

Performance IS 9137

Testing

Material test certificate Casing, Impeller, Shaft

Hydrostatic test 1.5 times shutoff head or twice the rated discharge head whichever is greater

Performance test IS 5120 and IS 9137 at full speed

Mechanical balancing As per ISO 1940, Gr. 6.3 or better

Visual inspection Pump shall be offered for visual inspection before shipment. The pump components shall not be painted before inspection Field Tests Field performance tests required for satisfactory operation

17 Disinfection System Shall include:

17.1 Suitable dosing pumps as approved by the Engineer In-Charge shall be established along with proper and adequate storage of sodium hypochlorite solution shall be provided.

17.2 Chlorination Room

The chlorination room/shed shall be constructed as per requirement as approved by Engineer In-Charge.

18 Valves

18.1 General

Valves shall be as per internationally recognized standards. Flanges shall be machined on faces and edges to ISO 7005, IS 6392. Valves shall be flanged type. For sluice / gate calves, back seat arrangement shall be provided. Valves buried or installed in underground chambers, where access to a hand wheel would be impracticable, shall be operated by means of an extension spindle and / or keys. Valves shall be suitable for frequent operation as well as operation after long periods of idleness in either the open or closed position. The valve stem, thrust washers, screws, nuts and all other components exposed to the water shall be of a corrosion resistant grade of stainless steel. All valves parts shall be in general of the material of construction best suited for the proposed application. The inspection category is detailed in subsection VII.

18.2 Sluice Valves

The gate face rings shall be securely pegged over their full circumference. Valves of 450 mm and above shall be provided with a thrust bearing arrangement for ease of operation.

They shall also have renewable channel and shoe linings. The gap between the shoe and channel shall be limited to 1.5mm. Alternatively, valve of diameter 450mm and above may be provided with a gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and gearing shall be such as to permit manual operation in a reasonable time and not to exceed a required rim pull of 80 N. All hand wheels shall be arranged to turn in a clockwise direction for opening and counter clockwise for closing. These directions shall be indicated on the hand wheels. All valves shall be rated for not less than PN 1.0.

All valve doors when fully closed will ensure door faces are riding on body seat ring by at least 50% of width of seat ring providing sufficient allowance for wear. Valves of diameter 450 mm and above shall be provided with a drain and air plug.

Material of Construction

Body, Bonnet, Wedge : CI conforming to IS 210 Gr FG 260

Spindle

Drain and Air Plug : IS 318 Gr LTBZ

Seat Ring, Wedge Ring : SS 304

Back seat Bush : Bronze IS: 318 Gr LTB 2

Gland Packing : Graphite Asbestos

Parameters

Type : Rising spindle

Nominal pressure : 2 times working pressure in pipeline

Nature of operation : Horizontal / vertical

Applicable code : IS 14846

Tests: : Acceptance tests as per IS 14846

18.3 Knife Gate Valves

Knife gate valves shall be suitable for use at suction and delivery side of pumps in a sewage pumping station. The valve should be provided with gate made of stainless steel and the gate should have bevelled knife edge at the bottom to cut through and easily enter in the solids settled in the bottom and ensure positive shut-off / closure in sewage environment. The valve should be bonnet-less and suitable for face to face flange connections in between pipelines. It should be suitable for uni-directional application. The valve body should be of Cast Iron Gr. FG 260. The body shall be designed to withstand 6 bar pressure.

The valve shall be provided with replaceable type flexible sealing seals to offer drop tight shut off. The seals should be made of EPDM rubber and should be held in place by an easily removable type seal retainer ring. The seal retainer ring should be designed in a manner so that the flow of the fluid should be away from the sealing perimeter and towards the centre of the valve.

The valve housing should have integral as cast tapered lugs provided for pushing the gate towards the flexible rubber seal only at the verge of closure with a view to avoid seal wear and achieve drop tight shut off. The surface of the gate coming in contact with the seal should be polished & buffed.

The valve shall be provided with sufficient ply of stuffing seals in the in built stuffing box to seal the rear opening. The stuffing box should have internal tappers for pushing the seals on to the gate. The seals should be of non-asbestos PTFE to reduce the friction and offer higher life. Provision shall be made to enable tighten the stuffing seals by means of a pusher arrangement to minimize the leakage through the back of the valve. Replacement of stuffing seals should be done in installed condition of the valve.

The spindle should be double start threaded and non-rising type for compact & safe operation. The gate movement area should be covered by protection shields. Gate opening indicating arrangement should be provided to find out the extent of gate opening /closing. Flange drilling suitable to mount between flanges as per IS 1538 -1993.

Body: Cast Iron FG 260 as per IS 210

Knife gate: AISI:304 Gr. ASTM A240

Retainer ring: SS:304 ASTM A351 Gr. CF:8

Inlet Seal: EPDM

Spindle: AISI:410 Gr. ASTM A276

Spindle Nut: Cast Iron Gr. FG 200 as per IS 210

Stuffing plate: Cast Steel ASTM A216 Gr. WCB

Stuffing seal: Synthetic yarn with PTFE

18.4 Reflux Valves

Reflux valve shall possess high speed closing characteristics and be designed for minimum slam conditions while closing. External counterweights are not acceptable. Check valves shall conform to API 594 and API 598. They shall have metal to metal sealing. The pressure drop in the valve at design flow shall be limited to 0.4 mWC.

Material of construction

Body CI conforming IS 210 Gr FG 220

Plate SS AISI 316

Spring SS AISI 316

Seal SS AISI 304

Parameters

Nominal pressure Twice the pressure in pipeline

Nature of operation Automatic

Closure characteristic Non slamming

Applicable code API 594

Tests Acceptance tests as per API 598

19 Pipe Work

All pressure pipes carrying raw sewage and sludge within the pumping stations shall be DI K-9 Class. All gravity pipes carrying raw / treated sewage shall of RCC NP2 Class. The treated and chlorinated sewage should be disposed off to the adjacent stream by closed RCC NP2 pipe in case of gravity or DI K-9 pipe in case of pumping. All Air pipes above water shall be of MS. Air Down comers to diffuser grid shall be in SS304. All sludge pipes below water shall be of SS304.

The pipe works for the plant involves procuring, supply, laying and jointing of suitable size electrically welded steel, cast iron, ductile iron, u PVC, RCC and PSCC pipes along with matching specials etc. as required. All yard piping inside the plant shall be cast iron or ductile iron. All pipe work and fittings shall be a class rating in excess of the maximum pressure attained in service including any surge pressure. The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or major items of equipment.

CI/DI Piping above ground level shall be only flange jointed and adequately provided with structural/ masonry supports. All pipe work shall be adequately supported with purpose made fittings, wherever necessary. Flange adapters and union shall be fitted in pipe work

runs, wherever necessary, to permit the simple disconnection of flanges, valves and equipment. The Contractor shall be responsible for ensuring that the internal surfaces of all pipe work are thoroughly cleaned before and during erection and commissioning. Cleaning shall include removal of dirt, rust, scale and welding slag due to site welding. Before dispatch from manufacturers works, the ends of the pipe, branch pipes etc., shall be suitably removed until immediately prior to connections adjacent pipes, valves or pumps. All small-bore pipes shall be blown through with compressed air before connection is made to instruments and other equipment. No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of the Employer's representative. All underground buried mild steel piping unless found otherwise necessary, shall be protected by the application of hot coal tar enamel and fibreglass wrapping. The coating shall consist of one coal` tar primer one coat, wrapping of fibre glass one more coat of enamel and the final wrap of enamel impregnated fibre glass. However, all water supply plumbing pipelines shall be of GI class B and either anchored externally with SS AISI fasteners or appropriately buried below the ground with a sand cushion of 20 cm all round. All sanitary piping shall be of UPVC class 4 suitably buried below the ground with a sand cushion of 20 cm all round. Changes in direction on the ground shall be achieved with inspection chambers of 45 cm x 45 cm and heavy-duty CI/Steel reinforced fibreglass chamber covers. The minimum size for sludge pipes shall be 100 mm diameter. The minimum delivery piping for pumps shall be 80 mm. Velocities in the delivery lines shall be 1.0 to 1.2 m/s. All sludge lines should have provisions for flushing.

19.1 C I Pipes

The C I pipes and specials their laying and jointing and their dimensions shall conform to IS 1536, IS 1538 and IS 3114 with their latest revisions. The quality of cast iron shall meet grade 15 of IS 210 and be free from flaws, air bubbles, cracks, sand holes and other defects and shall be truly cylindrical and of uniform thickness. The methods for sampling of C.I. pipes and fittings shall conform to IS 11606. Pipe work outside the buildings shall use Tyton ring joints and inside, double flanged joints. All underground pipes shall be provided with granular bedding. Thrust blocks wherever required in the opinion of the Employer's representative shall be provided in accordance with relevant specifications of the BIS Tests:

Following tests shall be carried out on the C.I. pipes:

(i) Mechanical Tests

as specified in I.S. 1536 during manufacture of the pipes.

(ii) Hydrostatic tests at works

The pipes shall be tested hydrostatically at the pressure specified in Table 1 for spigot and socket pipe and as per Table 2.0 for flanged pipes of IS 1536. The pressure shall be applied internally and shall be steadily maintained for a period of minimum 10 seconds and the pipes shall be moderately struck with a 700 gm hammer. The pipes shall withstand the pressure test and shall not show any sign of leakage, sweating, cracks or fracturing or other defects.

(iii) Testing at site

The following site tests shall be carried out after a new pipe is laid, jointed and partially backfilled.

(a) Pressure test

The pressure test at a field test pressure specified in clause 7.2.1 of IS 3114 shall be carried out. Pipes and joints shall be absolutely water tight under the test. The procedure for testing shall be as per clause 7.2.1 of IS 3114.

(b) Leakage test

The leakage test shall be conducted as per clause 7.3 of IS 3114 and the leakage should be within the specified allowance as calculated using formula given in clause 7.3.2 of IS 3114.

(c) Water required for any type of testing shall be arranged by the Contractor, at his own cost.

(d) Markings:

The following markings on the pipe shall be cast, stamped or indelibly painted-

1. Manufacturer's name or identification mark

2. The nominal diameter

3. Class reference

4. Mass of pipe

5. The I.S. Code reference

6. The year of manufacture

The marking shall be done outside the socket or towards the end of barrels of the pipe. The coating on the pipes, both internally and externally shall be provided as per clause 15.0 of IS 1536.

19.2 Galvanized Iron pipe

The procurement, supplying, laying, jointing and testing at works and site of Galvanized Iron (G.I.) pipes and fittings shall be in accordance with IS 1239 (Part I and II) and its latest revisions. The general requirements relating to the supply of mild steel tubes shall conform to IS 1387. The sulphur and phosphorus requirements in steel shall not exceed 0.05 percent each. The galvanizing of the pipes shall be as specified in IS 4736. The zinc coating shall be uniform adherent, reasonably smooth and free from imperfections. The pipes shall be galvanized before screwing. All screwed pipes and sockets shall have pipe threads conforming to the requirements of IS 554. Gauging in accordance with IS 8956.25 shall be considered as an adequate test for conformity of threads of IS 554. Screwed tubes shall have taper threads while the sockets shall have parallel threads. The specifications for G.I. pipes shall be generally in accordance with Clause 15.4 of standard specifications. The tolerances on the length of pipes shall follow clause 11.0 of IS 1239 (Part I). The fittings for G.I. pipes shall be of mild steel tubular or wrought steel fittings conforming to I.S. 1239 (PartII). The laying of G.I. pipes and fittings shall follow the relevant I S code of practice. These pipes shall be used for drinking water supply for the office and laboratory buildings. The pipes shall be painted with two coats of anticorrosive bitumen paint.

Testing of G.I. pipes

Hydrostatic test shall be carried out at works at a pressure of 5 M Pa, maintained for at least 3 sec and shall not show any leakage in the pipe. The tensile strength of length or strip cut from selected tubes, when tested in accordance with IS 1894 shall be at least 320 N / mm2. The elongation percentage shall be as per clause 14.1.1 of IS 1239 (Part I). The bend test shall also be carried out as per clause 14.2 of IS 1239. The G.I. pipes and fittings shall be tested at site, after they are laid and jointed as per clause 15.4.11 of standard specifications.

19.3 LDPE Pipes: (Low Density Poly Ethylene Pipe)

The International standard specifies the required properties of pipes made from poly ethylene (PE). Confirming to ISO 2527:1996.

Dimensions

The dimensions of pipes shall be measured in accordance with ISO 3126.

The tolerances on the outside diameters shall be in accordance with ISO 11922-1 as

Grade A for normal tolerance (NT pipes)

Grade B for close tolerance (CT pipes)

Length of pipe.

The length of straight pipes & coils shall be not less than that agreed between supplier and user.

Finishes

All internal surfaces of the pipes should be regular and smooth. The shape of the finished ends should be fixed by the manufacturer to suit the type of joint used.

Specials

The specials should be manufactured from LDPE/Hard plastic, polyacetal split rings for positive grip and should sustain maximum working pressure 16 bar at 20° C. should be available in sizes 20mm (1/2"), 25 mm (3/4"). The fittings should also be supplied by the manufacturer of the pipes. They should preferably be manufacturer by the manufacturer of the pipes. In case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under its own supervision and have it tested at his / sub contractor's premises as per the contract. The pipe manufacturer will however be responsible for the compatibility and quality of the products.

19.4 Ductile Iron Pipes

The DI pipes shall be centrifugally cast (spun) for Water and Sewage and confirming to IS 8329-2000. The pipes used shall be both gasket joints and flanged joints. The minimum class of pipe to be used shall be class K-9 conforming to IS 8329. In general, pipes inside the buildings and below the structures shall be jointed as double-flanged pipes and those outside the building can be either EPDM gasket in accordance with IS 5382 and manufactured by the pipe manufacturer only. The pipes shall be supplied in standard lengths of 5.5m and 6.00m length with suitably rounded chamfered ends. Any change in the stipulated lengths will be approved by the Engineer's representative. The flanged joints shall confirm to the Clause 6.2 of IS 8329. The pipe supply will also include one rubber gasket for each flange.

Inspection and Testing:

The pipes shall be subjected to following tests for acceptance:

(i) Visual and dimensional check as per clause 13 and 15 of IS 8329.

(ii) Mechanical tests as per clause 10 of IS 8329.

(iii) Hydrostatic test as per clause 11 of IS 8329.

(iv) The test reports for the rubber gaskets shall be as per acceptance tests of the IS 5382 and in accordance to clause 3.8

The sampling shall be as per the provisions of the IS 8329.

Markings

All pipes shall be marked as per clause 18 of IS 8329 and shown as below:

(i) Manufacturer name / stamp

(ii) Nominal diameter

(iii) Class reference

(iv) A white ring line showing length of insertion at spigot end.

Packing and Transport

The pipes should be preferably transported by road from the factory and stored as per the manufacturer's specifications to protect them from damage.

Specials for DI Pipes

The DI specials shall be manufactured and tested in accordance with IS 9523 or BS 4772.

The mechanical test and hydrostatic test shall confirm to clause 9 and clause 10 respectively of IS 9523. The tolerances on dimensions shall be as per IS 9523. The manufacturer of the pipes shall supply the fittings.

All the DI fittings shall be supplied with rubber rings for each socket. The rubber ring shall conform to IS 12820 and IS 5382. Flanged fittings shall be supplied with one rubber gasket per flange and the required number of nuts and bolts.

20 Sluice Gates

The construction of sluice gates shall be in accordance with the specification and generally as per AWWA C 501 or IS 13349. The sluice gates shall be capable of performing the duties set in the specification without undue wear or deterioration. They shall be constructed so that maintenance is kept to a minimum. All parts of sluice gate, including mechanism components shall be designed for the heads specified with a minimum safety factor of five.

All sluice gates shall be of the raising spindle type.

All sluice gates shall be manually operated. Motorised gates, if provided by the Contractor, the actuator specs be got approved from the Employer's representative.

Constructional features

The sluice gates shall be standard design of manufacturer's and of robust construction. The special features shall be as follows

Frame:

The frames shall be of ample section and cast in one piece. All surface forming joints and bearings shall be machined. The frame shall be of the flange back type and shall be machined on the rear face to bolt directly to the machined face of the wall thimble.

Guide:

The guide shall be bolted to the frame or cast integrally with it and shall be machined on all bearing and contact faces. The length of the guide shall be such that it should support the gate upon the horizontal line of stem nut pocket. Arrangements shall be such that it should support the gate upon the horizontal line of stem nut pocket. Arrangements shall be made to prevent lateral movement of bolted on guides. They shall be capable of taking the entire thrust produced by water pressure and wedging action. Wedges or wedge facings shall be attached to the guides at point where, in the closed position, they will make full contact with the wedging surface on the slides.

Seating Faces

The seating faces shall be of full width, solid section. They shall be secured firmly by means of counter sunk fixings in finished grooves in the frame and slide faces in such a way as to ensure that they will remain permanently in place as well as free from distortion and loosening during the life of the sluice gates.

Wedging devices

Sluice gates shall be equipped with adjustable side, top and bottom wedging devices required providing contact between the slide and frame facing when the gate is closed position. All faces shall be machined accurately to give maximum contact and wedging action. Wedges shall be fully adjustable with suitable adjusting screws and lock nuts and so designed that they will remain in the fixed position after adjustment.

Gate slides

The slide shall be with strengthening ribs where required and reinforced section to receive the seating faces. The slide shall have tongues on each side extending its full length and tongues shall be machined accurately on contact surfaces. Surfaces of the slide that in come in contact with the seat facing and wedges shall be machined accurately. The maximum allowable clearances between the slide and slide gate shall be 1.6 mm. An integrally cast stem nut pocket with reinforced ribs shall be provided above the central line of the slide.

Stem nut and Lift nut

A gate shall be provided with lower fixed stem nuts for connecting the stem to the slide and revolving lift nut located in the lifting mechanism in the head stock. They shall be of ample design to endure the thrust developed during gate operating under maximum gate operating condition loads in opening and closing direction. The stem nut and slide shall be constructed to prevent turning of the stem nut in the pocket in the slide. The stem nut shall be threaded and keyed or threaded and pinned to the stem.

Stem

The operating stem shall be designed for a tensile strength to withstand 90 kg effort on the crank and for a critical buckling compressive load assuming a 36 kg effort on the crank. The threads of the stem be machine cut or rolled and of the square or acme type. The number of threads per inch shall be such as to work most effectively with the lift mechanism used. The top of the stem be provided with a stop collar. Stem shall be provided with polycarbonate cover fixed to the headstock.

Stem coupling

The coupling shall be threaded and keyed or threaded and bolted and shall be of greater strength than the stem

Stem guide

Stem guides shall be cast, with bushings and mounted on cast brackets. Guides shall be adjustable in two directions and shall be so constructed that when properly spaced they shall hold the stem in alignment. The number of stem guides shall be such that the unsupported length of stem shall not exceed one hundred times its diameter.

Lifting Mechanism

Sluice gates shall be operated through a suitable lifting mechanism, which shall incorporate gearing if required. The lifting mechanism shall be suitable for operation by one man under all conditions. The lifting mechanism shall incorporate a strong locking device suitable for use with a padlock or padlock and chain. The manual operation shall be of the hand wheel crank operated type and shall have a lift nut threaded to fit the operating stem. The crank shall be removable. Ball or roller thrust bearings shall be provided above and below flange on the lift nut to take the load developed in opening and closing the gate with torque of 14 kg-m on the crank. Fittings shall be provided to lubricate gears and bearing. The design of the lift mechanism of the hand operated gates shall be such that the slide can be operated with torque is not more than 7 kg-m on the operator after the slide is unseated from wedges based on the operating head. The maximum crank radius shall be 380 mm.

Gears and bearings

All gears and bearings shall be enclosed in cast iron housing with labyrinth seals. The lifting mechanism shall be of cast iron pedestal, machined and drilled to receive the gear housing and suitable for bolting to the operating floor. The gates shall close with clockwise rotation of the crank. The direction of rotation to close the gates shall be indicated on the lift mechanism. A suitable means shall be provided for lubricating the stem threads directly adjacent to the lift nut. An inspection cover shall be provided to access the lift nut and gearing.

Fasteners

All anchor bolts, assembly bolts, screw, nuts etc., shall be of ample section to safely withstand the forces created by the operation of the gate.

Wall thimbles

The wall thimbles shall be made of cast iron and shall be supplied along with the gate. The wall thimbles shall provide a rigid mounting and designed to prevent warping of the gate frame during installation. The cross section of the thimble shall have the shape of the letter ‘F’. The front, or mounting flange, shall be machined and shall be attached to the thimble with bolts and studs. The depth of the wall thimbles shall not be less than 300mm. To permit entrapped air to escape as the thimbles are being encased in the concrete, holes

not less than 35 mm diameter at not more than 600 mm span, shall be cast or drilled in each entrapment zone formed by the reinforcing ribs or flange and water stop.

Material of Construction

Frame, Guide, Thimble, Stem C I conforming to IS 210 Gr 260

Guide Bracket, Wedges,

Door Sealing faces Bronze conforming to IS 318 Gr LTB 2

Spindle SS AISI 431

Flush bottom resilient seal Natural or synthetic rubber conforming to IS: 1855

Anchor bolts SS conforming to IS 6603

Hand wheel Cast iron

Stem cover Polycarbonate transparent tube.

Parameters

Type Rectangular rising spindle

Size As per requirement

Applicable code IS 13349

Class 1

Maximum seating head As per contractors design

Unseating head As per contractors design

Maximum distances between gates As per contractors design.

centre line and operating platform

Tests Seat clearance check, moving tests, leakage tests and Hydrostatic tests as

per IS 13349/ AWWA C 501 shall be conducted at Manufacturer's works in accordance with the Inspection category.

21 Open channel Gates

The manufacture of open channel gates shall be in accordance with the manufacturer's standard. All open channel gates shall be of the rising spindle type. All open channel gates shall be manually operated or motorised as per process requirements. Open channel gates shall be tested as per manufacturer's standard. The open channel gates for pumping stations shall be CI sluice gates. The material of construction shall be as follows.

Components Material Specification Grades

Gate frame, shutter,

Headstock, Flush bottom

seal support bar, Stop nut.

Cast Iron IS: 210 –

1993

FG: 260

Sealing faces/ Seat facings Stainless Steel ASTM A276 AISI: 304, 316

Resilient rubber seal Natural Rubber EPDM

Rubber Neoprene

Rubber

Seal retainer bar Stainless Steel ASTM A276 AISI: 304, 316

Stem / Spindle Stainless Steel ASTM A276 AISI: 304, 316

Operating Nut/ Stem Nut Leaded Tin Bronze IS: 318 – 1981 LTB 1, LTB 2

Fasteners Stainless Steel ASTM A276 AISI: 304, 316

Anchor Bolts Stainless Steel ASTM A276 AISI: 304, 316

Yoke Mild Steel IS: 2062 – 1992 Grade A

22 Chain Pulley Blocks

Geared Chain Pulley Blocks shall be adopted. The monorail and trolley and the chain pulley block shall be provided for lifting the blowers and submersible pumps. The trolley and chain pulley block shall be hand driven. The capacity of the trolley and the chain pulley block shall be for the maximum weight to be lifted during erection and maintenance of the equipment but should not be less than 1 tonne. The travelling trolley shall run on the lower flange of the rolled steel joist. The trolley shall have two wheels on both sides of the joist web. The trolley wheels shall be single flanged with treads machined to match the flange of the beam. The wheels shall be of carbon steel casting conforming to IS 1030. The trolley shall have an arrangement for the fixing chain pulley block and sling. Pushing the load shall move the trolley. Suitable arrangement shall be provided on the joist to prevent over travelling. The chain pulley block shall have frame housing gears load sheave, brake unit, hand chain wheel and load chain wheel shall have hooks on both sides, one fixed with traveling and other for the load. The frame shall be of welded construction.

The gears shall be of spur type incorporating high grade hardened carbon steel pinion and heat treated carbon steel wheels. The width of the gear shall be adequately sized for long life. The driving pinion shall be integrated with the driving shaft. The load hook (bottom hook) shall rotate on the ball bearing. The chain shall be electrically welded, accurately calibrated, pitched and polished. The length of the load chain shall be sufficient for taking out the blower/pumps from their location. The hand chain wheel shall be provided with roller type guarding to prevent slipping the chain. The hand chain wheel shall hang to cleat of the hook.

The braking shall be automatic, the screw and friction disc type and shall offer no resistance. The load shall be sustained in any position of lift when effort for hoisting or lowering is removed. Each chain pulley block shall be supplied with one set of 1 tonne sling with galvanized D- shackles and clamps. The slings shall be about 3 m long. The monorail shall be 'I' section. The exposed mild steel surfaces shall be enamel painted. The fasteners shall be GI or Cadmium plated. The chain pulley block shall be tested for 150% overload through a length of lift which will be ensure that every part of the block mechanism and every teeth of gears come under load.

23 Valve Actuators

All actuators shall be motorized type and local controls shall be protected by a lockable cover.

Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required. The gearbox shall be oil or grease filled, and capable of installation in any position. All operating spindles, gears and head stocks shall be provided with adequate points for lubrication.

The valve actuator shall be capable of producing not less than 11/2 times the required valve torque considering valve spindle jamming and shall be suitable for at least 5 continuous operations.

The actuator starters shall be integrally housed with the actuator in robustly constructed and totally enclosed weatherproof housing. The motor starter shall be capable of starting the motor under the most severe conditions.

The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication, and shall also be fitted with internal heaters so as to provide protection against damage due to condensation. Heaters shall be suitable for single phase operation. The heaters shall be switched "ON" when the starters are "OFF" and shall be switched "OFF" when the starters are "ON".

Each actuator shall be equipped as follows:

(a) AC electric motor with engage/disengage clutch mechanism of the dry type.
(b) Reduction gear unit (with thrust bearing if required)
(c) Torque switch mechanism
(d) Limit switch mechanism
(e) Geared hand wheel for manual operation of valve.
(f) Valve position indicator – open/closed
(g) Auto-Manual lever with suitable locking arrangement
(h) Reversing contactor starter complete with overload relays of suitable range and adequately rated control fuses
(i) Actuator shall have selection between local/remote operation
(j) Local control switch/push buttons
(k) 415 V/110 V AC control transformer
(l) A white lamp for supervision of main supply to be provided locally.
(m) A potential free contact shall be provided to annunciate over-load trip/main supply failure on remote panel
(n) Provision for local as well as remote operation

01 CHAPTER SPECIFICATIONS - ELECTRICAL

1.0 INTENT OF SPECIFICATIONS / SCOPE

1.1 This specification along with specific job requirements (if any) is intended to cover the design, engineering, supply, installation, testing and commissioning of entire electrical facilities / equipment and items and accessories including consumable against item rate price for entire treatmemt plant / facility as indicated here in and else where covererd in the scope of this tender.

1.2 It is not intended to cover all aspect of system design but to indicate the basic requirements only. Contractor shall ensure that detailed design and installation is carried out as per good engineering practices and shall meet requirements of safety, reliability, ease of maintenance & operation, aesthetics, scope for future expansion and maximum interchageability of the equipment.

1.3 Bidder must quote the price according to intent, besides content of the of the tender.

Engineer's / Consultant's interpretation of the meaning of the specifications, drawings shall be final who shall have the right to accept or reject any material or work which in his assessment is not complete to meet the intent of this specification and/or applicable standards.

1.4 The equipment and accessories shall be complete in all respects and any device not included in this specification but essential for proper operation of the plant shall be deemed to be with in the scope of this specification whether specifically mentioned or not.

1.5 It is the responsibility of bidder to visit and assess the site conditions for the purpose of this work.

1.6 Bidder shall also ensure to take care of existing works / piping / cabling, if any, during execution and ensure no damage is done and obstruction be resolved in consultation with engineer in-charge at no extra cost. In case of any damage, it is the responsibility of bidder to rectify the problem to the satisfaction of engineer in-charge at no extra cost.

1.7 The equipment / items shall be supplied only as per approved vendor list for major items enclosed herewith as part of this tender document. Bidder shall furnish necessary technical catalogue and details and obtain approval for the make of items he proposes to procure before placement of order. The decision of client / engineer in- charge in the matter is final and binding. Approval for makes of items not mentioned in the approved list of vendors will also be required to be obtained from engineer in- charge before procuring the same.

1.9 Compliance with this specification and / or review of any of the vendor documents shall not relieve the vendor of his responsibility towards his contractual obligation with regard to the completeness and satisfactory operation of the plant.

2.0 SCOPE OF WORK

Supply, Installation, Testing and Commissioning of the entire electrical facilities

including electrical equipment, control devices, fittings, cables/wires, conduits, hardware and consumable and also including all relevant works like termination, cable jointing, earth excavation/backfilling, structural works for equipment support / M.S. fabricated cable trays, all allied civil works, etc.

In outdoor areas cables shall be mostly laid directly buried underground with adequate mechanical protection wherever applicable. Where as in indoor areas, cables shall be laid in trenches / walls / ceilings / structures through suitable trays / cleats.

Installation of the contract work including furnishing labour (Skilled / Unskilled) and supervisory personnel inclusive of the services of an experienced engineer, having authorized and valid supervisory license is included in the scope of work / services.

All installation are to carried out as per the staturoy requirement of local Electrical Inspectorate / I.E. rules / applicable I.S. Code / code of practices and obtaining statutory clearance from Electrical Inspectorate shall be in the scope of executing contractor.

3.0 SPECIFICATION OF ELECTRICAL WORKS (GENERAL) General

Following clauses specify General Electrical requirements and standard of workmanship for the equipment and installations. General specification clauses shall apply where appropriate except where particularly redefined in the Special Specification Clauses.

3.1 Equipment Selection

The general basic requirements for design and selection of equipment shall be:

Safety of Personnel and Equipment

Adequate operational reliability

Ease of Installation, Operations and Parts
Interchangeability of Equipment and parts
Robust and economical design

The offered equipment shall be brand new with state of the art technology and proven field track record. No prototype equipment shall be offered.

3.2 CODES & STANDARDS

The electrical equipment and complete installation offered shall comply with the

relevant Indian Standards / Codes of Practices, this specifications, Statutory regulations and sound engineering practices.

The complete system shall conform to the latest revisions of the following:

The Indian Electricity Act & Rules

The Indian Electricity (Supply) Act, 1948

Regulations laid down by local statutory authorities and CEA / Electrical

Inspectorate.

The requirement of JVVNL State Electricity Board.

Fire advisory Committee Insurance Act / Fire Insurance Regulations

Indian Petroleum rules and any other regulations laid down by the Chief Controller of

Explosives

The factory act and any other regulations laid down by factory inspectorate

3.2.1 Obtaining approvals from statuory authorities for materials, plant design / drawings and complete installation shall be the responsibility of the contractor. The contractor shall get the drawings, layouts of HT sub station etc. approved from local electric supply company and Chief Electrical Inspector, as applicable. The contractor also shall arrange to get the installation inspected by CEIG and carryout modifications / rectification as required by CEIG, prior to commissioning of sub station / electrical equipments.

3.2.2 Wherever Indian Standards do not exist, the relevant IEC, British or German (VDE) / IEEE / NEMA standards shall apply. Any other Standard which is considered equivalent to or superior than applicable Indian Standards may also be acceptable. The tenderer however, shall have to substantiate equivalence or superiority.

3.4 VOLTAGE REGULATION

During starting of heavy equipment the voltage may drop by a maximum of 15% for period of up to 45-60 seconds depending upon the duty of the driving equipment. All the electrical equipment shall, therefore, be suitable for trouble free and uninterrupted operation even during such voltage variation at the time of starting of heavy equipments.

3.5 SITE / AMBIENT CONDITIONS

All electrical equipment and installation shall be designed for the tropical climatic conditions and be suitable continuous operation under the site conditions as described below for design purpose :

Maximum ambient temperature :
45 deg. C Minimum ambient temperature :
5 deg. C

Design Ambient temperature : 45 deg. C (unless otherwise specified for specific components/equipment)

Relative humidity : 94%

Climate : Tropical, dusty, Corrosive

If not specifically mentioned, an altitude not exceeding 1000 m above mean sea level shall be taken into consideration for design purpose.

Where the equipment is installed outside and exposed to direct sunrise, these shall be suitable for operation at higher ambient temperature and rigorous weather conditions under which they are required to operate.

3.6 DESIGN BASIS

The distribution system shall be designed in accordance with project specifications and shall ensure continuity / reliability of supply, flexibility of operation and safety.

All components of the Electrical System shall be sized to suit the maximum load under the most severe operating conditions. Accordingly, the maximum simultaneous consumption of power, required by continuously operating loads shall be considered and additional margin shall be taken into account for intermittent service loads, if any.

The basic design data to be considered as follows: Incoming Supply Conditions:

Voltage and variations : 415 V $\pm$ 10%

Frequency and variations : 50Hz $\pm$ 3%

Combined variation : $\pm$ 10%

System Grounding : Effective

Fault Level at 415V (Design) : 43.1 kA Symmetrical (1 sec)

Control circuit voltage : 110V DC for 11KV switch gear from

Built-in power pack within scope of SWGR

240V AC for PMCC/MCCs tapped from P & N HV

Cabling : 3C XLPE, 11 kV (E)

LV Cabling : Alu Conductor XLPE/PVC, excepting

for Motor up to and including 3.7kW for which

to use 3C x 2.5 sq.mm, Cu conductor, PVC or XLPE cables subject to voltage drop within specified limits. Cables having aluminium conductor shall not be less than 6 sq.mm

Control / LCS Ammeter Cables: Multicore 2.5 sqmm Cu cond., PVC / XLPE LDB to Lighting Points : 2.5 sqmm 3/4C, Cu conductor, PVC cable Earthing : Earth Pit: Cu Plate type (For Tx. & DG Set

Neutral) / G.I. Pipe electrode as per IS:3043

OR

Chemcial Earthing, as specified in BOQ Main Earth Grid: GI Strip as per BOQ Transformer / PCC-MCC / MLDB: GI Strip as per BOQ

Motors : Squirrel Cage Induction Motor, TEFC, IP-55, Continuous Duty (S1) rating, Class F insulation with temp. rise limited to Class B, as per IS:325 and other relevant IS specification. Motors shall be Energy Efficient as per Eff2 / Eff1 Class. However, motors operating with VFD shall have vacuum impregnated, double insulation winding

with Class H insulation. Force cooling arrangement preferred for motor rating 11kW and above and interlocked with VFD operation.

3.7 Power is expected through single circuit 415 V overhead line from the Local Power Supply Company to be terminated in proposed new plant's Two Pole Structure, fuses and lightening arrestors. Power is then transmitted through cables buried underground and terminated to the indoor 415 V switch gear board located in substation.

3.8 The 415 V switchgear shall comprise of suitable Circuit Breakers.

415V Power Control Centre (PCC) at sub station building. This PCC shall in turn feed down stream PMCC / MCC and MLDB etc. for feeding various loads.

3.9 The motors shall be suitable for outdoor installation with tropical insulation and weather proof to IP-55 as a minimum. All motors shall be started and stopped by push buttons at Local Control Stations located near respective motors. Starters shall be housed in PMCCs / MCCs with START, STOP (Mushroom head stay put type) & OVERLOAD Reset Push Button. Motors of rating less than 7.5 kW shall be provided with Direct-On-Line starting provision unless otherwise specified, motors of rating

7.5 kW and above but less than 75kW shall be provided with fully automatic Star/Delta Starters and motors of rating 75kW and above shall be provided with Soft Starters unless specifically mentioned to operate with alternative mentods like VFD, etc. or as specified in enclosed SLD. Motors shall be energy efficient as per Class EFF2 / Eff1.

3.10 In outdoor areas cables shall be mostly buried directly underground with mechanical

protection wherever applicable. In indoor areas, cables shall be laid in trenches through medium duty GI cable trays. Cables shall be so selected that voltage drop at consumer end does not exceed 3%. Cables having aluminium conductor shall not be less than 6 sq.mm.

Cables shall be sized based on the maximum continuous rated load current after suitable derating, min. 10% overload capacity after derating and the voltage drop. The derating due to ambient air temperature, ground temperature, grouping and proximity of cables with each other, resistance@70°C max permissible temperature rise for cables, etc. shall be taken into account. The de-rated cable current shall be atleast

10% higher over the rated load current. A derating factor of 0.65 shall be used as a minimum or higher as per site conditions. Vendor will have to submit the calculations for the same.

3.11 Sub-station / MCC Room: Sub-station or MCC room, wherever required shall be located in a safe area close to load centre. The building shall be sized to take care of present and future needs and to maintain adequate clearances between equipment for ease of maintenance. Clearance around equipment shall be maintained as per IE rules and equipment supplier's recommendations, which ever is higher.

Due to DC Power Pack, battery banks are not anticipated. However, if Battery Banks are required / provided, same shall be located in a separate adequately ventilated room along with necessary exhaust system and water connection with sink. Floor of battery room and walls upto 1.0m height shall have acid/alkali resistant protective material coating/tiling.

Adequate safety equipment such as insulating mats, exit signs, shock/fire hazard charts, Warning signs, first aid boxes, portable fire extinguishers, etc. shall be provided in sub-station / MCC room as per statutory regulations.

3.12 Earthing system design and installation shall be genrally as per IS:3043. Earthing system shall be carried out by GI strips, electrodes by GI pipes. All equipment shall have two separate and distinct earth points. Earth reistance shall not exceed one ohm at any point.

3.13 Suitable rating automatic power factor improvement panel with integral capacitor bank shall be provided at each Main bus to improve and maintain a lagging power factor of 0.95 or better.

3.17 DRAWINGS / DOCUMENTS

Execution Drawings / Documents

Following detailed design drawings / documents to be prepared in line with

recommended specifications / details and submitted to engineer in-charge in a timely manner to allow for review and approval as a minimum:

a) List of Drives / Loads with Qty. / Rating / Specifications along with power load statement

b) Transformer, D.G. Set and Capacitor Sizing Calculations c) SLD and control diagram of complete electrical system

d) Wiring / Schematic Drawings for complete electrical system (HT Panels, LT Panels, Lighitng Panels, PDBs, etc.)

e) Overall Cable Layout & Unit Wise Cable Tray layout f) Earthing Layout with Earthing Calculations

g) Internal Lighting Layout with Calculations h) External Lighting Layout

i) Cable Schedule with voltage drop calculation / sizing calculations j) Interconnection Schedule

k) G.A. Drawings for all equipment including sectional drawing wherever necessary, and specifying recommended installation, weight, clearnance requirements, etc.

l) Filled in Data Sheets

m) Schedule of quantities along with brief specifications

n) Design / sizing calculations for equipment as applicable o) O&M manual for all equipment

As-Built Drawings / Documents

All above final documents and drawings incorporating modifications, if any, done

during erection / commissioning shall be furnished in number of sets as specified in scope of work.

3.18 Condition of Operation

The equipment offered shall be suitable for continuous operations under high ambient temperature of 45^0C, which shall also be considered as design temperature for selection/sizing of equipment, unless otherwise specified.

The Contractor shall submit layout drawings, showing the location of switch board and other equipment proposed to be installed for the approval of Engineer.

4.0 EQUIPMENT / TECHNICAL SPECIFICATIONS

All equipment shall be new and supplied by approved reputed manufacturer only. All equipment shall be complete with all necessary weather and anticorrosion protection including tropicalization to prevent damage due to climate, harsh atmosphere, dust and corrosive vapours.

Certain minimum requirement for the major equipments shall be as follows:

4.6 LT PANELS (MV SWITCHBOARDS) – PCC / PMCC / MCC / OTHER MV SWITCH BOARDS

SPECIFIC DESIGN REQUIREMENTS

The panels shall be floor mounting, free standing, totally enclosed and dust, damp & vermin proof, compartmentalized. Enclosure shall have IP-52 degree of protection as a minimum. Overall height of Panel (including base frame) shall generally not exceed

2100 mm.

The motor control centers should be fabricated out of minimum14 SWG CRCA sheets except that the doors and covers may be made of 16 SWG CRCA sheet. Wherever required, stiffeners shall be provided to increase stiffness of large size doors and covers. The switchboard shall be provided with integral base frame for each vertical panel suitable for tack welding to the floor embedded channels (ISMC-

75 as a min.). All the doors and others openings shall be provided with gaskets of durable material (e.g. neoprene).

All hardware shall be corrosion resistant. Star washers shall be used for effective continuity.

Suitable removable type lifting hooks and / or jacking pads shall be provided on each panel or shipping section for ease of lifting of switchboard. These hooks when removed shall not leave any opening in the panels.

It shall be of fixed type, single/double front execution. Circuit breakers (ACBs) panels shall be in single front execution only. Motor starter and power feeders / switch fuse modules accommodated at front and rear of incomer and bus coupler panel are not acceptable. Also vacant space on incomer and bus coupler panel shall not be used for mounting the starter and switch fuse modules. Access to all operating devices shall be from the front of the switchboard.

All metering and protection equipment associated with a particular circuit shall be housed in separate and independent compartment earmarked for that particular circuit and in the fixed portion of the vertical panel in case of breaker panels.

All auxillary devices for control, indication, measurement and protection such as pushbuttons, control and selector switches, indicating lamps, ammeters, voltmeters, kWH meters and protective relays shall be mounted on the front side of respective compartment. The design shall be such that unless required for maintenance / inspection purposes, all power on/off or start/stop and relay reset operations shall be performed without opening panel door.

All ACBs shall be drawout type and rest circuit breakers / motor starters shall be fixed type. Type of ACBs shall be as specified below in other specifications / requirements for ACB

All feeders to be housed in separate compartments. All compartments to be fully segregated from one another, as well as from bus bar chamber, with sheet steel barriers. This type of construction shall be single front or double front as required. Each feeder compartment to have a separate door. PCC incoming feeder shall have bus duct entry from top. Bottom cable entry for rest feeders through cable alley where as outgoing/incoming Circuit Breaker feeders to have bottom exit/entry from respective compartment itself. Cable termination compartment shall be provided.

Main Bus Bar shall have rating at least equal to the maximum demand under any circuit configuration. Incomers of these switch boards shall also be designed to cater to the complete load. Bus bars shall be of high conductivity, electrolytic aluminum (E91-E). The maximum temperature of bus bar shall be 85º C i.e. maximum permissible temperature rise over design ambient of 45º C shall be 40º C.

All incomers to same switch board shall be of equal rating. All circuit breakers shall be of single break type having one pole per phase.

Each short circuit interrupting device shall be designated to have breaking capacity equal to or higher than the maximum value of the short circuit current at the point of installation. MCCBs with back-up fuses shall not be acceptable.

Air Circuit Breakers shall be provided in LT/MV Switchboards for all feeders rated

630A and above and MCCBs for feeders rated below 630A. Provison of MCB/SFU

can be accepted for power feeders of up to 63A rating.

Circuit Breakers for capacitors shall have a current rating of atleast 135% of the capacitor rated current. Circuit breakers capability to interrupt applicable capacitative current shall be specifically verified.

The switch board components viz. circuit breakers, main horizontal and vertical busbars, busbar joints, busbar supports etc. shall be designed to withstand the maximum expected short circuit level for minimum 1 sec.

Moulded Case Circuit Breakers for power feeders shall have built-in short circuit and thermal overload releases. The rated service short-circuit breaking capacity (Ics) of MCCBs shall be more than or equal to the specified fault level.

The Power Control Centre (PCC) shall generally include incomers & bus coupler with necessary electrical / mechanical interlocks or shall be as per deisgn, and shall have required outgoing breaker feeders.

Heavy Duty type load break switch / ACB shall be provided for incoming and tie feeders and these shall have suitable interlocks and shall be designed to withstand the specified/design short circuit level for minimum 1 sec.

For capacitor bank feeder SFU is acceptable and for feeders of up to 63A rating for

which MCB/SFU can be accepted.

Where required, contactor controlled feeders shall be provided to feed lighting panel. The outgoing Motor Feeders should Comply to Type-2 Coordination as per IS:13947. SW. Bds shall have main horizontal and riser bus bars air insulated, housed in a separate compartment, segregated from all other compartments, with sheet steel barriers. Busbars shall be of high conductivity, electrolytic aluminum, suitable for carrying the rated and short time current without overheating. Busbars shall be adequately supported on insulators to withstand dynamic stresses due to short circuits. Busbar support design should ensure free thermal expansion.

Busbars for risers shall be rated to carry 125% of the rated current of all feeders connected to the risers.

Isolators shall be heavy duty load break, of AC23 category.

Isolators shall be rated for 120% of circuit full load current with minimum rating of 25 Amps.

All fuses shall be HRC, link type.

All power contactors shall be rated for duty category AC3 except for auxillary contactor which shall have 4 Amps, 4NO + 4 NC.

All bimetal overload relays shall be of hand reset type with atleast 1NO and 1NC contact with reset type push buttons, mounted on door such that it shall be possible to reset the O/L relay with door closed.

The MCC shall be provided with a continuous earth bus having sufficient cross section to carry the specified fault current for specified duration without exceeding the safe temperature throughout its entire length.

All control wiring except C.T. secondary wiring shall be carried out with minium 1.5 sqmm copper conductor. C.T. secondary wiring shall be carried out with 2.5 sq.mm copper conductor.

Adequately rated anti-condensation heater with poecelain connectors shall be provided in each breaker panel and in cable alley to maintain inside temperature 5 deg C above outside ambient temperature. It shall be supplied from 240V AC auxillary bus for space heater. The space heater shall be provided with a thermostat having variable setting of 30-70 deg C and manually operated switch fuse and link for phase and neutral respectively.

All LDB shall be sheet steel enclosed with ELCB (30 mA) / MCB and with 20A S.P.,

9 kA MCB Outgoing feeder or as per requirement.

It shall be possible to monitor the LT breaker status including various fault conditions from remote location for which required spare potential free contacts shall be made available wired at terminal block. Similarly it shall be possible to operate the electrically operated breakers (EDO ACBs) from remote location and control wiring shall be designed accordingly. All microporocessor based relays & multifunction meters, where provided as per specifications, shall communicate with PLC/SCADA through required communication port & cable. Spare contacts (min. 1 NO + 1 NC) shall be made available at control terminal strip for all breakers module status including on, off, trip, spring charged (for elect. motor oper. Breaker), L/R selector switch as a minimum.

Indicating instruments (meters) shall be of digital type for all PCC/PMCC incomers and analog type for all outgoing feeders & starters. The meters shall be generally of square pattern type of 96 x 96 mm suitable for flush mounting. Instrument shall generally conform to IS: 1248 & shall have accuracy class of 1.0 or better. All incomers of PCC/PMCC/MCC shall be provided with digital type ammeter and voltmeter with required

selector switches / with Multifunction meters, as specified.

Analog Instrument dial shall be white with black numerical and lettering. The meter shall have external zero adjustment. Ammeter fitted in motor circuit shall have suppressed scale to indicate maxi. starting current.

Digital meters shall have 3 ½ Digit, LED / LCD display as a minimum Multifunction meters (MFM): MFM where specified digital type only suitable to measure & display various parameters including Per Phase RMS Voltage & Currents, kW, PF, Frequency, Phase Sequence, kVA, kVAr, kWh, kVAh, kVArh,

MDS, etc. MFM shall be with RS-485 serial port (Modbus) for remote communication.

All starter feeders shall be suitable for operation from local & remote location as well as in manual and auto modes. Auto-Manual and Local-Remote Selector Switches shall be provided at each starter for this purpose. The drive shall operate in auto mode (from ICP / PLC, etc.) when A/M selector switch is placed in auto mode and when placed in manual mode, the drive shall operate through LCS when L/R switch is placed in remote mode and from MCC starter when in local mode. It shall be possible to monitor the starters including various fault conditions from remote location for which required spare potential free contacts shall be made available wired at terminal block. Similarly it shall be possible to operate the electrical drives from remote location and control wiring shall be designed accordingly. All multifunction meters, VFD and soft starters, where provided as per specifications, shall communicate with PLC/SCADA through required communication port & cable. Spare contacts (min. 1

NO + 1 NC) shall be made available at control terminal strip for all starter module status including on, off, trip, A/M selector switch status in auto mode, etc. as a minimum.

All indicating Lamps shall be of min. 20 mm dia. LED type with series resistance & metal body.

Push Buttons shall be oil tight type with 2 NO + 2 NC contacts with min. 4A rated current (AC-11). All push button except for Emergency Stop PB shall be flush type with spring aided self reset contacts. Emergency Stop PB shall be mushroom headed type with stay put contacts and shall be press to lock & twist to release type. All motor starters cubicles (at PMCC / MCC) shall be provided with Emergency Stop Push Button only.

OTHER SPECIFICATIONS / REQUIREMENTS Bus Bar

Bus bar shall be of high conductivity aluminium (E91-E) supported on insulators made of non-hygroscopic, non-inflammable material with tracking index equal to or more than that defined in IS. The main bus bars shall have uniform current rating throughout their length. The current rating of neutral shall be half that of phase busbars. Removable neutral links shall be provided on feeders to permit isolation of the neutral bus bar.

Both horizontal and vertical busbars, bus joints and supports shall be capable of withstanding dynamic and thermal stresses of the specified short circuit currents for 1 second. Only zinc passivated or cadmium plated high tensile steel bolts, nuts and washers shall be used for all bus bars joints and supports. The short circuit capacity of neutral bus bars shall be in line with IS:13947.

The hot spot temperature of bus bars including joints at design temperature shall not exceed 85 deg C for normal operating conditions i.e. 40°C temperature rise over design ambient temperature of 45°C.

All busbars shall be insulated with heat shrunk PVC sleeves of 1100V grade.

Vertical busbars for circuit breaker panels shall be sized depending upon the rating and number of breakers per vertical panel. Vertical busbars for MCC panels shall be of uniform cross section. Size of vertical busbars of MCC panels shall not be less than

50 x 10mm aluminium per phase. Minimum size of busbars for starter/feeder power connections above 100 amp rating shall be 20 x 6mm aluminium.

Wiring and Terminal Blocks

All wiring shall be done with IS approved PVC insulated copper conductors. The insulation grade for these wires shall be 660V grade. The control wiring shall preferably be enclosed in plastic channels or neatly bunched together.

Control / CT circuit wiring shall be PVC insulated, copper conductor of 2.5 sqmm size. Each wire shall be terminated at a separate terminal. Shorting links / suitable shorting arrangement for shorting CT secondary shall be provided.

Each wire shall be identified at both ends by PVC ferrules.

Interpanel wiring shall be done through PVC sleeves or rubber grommets.

A minimum of 2 nos. or 20%, whichever is higher, spare terminals shall be provided on each terminal block. Conductors shall be terminated with adequately sized compression type lugs. Clamp type terminal for direct conductor termination shall be acceptable for wires upto 10 sqmm size and bolted type terminals with crimping type copper lugs shall be provided for all outgoing cable connections larger than 10 sqmm.

Marking on the terminal strips shall correspond to wire numbers on the wiring diagrams.

All spare contacts and terminal of panel mounted equipment and devices shall be wired to terminal blocks.

Earthing

All vertical panels shall be connected to a tinned copper earth bus bar running through out the length of the switchboard. The minimum earth bus size shall be 30 x 6 sqmm tinned copper for fault level upto 31.5 kA and 50 x 6 sqmm tinned copper for fault level above 31.5 kA. All doors and movable parts shall be earthed using flexible copper connections to the fixed frame of the switch board. Provision shall be made to connect the earthing busbar to the plant earthing grid at two ends. All non-current carrying metallic parts of the mounted equipment shall be earthed. Minimum 4 nos.,

10mm dia bolt with nuts shall be provided on the earth bus for termination of fourth core of cable per vertical panel.

Name Plate

A name plate with the switch board designation shall be fixed at the top of the central panel. A separate name plate giving details of each feeder compartment of all vertical panels shall be provided.

Name plate or polyester adhesive stickers shall be provided for each equipment (lamps, push buttons, switches, relays, auxiliary contactors, fuses, etc.) mounted in the switchboard. Special warning plates shall be provided on removable covers or doors giving access to cable terminals and busbars. Identfication tags shall be provided inside the panels matching with those shown on the circuit diagram.

Painting

The panels shall undergo chemical derusting sand blasting decreasing, pickling in acid bath and phosphatised as per IS : 6005 and primed. The panels shall be thoroughly rinsed with clean water after phosphating, followed by final rinsing with dilute bichromate solution and oven drying. The phosphate coating shall be sealed by the application of two coats of ready mixed, stoving type zinc chromate primer.

After preparation of the under surface, the switch board shall be spray painted with two coats of synthetic enamel paint, each coat followed by stoving. The final finished thickness of the paint film on steel shall not be less than 100 microns and shall not be more than 150 microns. The colour shade for the final paint shall be 631 as per IS : 5 or as approved by client. The finished painted appearance of panels shall present and

aesthetically pleasing appearance free from dust and uneven surface.

The paint shall withstand humid tropical climate, rain, etc. The paint shall not scale of or removed by abrasion during normal handling.

Switchgear Modules

Switchboard shall be completely lined up in one straight row with the type and quantities of feeders. Generally the feeders of three main categories are identified as circuit breaker, switch fuse and motor starters.

Minimum 2000VA control transformer shall be provided for each bus section for motor control circuit voltage and each transformer shall be sized for the entire switchboard. For PMCC/MCC having two bus sections and coupled by bus tie shall have manual changeover switch for the control transformers.

To facilitate site modification due to changes in motor kW ratings and to minimize spares inventory, overload relays and power fuse links shall meet the following requirements:

a) The bimetal overload relays shall be separately mounted type with connecting links rated for the maximum rating of the contactor in a starter module.

b) Bimetal overload relays of various current ranges required for motors likely to be connected to a contactor must be identical in dimension for inter-changeability. In case offered relays are with different dimension for any particular starter module, special mounting plate suitable for mounting different relays shall be provided in all modules of that size.

All combination starter feeders shall meet the requirement of Type-2 co-ordination as per IS:13947.

Air Circuit Breakers

Circuit breakers shall be air break, draw out type for feeders rated 630A and above. The

medium voltage cubicle type switch board shall consist of ACB, 50kA (1 Sec.)

s.c. wihtstand rating / as per design. Time setting for over load, adjustable current

setting for short circuit protection and also earth fault protection adjustment facility shall be provided in the ACB. The ACBs shall be as under:

All Incoming ACB and Buscoupler for PCC/PMCC shall be Four Pole Type

All incoming & outgoing ACB and bus-coupler ACB of PCC / PMCC shall be

Microprocessor type only.

All PCC/PMCC outgoing feeder ACB shall be Three Pole Type (TPN). All Incoming ACB for MCC shall be Three Pole Type (TPN).

All ACBs shall be Drawout Type & Motor Operated for PCC Incomers & Bus

Coupler (EDO type) and rest shall be manually operated (MDO type) .

Trip release of ACBs for PCC/PMCC incomers shall be with communication port (shall communicate with PLC/SCADA for which necessary and compatible communication cable / cards shall be provided at PLC/SCADA) and for rest ACBs it shall be communication upgradable in future.

ACB Trip Release should have Minimum following

Overlaod with time delay

S/C with time delay and Inst. Trip Setting

Earth Fault with Time Delay. Under Voltage for incomer Trip Indications

Ammeter Dispaly

ACB shall be fitted with following

Heavy duty switch having not less than 4 NO + 4 NC contacts

Built in resin cast current transformer

Auxiliary contacts

Shunt and under voltage tripping device

Neutral CT for earthfault protection

The ACB shall be suitable for locking the breaker in various position. Provision for door locking ACB shall be provided with the requisite end termination lugs/sockets. Terminal bars for connecting more than one terminal.

The ACB shall have breaking capacity not less than 50 kA at 415 V AC.

Switches

The switches or fuse switches shall be load break, heavy duty / motor duty, air break type provided with quick make/break manual operating mechanism. The operating handle shall be mounted on the door of the compartment having the switch.

Rating of heavy duty switches or motor duty starter modules shall meet the requirement of AC-23 duty as per IS:13947.

Fuses

Fuses shall be non deteriorating HRC cartridge link type.

Power fuses shall be pressure fitted type and shall preferably have ribs on the contaqct blades to ensure good line contact.

It shall be possible to handle fuses during off load conditions with full voltage available on the terminals. Whenever required fuse pullers shall be provided.

The fuses shall have operation indicators for indicating blown fuse condition. The fuse and fuse carrier shall be suitably selected for rated and fault currents.

The fuse for motor control circuits shall be so selected that the same shall not operate during motor starting. For switch ratings above 200 Amps, fuse switch shall also be acceptable.

Contactors

The contactors shall be air break type, equipped with three main contacts and minimum 2NO + 2NC auxiliary contacts. The main contacts of a particular contactor for motor starter module shall have AC-3 rating.

Unless otherwise specified, the coil of the contactor shall be suitable for operation on

240V, 1 Ph, AC supply and shall work satisfactorily between 65 to 110% of the rated value.

Bimetal Relay

Bimetal relays shall be provided for protecting the motor from thermal overload. Bimetal relays shall be manually reset type with the reset push button brought out on the front of the panel. The reset push button shall be capable of being operated without opening the compartment door.

Bimetal relays shall be positive acting ambient temperature compensated type with

adjustable setting range.

Bimetal relays shall have built-in single phasing prevention feature which operate even with 50% rated current at the time of single phasing.

Moulded Case Circuit Breakers

Moulded case circuit breakers shall be fixed type fitted with trip free, manually closing mechanism, accommodated in a sheet steel housing of robust and vermin proof construction matching with switch boards. All MCCBs shall be tested as er IS – 2516 / IEC 947-2 and shall be provided short circuit and over load protection

(position of the knob shall clearly indicate ON, OFF and TRIP conditions.) Operating

handle shall be mounted on the door of the compartment housing MCCB. Each MCCB

shall be provided with minium 1 NO + 1 NC auxiliary contact.

All MCCBs for incoming of PCC / PMCC /MCC shall be Microprocessor type only.Rest MCCBs of thermal-magnetic type for outgoing feeders of PCC / PMCC / MCC are accepted.

MCCBs should be used for below 630 Amp. rating only.

All MCCBs shall selected considering the Total Discrimination Protection. Back up chart should be submitted during Drawing approval.

All PCC Feeder MCCB should be of min. 50 kA All
Load MCCBs should be of 50 KA

All MCCBs should be with Earth Fault Protection.

Settings –

O/L – 40 % to 100 % of In

S/C - 2 to 10 Ir

E/F – 20 % to 80 % of In.

MCCB as part of motor starter module shall be current limiting type and type tested for Type-2 co-ordination as per IS:13947.

Protective Relays

Relays shall be rectangular in shape, flush mounting type, having dust tight covers, removable from front, and shall be equipped with externally reset, positive action operations indicators. The relay shall have auxiliary units of either series connected or shunt connected type. All auxiliary relays shall be non-draw out type and protection relays shall be draught type with test facilities.

Test plug shall be supplied loose. All relays shall conform to the requirements of IS-

3231 or relevant IEC in general and IS – 3231 in specific.

Relays shall be provided with adequate number of potential free self reset / hand reset out put contacts as required. Provision shall be made for easy isolation of trip circuits of each relays for the purpose of testing and maintenance.

No control relay which will trip a circuit breaker when relay is de-energized shall be used.

Each tripping relay shall be lockout type with hand reset coil cut-off contact. The tripping relay shall be suitable for satisfactory operation from 50% to 100% of the specifed control supply voltage.

Instrument Transformers (CTs/PTs)

Current transformer shall generally conform to IS:2705 and any special requirement w.r.t. numerical relay shall be taken care of by contractor.

Current transformers for instruments shall have an accuracy class 1.0 and accuracy limit factor less than 6.0. The current transformers in breaker feeders shall be capable of withstanding the applicable peak momentary short circuit and the symmetrical short circuit current for 1.0 sec.

The voltage transformer shall be cast resin type. PT shall be provided with HRC fuses on primary side and MCBs on the seconday side.

Control Switches

All control switches, wherever applicable, shall be rotary, back connected type, having a cam operated contact mechanism. Switch shall have pistol grip handles for circuit breaker control and knob type handle for other applications. Ammeter selector switches, wherever applicable, shall have make before break feature on it's contacts. The selector switch shall generally have 4 positions for reading 3-phase current and fourth position for OFF. The voltmeter selector switch, wherever applicable, shall also have 4 positons. Three positions shall be used to measure phase to phase voltage and fourth shall be off position.

Push Buttons

Pushbuttons shall be oil tight type with 2 NO + 2 NC contacts; each contact shall have rated operational current of not less than 4A(AC-11)

Pushbuttons for START, OPEN, CLOSE, LEFT, RIGHT, FORWARD, REVERSE, etc. shall be flush type with spring aided self reset contacts.

Pushbuttons for STOP shall be flush type with spring aided self reset contacts & shall be coloured red.

Pushbuttons for EMERGENCY STOP shall be mushroom headed type with stay put contacts & shall be colored red. Further the operation of the button shall be press to lock and twist to release. All starters and LCS shall be provided with EMERGENCY STOP type push buttons for stopping the drives.

Push button colours shall be as follows:

Stop / Open / Emergency	-	Red
Start / close	-	Green
Reset / Test	-	Yellow / White

Indicating Lamps

Indicating Lamps shall be panel mounting type with rear connection. The lamps shall be of True Color Protected LED type with minium 8mm diameter size with min.

20mm dia lens.

Auxiliary Relays / Contactors

Auxiliary relays/contactors shall generally be used for interlocking and multiplying contacts. Auxiliary contact shall be capable for carrying the maximum anticipated current.

Timers

For reacceleration duty, timers unless otherwise stated, shall be pneumatic type and shall have adjustable time setting of 0-60 sec. Alternately static timers may be considered.

4.7 D

4.8 LOCAL CONTROL (PUSH BUTTON) STATION

Technical Requirements

Each motor shall be provided with a local control station in the field near the motor. The local control station shall have die-cast aluminium / FRP / Engineering Plastic enclosure with IP-65 protection for safe area. They shall be provided with canopy made of atleast 14 SWG (2mm) galvanized sheet steel or 6/8mm thick FRP as per BOQ. The canopy shall be suitable for providing protection against rain from top and two sides.

The control station shall include START/STOP push buttons, Local/Remote selector switch, breaker control switch, cable glands, ammeter as for motor rating specified elsewhere, Auto/Manual selector switches, etc. as required shall be provided as specified.

STOP push button shall have stay put feature and lockable in pressed position. Each push button shall have 1NO + 1NC contact and shall be complete with necessary inscription plates.

All control stations shall be suitable for 240V AC as well as 110V/220V DC control supply.

The control stations shall be provided with neoprene or other suitable / superior gaskets.

The enclosures shall be treated and prepared for painting with two coats of epoxy paint with final colour shade (both internal and external) of Dark Admiralty grey shade 632 of IS:5, as applicable.

All the accessories like nuts, bolts, washers, etc. shall be of the best quality electro galvanised or passivated to withstand attack from corrosive atmosphere.

The control stations shall be provided with two earthing studs with lugs on the external surface of the enclosures for termination of 8 SWG GI wire.

The control station shall have external fixing lugs for mounting on wall or column. The holes provided on these lugs shall be oblong type.

A name plate indicating TAG NO. shall be provided on each control station. The name plates shall be engraved on 3 ply black white black lamicold sheets using square cutters or Black engraved prespex sheet. Name plates shall be fixed by screws and shall not be pasted.

Component Specifications

Push buttons for START and STOP shall be of GREEN and RED colour respectively. Unless otherwise specified each push button shall have one normally open and one normally closed contact. The STOP push button shall be mushroom type with stay put feature and lockable in pressed position.

Terminals & Wiring:

- The control station shall be provided with sufficient number of terminals. More than 2 wires per terminal shall not be permitted. If required, additional terminal with shorting link may be used. Each terminal for external cable connection shall be suitable for termination of 2.5 sqmm solid copper conductor. Lugs for calbe termination shall be provided of tinned copper type.
- All internal wiring shall employ 2.5sqmm, 660V grade, PVC insulated copper conductor wires.

4.9 CABLES

All power and control cables for use on medium / high voltage shall be heavy duty type, aluminum / copper conductor. PVC/XLPE insulated, inner sheathed, armored and overall PVC sheathed as described below.

The Power and Control cables shall have the following minimum overall cross

sectional areas:

a. Meduim Voltage Power 6 sqmm (Aluminium) / 2.5 sqmm (Copper)

b. Control Cables 2.5 sqmm (Copper)

c. Lighting Cables 2.5 sqmm (Copper)

Cables shall be sized based on the maximum continuous load current and the voltage drop. The derating due to ambient air temperature, ground temperature, grouping and proximity of cables with each other etc. shall be taken into account.

Below grade cables in paved areas shall be in concrete lined trenches with concrete covers having proper slope and suitable drainage arrangement to avoid water collection. In unpaved areas cables shall be in lined trenches or directly buries in gound. In hazardous areas and transformer bays, trenches shall be completely filled up with sand. Concret lined cable trenches shall be sealed against ingress of liquids or gases wherever the trenches leave a hazardous area or enter control room or substation. The cable trenches shall be sized depending upon the number and voltage grade of cables. Where underground cables cross roadways, pipe sleepers at grade, etc., they shall be protected by being drawn through PVC sleeves/ducts or suitable RCC Pipes to provide a permanent crossing. Pipes laid for mechanical protection shall be sealed at both ends.

High voltage, medium voltage, control and signal cables shall be separated from each other by adequate spacing or running through independent pipes, trenches or cable trays as applicable. Cable trays, racks and trenches shall be sized to allow for 20% future cables. Cable installation shall provide minimum cable bending radii as recommended by cable manufacturer.

Cable route markers shall be installed at every 30m interval all along the routes of directly buried cable trench and also at locations where the direction of cable trench changes.

All power and control cables shall be of continuous lengths without intermediate joints. Where joints are unavoidable, these shall be provided with the permission of Engineer-in-charge. All cables shall carry tag numbers for easy identification. In case of control cables all cores shall be identified at both sides by their terminal numbers using PVC ferrules as per interconnection diagrams.

Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing/engraving shall be legible and indelible. Control cables having 6 cores and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers shall contrast with the colour of insulation with a spacing of maximum

50mm between two consecutive numbers. Colour coding for calbles upto 5 cores shall be as per IS.

A. PVC Insulated Cables (Medium Voltage)

The conductors of nominal area less than 25 sq.mm shall be circular and above that it may be circular or sector shaped.

The inner sheath shall be of vulcanized rubber proofed or plastic tap shall not be harder than PVC used for insulation. This shall conform to requirements of type ST-1 of IS:5831.

Armouring shall be applied over inner sheath, where specified and shall be of galvanized steel strip as per IS 3975. The armour shall be applied as closely as possible with left hand direction of lay. For cables having diameter over the inner sheath less than 13 mm, the armour shall be of galvanized round steel wires orgalvanised steel strips. The dimension and resistance of armour shall be as per IS 1554 Part 1.

The outer sheath of the cable shall be applied by extrusion and shall be of black colour PVC compound conforming to requirements of type ST-1 compound of IS. 5831. The thickness of outer PVC sheath and its tolerance shall be as per IS 1554 (Part – I). To

protect the cable against rodent and termite attack, suitable chemicals may be added into the PVC Compound of the outer sheath.

Bidder may also offer XLPE insulated aluminium conductor power cables conforming to relevant IS instead of PVC insulated

B. XLPE Insulated Cables (High Voltage)

The conductors shall be made form % H or H aluminum wires, thesese shall be stranded and compacted circular in shape upto 35 sq.mm. size cables. The conductors of three core cables having their nominal cross section 50 sq. mm and above shall be either circular or sector shaped. The conductor and its constructor shall conform to IS 130 and IS 709 (Part II).

Insulation

The insulation shall be chemically cross-linked polythene conforming to the physical, electrical and ageing properties as required by IS 7098 (Part – II). Only natural colour compounds shall be used for insulation of cables. It shall be free from voids and shall withstand all mechanical as well as thermal stresses under steady state and transient operation conditions.

Insulation screening shall be in two parts, first non-metallic semi-conduction part and second metallic part. Non-metallic part shall be applied directly over insulation of each core and shall consist of tapped of extruded semi-conduction compound. On top of this, metallic screening of non-magnetic tap or braid or concentric serving of wire shall be applied.

In cables have three cores, the individual core shall be laid up with suitable non-hygroscopic fillers and then applied with common covering of PVC or thermoplastic material by extrusion or tapping such that circulation of cable is maintained. The sheath shall conform to requirements of tye ST-2 compound of IS 5831. The thickness of sheath shall be as per IS 7098 (Part II).

The Armoring and outer sheath of XLPE cables shall be generally in line , as described above/elsewhere of this document. However, size and tolerance for XLPE Cables shall be as per IS 7098 (Part II), except for outer sheath to be of type ST-2 as per IS 5831.

C Cable Accessories

All accessories like cable glands, lugs and terminal markings etc. shall be used conforming to relevant standards / as specified. The end termination for HT cables shall be heat shrinkable type. For 1100 V grade cables, Ni-Plated Brass Double

Compression type glands WP to IP-65 as a minimum and tinned copper crimping type lugs shall be used.

D Cable Laying

HV, MV and control cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cable trays.

Cable Laying and termination shall be such that chances of cable getting damaged are remote.

LT cable shall be laid in cable tunnel or tray racks or burried underground with appropriate protection. Black shall indicate the neutral, while red, yellow and blue for three different phases. All LT cables when laid on the cable racks shall be properly dressed and clamped as required without crisscrossing and unnecessary overlapping. Cables shall be properly dressed and clamped.

Laying of HT and LT under ground cables.

Minimum depth of cable trench shall be 750mm for LT cables and 900mm for HT cables.The cables shall be protected by filling trench bottom with a layer of sand after clearing the bottom from all rocks, stones and sharp objects, before the calbes are

placed. These sand shall be leveled and cables laid over it. These cables shall be covered with 150mm of sand on top of the largest diameter cable and sand shall be lightly compacted. A flat protective cover of 75mm thick second class red bricks shall then be laid and compacted and then remainder of the trench shall then be backfilled withy soil, rammed and leveled.

In routing, necessary barriers and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angles and these two shall not run in close proximity.

LT cables shall be bent in radius not less than 12 times their individual overall diameters, while HT cable shall have bends not less than 15 times their individual overall diameter.

Cable routing between cable trench and equipment/motors shall be taken through GI

pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45

Deg to the trench wall. Bending radii of pipes shall not be less than 8D. It is ensured that both ends of the GI pipe sleeves shall be sealed with approved WP sealing plastic compound after cabling. In places where it is not possible, cables shall be laid on smaller branch trays.

All cable shall be identified close to their termination point by cable tag numbers as per cable schedule. Cable tags shall be punched on aluminium straps (2mm thick,

20mm wide of enough length) securely fastened to the cable and wrapped around it.

Routes of these cables shall be arrived at on the basis of the relevant drawings and after consulting the Engineer in charge.

E Drawings and Schedules

Size of cables shall be given in singe line power diagrams. A cable schedule shall be prepared on the basis of relevant drawings. All cables and wires shall be adequately sized to carry continuously the normal currents expected on the relative circuits. All trenches for electrical cables shall be separate from water or sewage pipe line trenches.

F Splicing and Termination

Straight through joints shall be avoided. In case, these are absolutely necessary they shall be made at convenient locations suitably protected as approved and sanctioned by the Engineer in charge but in no case within the conduit pipes or ducts. Branch circuit wiring shall be spliced only in switch boxes, panel switch socket outlet boxes light fixtures outlets and circular junction boxes. They shall be made only with approved porcelain connectors.

Cables shall be tested in accordance with IS : 1554 / 7098

4.10 AUTOMATIC PFIC PANEL & CAPACITOR BANKS

Each capacitor bank and its automatic control panel shall be coupled to each other to form one composite unit. The unit shall be free standing, floor mounting, with a 3mm thick base channel with foundation bolt holes.

The control equipment including capactiors shall be mounted in a panel made of 2 mm cold rolled sheet steel for load bearing members and 1.6 mm CRCA sheet steel for doors and covers. The panel shall be of indoor type.

The housing of the capacitor banks shall be of open construction with free ventilation for capacitor units. The connections from the capacitor units to the control panel shall be carried in totally enclosed, dust-proof, vermin-proof bus-ways or wire-ways.

The control panel shall be fully compartmentalized and extensible for future expansion. Busbars and feeder circuits shall be segregated.

The automatic control panel shall comprise of the following:- Main isolating switch TPN,

500 V, rating to suit Aluminium Busbars, rating to suit.

Link type HRC Fuses and Circuit Breakers / Fuse Bases of Power Circuit. Main

contactor of Power Circuit.

Auxiliary contactor of Control Circuit.

Power Factor Relay for sensing and correction the power factor of the system with required no. of steps to achieve the specifed improvement in power factor. Microprocessor based APFC Relay should be used of Suitable size.

Auto-manual charge-over switch.

'ON' and 'OFF' push Buttons for manual control of each capacitor unit.

'ON' indication lights with LED type lamps complete with series resistors for each capacitor unit.

Control fuses, HRC link type with fuse fitting.

SFU, MCB or MCCB for Protection of Each Capacitor Bank.(MCB should be suitable for Capacitor Switching)

Capacitor Duty Contactor

Any other components required for satisfactory and safe operation.

Capacitor Banks shall comprise identical delta connected three phase units. Capacitor Banks shall be either non-flammable, non – toxic, all poly propylene type with extended foil design. Capacitor shall be compact in size and hermetically sealed. In built fuses & surge suppressors shall be provided for protection of each capacitor element.

Capacitor Bank to be provided with a bus bar chamber on the top, dust / damp protects, vermin proof in constructions, fabricated from 2mm thick sheet steel. Continuous neoprene gaskets to be provide at all mating surfaces. Bus-bars to be aluminum, supported on porcelain insulators,.

Connection of individual units to bus-bars to be made through link type HRC fuses of specified rating. Individual unit to be provides with internal silvered fuses and discharge resistors connected across terminals.

The capacitor bank to be complete with fixing channel suitable for floor mounting. Total

kVAR and No of Steps to be decided by Bidder such as to improve and

maintain 0.96 lagging PF or better and get approval from EIC . Under no circumstance the power factor shall be below 0.95 lag at HT side / supply company meter. 8/10 step relay shall be provided as a minimum and in case of panel / bus section catering to large number of small loads / intermittent loads, the relay shall be in min. 12 steps with sufficient small banks to maintain required p.f.

Capacitors Should be of APP Double Layer Type only.

Test and Test Reports

All tests shall be conducted in accordance with the latest edition of IS – 2834 and as applicable for controls.

Type test certificates for similar capacitor units shall be furnished.

Drawings

The following drawings shall be submitted for the approval of the Engineers Representative. Fully dimensioned general arrangement drawings of capacitor and capacitor control panel with elevation, side view, sectional view and foundation details. Complete schematic and wiring diagrams for capacitor control panel.

Painting

The panels shall undergo chemical derusting, sand blasting, decreasing, pickling in acid bath and phosphatised as per IS : 6005 and primed. The panels shall be thoroughly rinsed with clean water after phosphating, followed by final rinsing with dilute bichromate solution and oven drying. The phosphate coating shall be sealed by the application of two coats of ready mixed, stoving type zinc chromate primer. After preparation of the under surface, the switch board shall be spary painted with two coats of synthetic enamel paint, each coat followed by stoving. The final finished thickness of the paint film on steel shall not be less than 100 microns and shall not be more than 150 microns. The colour shade fo the final paint shall be 631 as per IS : 5. The finished painted appearance of panel shall present aesthetically pleasing appearance free from dust and uneven surface.

The paint shall withstand humid tropical climate, rain, etc. The paint shall not scale of or removed by abrasion during normal handling.

Sufficient quantity for touch up paint (minimum of 2 nos. of 1 ltrs tin) shall be furnished for application at site.

4.11 GENERAL SPECIFICATION FOR VARIABLE SPEED AC DRIVE (VFD) SYSTEM

A. GENERAL REQUIREMENTS

1. **General**

This part of the specification describes the general requirements for the Variable Speed Drives, herein referred to as AC Drives, for use with standard IEC or [NEMA A] [NEMA B] [NEMA D] [NEMA E], [Wound Rotor] design AC motors. The nominal values, the standard documents and the drive's minimum performance are defined in this part.

To avoid any mismatch between the motor and its control equipment, the AC Drive shall be capable of auto adjustment by automatic measurement of the motor parameters without motor rotation.

VFD System shall be delivered to the site pre-assembled and wired with all specified interconnecting wires and cables with suitable enclosure (VFD panel) as specified in this specifications. Cabling for connection across shipping sections shall be neatly coiled and identified.

The VFD shall meet the following specific requirement as a minimum irrespective of any other specified else where of this VFD System specifications and contradicting with any of below requirement:

1. VFD current rating shall be after suitable derating for 50º C temperature.

2. The derated current rating of VFD shall be suitable for the rated motor current plus min. safety margin of 10 %.

3. The VFD enclosed / cubicle shall be to ensure that temperature rise within enclosure does not exceed 5º C over max. ambient temp. of 45º C. Necessary cooling fans and air inlet / outlet vents shall be provided. Vents shall be provided with washable filter.

4. Cooling fans for VFD feeder shall be interlocked with VFD such that VFD shall not turn ON / shall be tripped if any cooling fan is not working. Each cooling fan circuit shall be provided with MCB & aux. relay for this purpose.

5. VFD shall be with programmable keypad with graphical display mounted on door (remote mounting).

6. VFD shall be with RS-485 serial port (mod bus protocol) for remote communication.

7. Aux. contact of incoming breaker & contactor shall be used in series to provide

"VARIABLE FREQUENCY DRIVE READY" interlock signal for PLC/remote operation.

2. **Training**

The contractor shall arrange to provide training to the employer's operation, maintenance and service personnel at site (to be conducted by VFD manufacturer's engineer) covering theory of operation, maintenance, software mapping / programming, hand-on training, etc. The training shall be of at least 3 days duration and shall be attended by a maximum of 6-8 persons for employer's / consultant's representative.

3. **Requirements for the Manufacturer**

3.1 Certifications

The Frequency Converter Manufacturer shall have a valid ISO 9001 (2000 version) certification and an applicable quality assurance system. The Frequency Converter Manufacturer shall have the Environment Certification ISO14001.

3.2 Experience

The Frequency Converter Manufacturer shall have adequate experience in frequency converter manufacturing and have adequate business volume in order to provide credibility in his commitments and a capability of long term support. They shall have a direct presence / office in India.

3.3 Local support

The Supplier – manufacturer or manufacturer's authorized representative shall have a permanent representative office with a trained and skilled support staff, in the country where the goods are delivered, in order to prove his commitment for local support and to provide a channel for communication. The local representatives shall be easily accessible and shall be able to arrive at the site within 24 to 48 hours notice.

The engineers employed by the Supplier's regional office shall be certified by the Manufacturer and provide start-up service including physical inspection of the drive, connected wiring and final adjustments, to ensure that the AC Drive meets the required performance.

The supplier shall be able to give basic drives training to the customer's engineers, preferably on the site, in the country where the customer's site is. The training shall, as a minimum, include system concepts and basic troubleshooting. The Supplier shall also be capable of solving most AC Drive problems quickly.

The manufacturer shall be able to offer and will ensure to depute factory technician to supervise/inspect installation and commissioning of the drive to be done by the local office.

The most common spare parts like fuses, IGBTs as well as main control- and I/O-boards shall be available within 48 hours from the notification through a regional service center of the supplier. The more rarely used spare parts should be available in maximum 5 days on site.

B. GENERAL SPECIFICATONS OF VF DRIVE SYSTEM

1.0 SCOPE

1.1 This specification covers the complete materials, equipment and incidentals required to place into operation an integrated low voltage variable frequency drive (VFD) system, electrical machines and covers all components of the engineered system.

1.2 Every variable frequency drive system shall consist of all system components required to meet the performance, protection, safety, testing and certification criteria of this specification. These components may include harmonic filter complying with IEEE 519 requirements for harmonic limits / power factor correction unit, VFD converter / DC-link / inverter, and output filter, as required.

1.3 The VFD system must

Represent a fully integrated package

Include all labour and material necessary to interconnect any VFD system elements ike input transformer, harmonic filter (as per requirement), output filter, etc., even if shipped separately.

1.4 The VFD system shall have the following protection features:

Enclosure shall be with IP-52 protection. Each VFD cubicle shall have MCCB with S/C and O/L protection, E/F (if motor is rated above 5.5 kW) protection, indications on each compartment for ON/OFF/TRIP/Thermistor Trip/EF Trip (as applicable), etc. Each VFD shall also be provided with semi conductor fuse protection and contactor on incoming side.

Group fault signals and status of each motor shall be annunciated in the automation system at main control room.

Any modifications to a standard product required to meet this specification shall be performed by VFD manufacturer only.

VFD system as defined in 1.2 above shall be completely factory pre-wired, assembled and then tested as a complete package by the VFD manufacturer / VFD manufacturer's authorized system integrator, to assure a properly co-ordinated, fully integrated drive system. In case of assembly carried out by authorized system integrator, the enclosure (VFD panel) design including sizing / cooling arrangement and schematic shall be approved / vetted by VFD manufacturer.

The VFD shall be capable of operating any standard squirrel cage induction motor with a full load current rating equal to or less than the full load current rating of the VFD (after necessary de-rating). At any time in the future it shall be possible to install a new or rewound standard squirrel cage induction motor with a full load current rating equal to or less than the full load current rating of the VFD (after necessary de-rating) without making any modification to the VFD.

VFD after necessary de-rating for various operating conditions as specified shall be suitable to operate the motor at rated capacity. De-rating due to temperature and other factors like altitude, etc. shall be considered based on site / operating conditions.

2.0 CODES AND STANDARDS

The AC Drive shall comply with latest National and International standards and the recommendations for electrical industrial control devices (IEC, EN, UL, NFC, VDE) of:

National Electrical Code (NEC)

Underwriters Laboratory (UL)

American National Standards Institute (ANSI)

National Electrical Manufacturers Association (NEMA)

Institute of Electrical and Electronics Engineers (IEEE)

Canadian Standards Association (CSA)

International Electrotechnical Commission (IEC)

Federal Communications Commission (FCC)

CENELEC

The AC Drive shall be of the most modern design, yet user friendly and simple to install, commission and maintain. The AC Drive shall be able to start and control the speed of a standard squirrel cage induction AC motor. The AC Drives shall be:

CE marked, conforming to European Low Voltage (73/23/CEE and 93/68/CEE) and EMC (89/336/CEE) Directives, UL/CSA marked according to UL 508C. The AC Drives

have to be built to comply with the IEC standards.

The materials used in the AC Drive shall be recyclable, non-toxic and flame retardant. The AC Drive shall comply with the European directive RoHS (Restriction Of Hazardous Substances) that prohibits the use of materials such as lead, chromium 6...

3.0 PERFORMANCE

3.1 Operating Envelope

VFD shall meet the following speed and torque requirements:

3.1.1 The VFD shall be capable of producing a variable AC voltage / frequency output to provide continuous operation over the normal 10-100% speed range. As a commissioning and trouble shooting feature, the VFD power circuit shall be capable of operating without a motor connected to the VFD output.

3.1.2 VFD shall be capable of operating any standard AC motor of equivalent rating (HP

and speed) over the specified speed range.

3.1.3 The VFD for standard / variable torque application shall be capable of momentary overload of 110% for one minute. VFD for constant torque application shall be capable of momentary overload of 150% for one minute

3.1.4 For centrifugal pumps & centrifugal blowers, the VFD shall be of standard / variable torque capability type where as for applications like Positive Displacement (ROOTS) type Twin / Tri Lobe air blowers, Screw Pumps, etc. it shall produce full rated torque at any speed in the operating range (constant torque capability). Contractor shall furnish required performance curves (speed vs. torque, stc.) in support of selection of variable drives for rest applications, as applicable.

The AC Drive in general shall be a digitally controlled drive, using, at least, the Pulse Width Modulation (PWM) with flux vector control open loop and closed loop, with both speed and torque control modes, an algorithm to control unbalanced loads (ENA system), and a safety function (see chapter safety). It shall have IGBTs in the inverter section of the throughout the power range. VFD shall be provided with required EMC filter complying to EN 61800-3 and depending on the maximum length of the cable from VFD to motor.

3.2 Input Harmonics

3.2.1 The VFD shall be provided with necessary chokes in order to suppress and reduce total harmonic distortions for ensuring reliable and proper operation of VFD. The total harmonics distortion of the voltage and current at inverter output shall be as per IEC 61800 and considering the type of existing motors (non-inverter duty).

3.2.2 VFD shall include an input filter / reactor / choke to protect itself against damage due to normal transients and surges on incoming power line, reduce harmonic distortion on the AC power line, and correct the input power factor to 0.95 or higher.

3.2.3 Harmonics at the supply side of the drive system at PCC (point of common coupling)

shall be restricted within the maximum allowable levels of current and voltage distortion as per recommendations of the latest edition of IEEE-519. Accordingly, VFD shall meet the following distortion limits in general:

Voltage Harmonics: Individual and simultaneous operation of the VFDs shall not add more than 3% total harmonic voltage distortion while operating from the utility source, or more than 5% when operating from standby generator (if applicable).

Current Harmonics: Maximum allowable total harmonic distortion limits for each VFD shall not exceed limits as per IEEE 519 as calculated and measured at the point of common coupling.

3.2.4 Output choke/filter of required type shall be provided with all VFDs irrespective of cable length, as most motors are existing, non-inverter duty motors. Output filter type shall be considering maximum cable length of 300 ft. and / or 1000 ft. as specified else

where with general purpose (non-inverter duty) motors. De-rating, if required, due to voltage drop, shall be considered while sizing the VFD.

3.3 Motor Compatibility

3.3.1 VFD system shall provide an output waveform that will allow utilization of any standard motors, without any need for any special insulation or de-rating. Motor life expectancy shall not be compromised in any way by operation with the VFD system. The system must comply with all elements of the output harmonic section of this specification. The VFD must provide motor overload protection in any operating condition.

3.3.2 VFD output waveform shall be suitable for operating a squirrel cage induction motor without de-rating or requiring any additional service factor. To ensure that there are no problems with motor heating, VFD output current waveform shall be inherently sinusoidal at all speeds, with a total harmonic distortion not exceeding 3% between

10% and 100% speed regardless of loading. VFDs utilizing output transformers are not acceptable.

3.3.3 The system design shall not have any inherent output harmonic resonance in the operating speed range.

3.3.4 The VFD output shall produce no electrically induced pulsating torques to the output shaft of the mechanical system eliminating the possibility of exciting a resonance caused by VFD induced torque pulsations.

3.3.5 VFD shall inherently protect motor from high voltage Delta V/Delta T stress, independent of cable length of motor. VFD shall not require non-standard insulation systems or insulation ratings above the VFD output voltage rating. The VFD system shall be designed to produce no standing waves or over-voltage conditions based on a cable length of 1000 ft. (a typical length which will cover most application requirements and allow for potential future cable run changes) from VFD to motor. If the VFD requires an output filter to meet this requirement, it shall be an integral part of the VFD system/enclosure and included within the VFD enclosure.

3.4 Efficiency

Guaranteed minimum total VFD system efficiency shall be a minimum 96% at 100% speed and 100% load and minimum 95% at 80% speed and 50% load. Efficiency evaluation shall include input transformer, harmonic filter and power factor correction (if applicable), VFD converter, an output filter, and any other power handling component as may be required to handle motor current. As indicated below. Auxiliary controls, such as internal VFD circuit boards, cooling fans or pumps, shall be included in loss calculation.

The VFD system efficiency is as follows: ηsys = ηvfd x ηxfmr x ηpfc x ηharm x ηfilter

Note: If the motor power factor is poor (less than 0.85 at rated load), causing the VFD to provide higher than normal reactive current to the machine, the required total VFD system efficiency will be reduced by 0.5%.

A factory test shall be performed at the VFD manufacturer's facility certifying that efficiencies have been met. All components related with the LV drive like input transformer, LV inverter, output filter (if provided) or any other component handling the motor load current, should be a part of the system undergoing this testing.

3.5 Power Factor

VFD system shall maintain a 0.95 minimum true power factor from 30% to 100% speed. VFD system including power factor correction system and/or harmonic filter shall never have a leading power factor under utility or generator operation. VFD manufacturer is to supply a power factor correction system, if required, to meet the requirement.

3.6 Speed Regulation

VFD speed regulation shall be ±0.5% without encoder or tachometer feedback.

3.7 Sound Level

Maximum allowable audible noise from the VFD system shall be 80 dB(A) at a distance of 3 feet at any speed or load condition.

4.0 AVAILABILITY

4.1 Firing Signals

All internal firing signals and other communications which link operational controls with power components (such as status or diagnostic signals) must utilize fiber optic cables.

4.2 Power interrupt Ride-Through

The VFD system shall be capable of producing full rated torque in the event of a power loss of 5 cycles or less.

The VFD must be capable of automatically restarting in the event of a momentary loss of power, or a clearing of a drive trip. The VFD system shall provide the user with the choice of automatically restarting or not.

4.3 Power Sag Ride-Through

The VFD system shall be capable of continuous operation with a 30% voltage sag on the input power line.

4.4 "Catch-a-Spinning Load" Capability

The VFD system must be able to catch and take control of a spinning load if started while rotating equipment is already spinning. Appropriate safeguards must be included in this operation to prevent damaging torques, voltages or currents from impacting any of the equipment. The user shall have the option of employing this feature or disabling it.

4.5 Ground Fault Withstand

In the event of a ground fault, the VFD shall be capable of annunciating the ground fault condition, safely operating and by user selection, either trip or continue operation. As a result of a ground trip, the VFD shall be capable of being reset and operating normally. There shall be no risk of fire or electric shock as a result of ground fault.

5.0 SERVICEABILITY / MAINTAINABILITY

5.1 Front Access

VFD system should be deigned for front access only.

5.2 Remote Diagnostics

The VFD system shall be provided with the capability for remote diagnostics via modem communication / communication port. The required hardware shall be included in the supply and shall be interconnected with PLC / SCADA system at main control room.

5.3 All the VFDs to be supplied for each zone under this project shall utilize identical operator interfaces and employ same programming methods. Make / operator interface may vary from zone to zone subject to meeting the specifications.

6.0 PHYSICAL REQUIREMENTS

6.1 Environmental Requirements

VFD system shall be capable of continuous operation in an average ambient temperature between -10 deg C and 55 deg C at an elevation upto 1000m above MSL, with necessary de-rating, as applicable for the design of the VFD. The VFD system

shall also be simultaneously suitable for continuous operation in a maximum humidity between 0 and 95% non-condensing.

6.2 Heat Dissipation / Cooling System

Preferably VFD system shall be air cooled.

6.3 Air-Cooling Requirements

Air cooled VFDs shall be provided with required no. of cooling fans to limit the temperature rise up to max. 5°C within enclosure (panel) above the design site ambient temperature of 45°C for reliable operation of VFDs. One spare fan shall be provided for every five nos. of VFDs. Opearation of fans shall be interlocked with VFD operation.

VFD system manufacturer shall provide heat dissipation data necessary to design all auxiliary heating, ventilation and air conditioning (HVAC) systems, if required, for VFD system installation. However, bidder shall note that VFD system/enclosure shall be so designed and selected that the entrie system shall operate for the entire range of operating ambient temperature without air conditioning and the enclosures, cooling fans and VFDs shall be sized accordingly.

6.4 Enclosure

All VFD system components including transformer, as applicable, shall be mounted and wired by the VFD system manufacturer / authorized system integrator in a grounded enclosure meeting the following requirements without exception:

Input filters, transformer, power conversion, output filters and auxiliary equipment enclosure shall be NEMA-12 design. Air cooled units/enclosure shall be NEMA-12 ventilated, IP-52 or better degree of protection, with gasketed doors. Air cooled units shall have cleanable filter media covering all air inlets. Inlet air filters shall be 100% washable, front replaceable with VFD in operation. The fabrication, painting and other such construction requirements of Medium Voltage VFD cabinet (panel / enclosure) shall meet the requirement as per the specifications for LT panels.

Standard equipment of the enclosure

Protection by door interlocked MCCB (50kA S.C. current rating) as specified above in general specifications / requirements of VFD system.

Input disconnect with through-the-door operator handle that is mechanically interlocked with the enclosure door.

The Programming terminal of the AC Drive shall be accessible for programming and controls with the main door closed.

The whole assembly shall be implemented with a strict consideration of the EMC Compatibility and Regulations as described in this specification.

Total harmonics distortion shall comply with IEC 61800-3-12. Harmonic reduction shall be carried out with a 3% inductance or equivalent

Cables shall be handled by mechanical fixation

Air output shall not be located in on the front of the enclosure

Hand/Off/Automatic selector switch or Local/Remote selector switch.

Main power bus shall be tin plated, high conductivity copper, appropriately sized. Refer

specifications of LT Panels elsewhere in conjunction with this for further

applicable detailed specifications including those for fabrication.

VFD shall be preferably kept in electrical control room or at other suitable room/building with necessary provisions as per manufacturer's recommendations.

VFD shall not be located within in air blower room, etc. which shall pose problems related to vibration affecting reliability of VFD system, noise problem posing safety issues for operational staff, etc..

7.0 PROTECTIVE DEVICES / DIAGNOSTICS

7.1 Power Component Protection

VFD system shall include distribution class surge arrestors to protect input transformer and VFD against voltage surges. These shall be integral with the drive panel cabinet.

7.2 Protective Features and Circuits

Main Protections : Over current, short circuit between phase, short circuit between phase and ground, impedant short circuit, input phase loss, output phase loss, motor overload, over voltage, under voltage, over speed, IGBT over temperature, heat-sink over-temperature, other internal faults.

The VFD shall include a customer selectable automatic restart feature. When enabled, the VFD shall automatically attempt to re-start after a trip condition resulting from over current, over voltage, under voltage, or over temperature. For safety, the drive shall shut down and require a manual reset and restart if the automatic reset/restart function is not successful within a maximum of three attempts within a customer programmable time period. Auto-restart shall be programmable to allow for individual fault selection. If required to provide this function, the VFD system manufacturer must supply and mount within the VFD a separate programmable logic controller of approved make to provide this feature.

8.0 DATA DISPLAYS / PROGRAMMING TERMINAL

A door mounted LCD display shall be furnished, capable of displaying the VFD operational status and drive parameters. The digital display must present all diagnostic message and parameter values in English engineering units when accessed, without the use of codes.

As a minimum the following door mounted digital indications shall be available for viewing through 2/4 line or similar suitable English language display:

Speed demand in %

Output current in Amps. Output frequency in Hz Input Voltage

Output Voltage

Total 3-phase kW output

Kilowatt hour meter (Digital Energy meter) Elapsed time running meter

Using a shuttle button shall carry out the navigation in the menu and the parameter setting.

Parameter setting shall be easily accessible and user friendly with actual text messages and actual setting range.

Visibility and protection shall be selected for each parameter. Password protection shall be provided to avoid unauthorized tampering with the set parameters.

The programming terminal shall offer the possibility of memorizing and downloading

4 configurations of the AC drives to save time during the commissioning and to avoid mistakes.

Preferably 4 programmable function keys shall be available for short cuts, application functions

The AC Drive shall have self-diagnostic properties to display faults and warnings as they occur. The AC Drive shall be able to store at least 8 last faults into the fault memory including the value of 11 parameters of monitoring for each fault. The fault memory shall be accessible by the programming terminal.

A FAULT LOG and HISTORY LOG for each VFD system shall be logged in HMI at main control room for which necessary communication/interconnection between VFD system and PLC/SCADA system shall be provided.

9.0 Further VFD shall be suitable to following / have the following minimum specifications:

Operating conditions:

Rated Input Voltage : 3-Phase, 380V to 480V, +10% / -15%
Rated Input Frequency : 48 to 63 Hz

Fundamental Power Factor : 0.97 or better at nominal load
Efficiency : 98 % at nominal load Output
Voltage : 0 - U_N, three-phase

Output Frequency Range : 0 to 500 Hz or suitable as per mfr. Std.

Degree of Protection : IP-20/21 as a minimum (stand alone without panel enclosure)

Operating ambient Temp. : 40°C with continuous current output and without de-rating and see elsewhere of this specifications and also see Note-1 below for continuous current output after de-rating.

Maximum operating altitude : 1000 m without de-rating Max.
Relative Humidity : 95 %, without condensation

Mounting : Within Enclosure / Panel (Vertical)
Max. Corrosion Level

of the Cooling Air : IEC 721-3-3, class 3C1.

Chemical Gases : Coating shall be requested to comply with IEC 721-3-3 Class 3C2. Solid
Particles : IEC 721-3-3, class 3S2

Max. Vibration Level : Shall conform to IEC 60068-2-6

Shock Level : according to IEC/EN 60068-2-27

Max. Ambient Pollution degree

- according to EN 50178 : Degree 2, up to 15 kW (20 HP)

- according to UL 508C : Degree 3, above 15 kW (20HP)

Control supply : could be internal so provided by the AC Drive itself, or provided by an external 24V DC supply

Note-1: The AC Drive shall be able to give 100 % output current required for the for the rated capacity of the drive (motor), continuously, in the specified conditions. In order to ensure that the drive can provide the required output current in the specified ambient conditions, the manufacturer shall inform the required de-rating, for the specified ambient conditions of this specification or project-specific design/max. ambient temperature, whichever is higher (shall be de-rated for 50°C average ambient temperature in this case), or if the installation altitude is more than 1000 m above the sea level. The de-rating factor shall be specified so that neither the lifetime of the AC Drive nor the unit's performance, overload capability included, nor the

reliability of the AC Drive shall suffer.

10.0 Quality assurance

Every AC Drive has to be tested functionally. The inverter part of the AC Drive or each inverter module at least has to be tested by running it with a motor at full nominal load. A test report of the tests made shall be delivered by the Frequency Converter Manufacturer on engineer's request.

11.0 Protections

11.1 Circuit breaker co-ordination and short circuit protection shall eliminate the need for current-limiting and semiconductor fuses. Tables for Type 1 and Type 2 co- ordination, combining circuit breaker, contactor and AC Drive shall be provided and certified.

11.2 The AC Drive shall be UL 508C listed for use on distribution systems. The AC Drive shall have a coordinated short circuit rating designed to UL 508C and NEMA ICS 7.1 and listed on the nameplate. The AC Drive shall not create a hazard in the event of a short circuit at any point within the AC Drive when it is connected to a power source as specified on the nameplate and protected as specified.

11.3 Upon power-up the AC Drive shall automatically test for valid operation of memory, option module, loss of analog reference input, loss of communication, dynamic brake failure, DC to DC power supply, control power and the pre-charge circuit.

11.4 The Power Converter shall be protected against short circuits, between output phases and ground; supplies provided by the AC Drive shall be protected against short circuits and overloads.

11.5 The AC drive shall have a minimum AC under voltage power loss ride- through of200 msec. The AC Drive shall have the user-defined option of frequency fold-back to allow motor torque production to continue to increase the duration of the power loss ride-through.

11.6 The AC drive shall have a selectable ride through function that will allow the logic to maintain control for a minimum of one second without faulting.

11.7 The deceleration mode of the AC drive shall be programmable for normal and fault conditions. The stop modes shall include freewheel stop, fast stop, DC injection braking and as fast as possible.

11.8 Upon loss of the analog process follower reference signal, the AC Drive shall fault and/or operate at a user-defined speed set by a software programmed speed settings or last speed.

11.9 The AC Drive shall integrate a protection against IGBT chips over temperature that is different from the heat-sink overheat.

11.10 The AC drive shall have solid state thermal protection that is UL Listed and meets UL508C as a Class 20 overload protection and meets IEC 947. The minimum adjustment range shall be from .25 to 1.36% of the current output of the AC Drive. The motor thermal state shall be memorized and shall decrease following the motor rating even when the power is OFF.

11.11 The AC Drive should be able to protect the motor when PTC probes are connected.

11.12 The AC drive should be able to limit the motor terminal voltage to twice the DC bus voltage

11.13 The AC drive shall display all faults in plain text and help screens shall be available to guide the user in the troubleshooting. Codes are not acceptable.

12.0 Safety

12.1 The AC drive shall be integrated directly in the safety chain complying with EN 954-1 category 3, and with IEC/EN 61508-1 SIL2.

12.2 The AC drive shall integrate the "Power Removal" safety function which prohibits unintended equipment operation. The motor no longer produces torque.

12.3 This safety function shall comply with standard for safety of machinery EN 954-1, category 3; standard for functional safety IEC/EN 61508, SIL2 capability (safety control-signaling applied to processes and systems)

12.4 The "Power Removal" safety function shall have a redundant electronic architecture that shall be monitored continuously by a diagnostics function.

12.5 This SIL2 and category 3 level of safety function shall be certified as conforming to these standards by a certification body under a program of voluntary certification.

12.5 The Power removal function shall comply with the definition of the draft product standard IEC/EN 61800-5-2 for both stop functions, Safe Torque Off ("STO") and Safe Stop 1 ("SS1")

12.6 The AC drive manufacturer shall provide the certified schematics and the list of devices in order to comply with IEC/EN 60204-1 stopping category 0 and 1.

12.7 The relay contacts shall comply with EN-81 13.2.2.3

13.0 User interface

13.1 General

The user interface shall be identical throughout the power range to avoid confusion amongst the users and need for training in several different units. User interface shall be LCD type with sealed membrane type key pad. The mode of communication and display shall be in English language.

13.2 Inputs and outputs

13.2.1 At least, the following standard Inputs and Outputs shall be provided, to be used in interface with the control system:

Two Analogue Inputs:

- For Voltage	1 x 0 (2) to 10V, Programmable
- For Current	1 x 0 (4) to 20mA, Programmable
Potentiometer I/P	+10V, 10mA max.
Analogue Output	2 x Programmable analogue outputs 0(4) - 20mA
Logic inputs	4 x Programmable logic Inputs, isolated from the mains (One of these inputs could be used for PTC probe) All logic inputs may be used either in sink or source
Safety input	One input from above shall be dedicated to the Power removal safety function. In option, digital i/p may be used with 115V control supply
Relay Outputs	2 x Programmable digital o/p with a changeover dry contact

All the control terminals shall be clearly marked.

Contractor to furnish list of functions that are possible to assign to the I/Os along with the bid.

13.2.2 VFD offered with possibility to extend/expand the number of inputs / outputs of the AC Drive in future shall be preferred.

Following I/Os shall be provided / wired to PLC as a minimum:

Description	**Type of I/O**
Drive Ready Status	DI Drive On / Off Status
DI Drive Trip Status	DI Selector Swtich in Auto Mode Status

Drive Start Command	DO	Drive Stop Command	DO
Speed Control Command	AO		
% Speed Indication	AI		
% Current Indication	AI		

14.0 Communications

14.1 The AC drive shall have digital communication capability to allow direct control and status communication with a PLC / SCADA or other control system. It shall have inbuilt facility/ communication port to communicate with PLC / SCADA system preferably over Modbus, Profibus DP or Ethernet TCP/IP protocol or other suitable protocol offered by VFD manufacturer suitable for communication with PLC/SCADA.

14.2 The AC drive shall have the capability for internal mounted communication card.

VFD shall be capable of communication through any one of the following protocols

(through in-built or plug-in module) as a minimum:

- Ethernet TCP/IP

- Modbus Plus

- FIPIO

- Profibus DP

- DeviceNet

Communication card/protocol and required cable as necessitated by PLC/SCADA shall be provided. All drive status monitoring and control shall be possible from PLC/SCADA over communication cable / port.

14.3 The speed or torque command and reference may come from different control sources:

- I/O terminals

- Communication network

- programmable card

- Remote graphic display terminal

The AC Drive shall be able to accept / control as per the switching of these control sources according to the application requirements.

14.4 The AC drive shall integrate its own programmable communication scanner to always provide periodic variable exchange.

14.5 The control section of AC drive shall be supplied separately if necessary with 24V DC, to keep the network communication always available even if the power supply is OFF.

14.6 The AC drive behavior shall be programmable on communication fault

14.7 Advanced monitoring and diagnostic functions shall be available through the programming terminal like monitoring of:

- The communication scanner

- Command words sent by the different sources

- Command words taken by the AC drive

- 4 words which addresses are selectable, etc.

15.0 Application programming

The AC Drive shall be designed for both simple and the most complicated

applications, yet it shall be user friendly. The AC Drive shall have built-in application macros available in the Simply Start menu, to allow selection of the range of pre-programmed control configurations and further, the AC Drive shall be able to store at least two customer modified macro-configuration, to suit the specific application. It shall be possible to reset the parameter settings back to the original macro settings through the keypad. The parameter readouts shall be in text format and not coded.

16.0 PC Tools

The AC Drive Supplier shall have a Windows based PC software available for monitoring and controlling the AC Drives, and the software shall be offered as standard. The software shall be supplied with the necessary hardware and a provision for connecting a PC with the AC Drives. It shall be possible to set and modify parameters, control the drive, read actual values, and display and configure the oscilloscope function of the AC Drive.

17.0 Environmental effects

17.1 Harmonic Distortion

Guidelines for voltage and current distortion are addressed in IEEE Standard

519-1992 titled "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems", which suggests distortion limits dependent upon the electric power distribution system for industrial and commercial consumers. Collectively, all facility loads and the building electrical distribution network determine the harmonic levels at the user & electric utility interface. The Electrical Power Research Institute (EPRI) recognizes the 'Point of Common Coupling' or PCC as the interface between user and electric utility (energy meter) in the electrical distribution network. The AC Drive manufacturer shall provide calculations through computer modeling, specific to the installation, showing total harmonic voltage distortion based on the single line diagram drawings to be furnished by client / bidder to AC Drive / VFD supplier including transformer impedance. Drive manufacturer shall provide necessary solution / harmonic filter at point of coupling to comply with standards as specified below to limit THD.

17.1.1 The harmonic distortion analysis report shall be part of the approval drawing process, submitted to the engineer for approval.

17.1.2 If the calculations determine that harmonic distortion values are higher than the voltage and current values specified, the drive manufacturer shall provide solutions to comply with:

- IEC 61800-3-12

- IEEE 519-1992 guidelines

18.0 Documents

18.1 Documents to be submitted along with the bid

Efficiencies @ 100% and 50% load

List of recommended spares for 1 year and 5 years normal operation to be supplied as part of this contract and shall be certified by VFD manufacturer.

18.2 Documents to be submitted during detailed engineering for review / approval

Drawings: Dimension drawings, control connection diagrams and CAD drawings for a standard unit including order specific engineering requirements.

Quality assurance: Quality Plan

Equipment dimensions, including stub-up locations, shipping splits and shipping weights.

Block diagram showing the basic control and protection systems specifying the

protection, control, trip and alarm functions, etc.

Electrical Single Line Diagram showing main and auxiliary circuitry, including main power unit, switchgear, transformer, VFD system earthing and auxiliary supplies – showing all CT's, PT's, relays, meters, etc., for the control, protection and operation of the drive system with electrical data (i.e. voltage, current, time ratings, impedances, tolerances)

Recommended spare parts list

Efficiency and Power Factor values

Harmonic Distortion analysis (Current & Voltage)

18.3 Final As-built submission

Manuals: These must contain instructions on how to install and start-up the AC Drive, how to program the AC Drive, instructions for maintenance and for trouble shooting.
Drawings: Dimension drawings, control connection diagram.

Quality assurance: Test reports

Spare parts list with supplier's names and part numbers

4.12 GENERAL SPECIFICATION FOR MOTOR SOFT STARTER (MICROPROCESSOR BASED)

1 SCOPE

This specification covers the requirement for design, manufacture, installation, testing and commissioning of step-less reduced voltage / solid state torque controlled soft starter for motors in M.C.C panel to provide linear ramp starting and stopping of A.C induction motors.

The soft starter shall meet the following specific requirement as a minimum irrespective of any other specified else where of this soft starter specifications and contradicting with any of below requirement:

a. Soft starter shall be with bypass contactor, built-in or external.

b. Soft starter shall be selected for standard 3 wire Inline connection only. Soft starter shall not be selected based on 6 wire or inside delta configuration.

c. Soft starter current rating shall be after suitable de-rating for 50º temperature.

d. The derated current rating of soft starter shall be suitable for the rated motor current plus min. safety margin of 10 %.

e. The soft starter enclosed / cubicle shall be to ensure that temperature rise within enclosure does not exceed 5º C over max. ambient temp. of 45º C. Necessary cooling fans and air inlet / outlet vents shall be provided. Vents shall be provided with washable filter.

f. Cooling fans for soft starter feeder shall be interlocked with soft starter such that soft starter shall not turn ON / shall be tripped if any cooling fan is not working. Each cooling fan circuit shall be provided with MCB & aux. relay for this purpose.

g. The power structure shall consist of six SCR's mounted on a heat sink as a min.

h. Soft starter shall be with programmable keypad with graphical display mounted on door (remote mounting).

i. Soft starter shall be with RS-485 serial port (mod bus protocol) for remote communication.

j. Aux. contact of incoming breaker & contactor shall be used in series to provide

"SOFT STARTER READY" interlock signal for PLC/remote operation.

2 APPLICABLE STANDARDS

The Soft starter shall conform to the latest applicable standards specified below. In case of conflict between standards and this specification, this specification shall govern.

Microprocessor Soft Starter	IEC : 947.4.2 / EN 50081-1,50082-2 & 60204-
Metal Enclosed Switchgear	IS : 3427
Current Transformers	IS: 2705/BS : 7626
Degree of protection	IS : 13947(Part-1) / IEC : 947-1/BSEN :
Electrical Relays for Power	IS : 3231, 3842/BS : 142/IEC : 255
protection	
Electrical Indicating Instruments	IS : 1248/BS : 89 /IEC : 51
AC Electricity Meters	IS :722 / BS : 2692
Specification for copper rods and bars for electrical purposes	IS : 613
Code of practice for phosphating iron and steel	IS : 6005/ BS : 3189

3 CONSTRUCTIONAL AND PERFORMANCE FEATURES (MICROPROCESSOR SOFT STARTER)

The controller shall be of modular construction, consisting of a Power Control Board (PCB)

and Power Structure.

The PCB shall be compatible the full range of power structures. All

phases should be controlled during start/stop.

The power structure shall consist of six SCR's mounted on a heatsink for ratings up to suitable rating of motor.

4 CONTROL MODULE DESIGN FEATURES

4.1 MECHANICAL

a) The PCB module shall consist of a power supply, logic control circuitry, silicon controlled rectifier (SCR) firing circuitry. I/O circuitry a digital programming keypad, dual LED Displays and a serial communication port.

b) The PCB shall be designed for integral mounting on the power structure and shall be compatible with the full range of appropriate current ratings.

c) The PCB shall be easily removed from the power structure, without the need to disassemble associated printed circuit board assembles.

d) Control terminals shall be easily accessible and located on the front bottom of the device.

e) Digital parameter adjustment shall be provided through a built-in keypad.

Analog potentiometer adjustments are not acceptable.

Dual built-in alphanumeric, LED displays shall be provided for controller set-

up, diagnostics, status and monitoring. The Control Keypad and Display shall have the option for remote mounting.

g) For safety reasons the controller should have green lights for running and red for start/stop.

4.2 ELECTRICAL

The PCB shall be provided digital microprocessor control and supervision of all controller operation, including SCR pulse firing control.

The PCB power supply shall be self-tuning to accept control power input from 110 to 240 or 380 to 500 VAC, 50/60 Hz.

The SCR firing circuitry shall incorporate an RC snubber network to prevent false

SCR firing.

The logic circuitry shall incorporate a latch circuit for two wire / three-wire control.

4.3 USER ADJUSTMENTS

The two acceleration start ramp timers shall have individual adjustments from 1 to

60 seconds.

The two acceleration stop ramp timers shall have individual adjustments from 2 to

60 seconds.

The initial torque setting shall be adjustable from 0 to 200 % of motor torque.
The end torque setting shall be adjustable from 50 to 200% of motor torque.

Current limit starting shall be adjustable from 150% to 500% of the motor's full load current.

4.4 PROTECTION AND DIAGNOSTICS

Overload protection shall be as follows:

Meet applicable standards as a motor thermal protection device.

Shaft Power measurement without the use of external electro-mechanical sensors. Electronic thermal memory shall be provided for enhanced motor protection.

Shaft Overload and Underload protection shall be available through the controller, even in a bypass configuration.

Protections should be available in bypass mode.When fault conditions are detected, the controller shall inhibit starting or shut down SCR pulse firing.

4.5 PUMP CONTROL (standard feature)

The standard feature pump control shall be implemented to provide closed loop

control of a motor to match the specific torque requirements of centrifugal pumps for both starting and stopping. This shall aid in eliminating the phenomena commonly referred to as "water hammer". Methods utilizing Soft Start with Soft Stop shall not be independent of each other.

Pump stop shall be initiated without the need for a dedicated Pump Stop input. A

coast-to-rest stop shall still be possible with stop input.

The Pump Stop times shall be user adjustable from 0 to 60 seconds for small capacity at valve actuator & need not higher.

4.6 POWER STRUCTURE DESIGN FEATURES

a) Electrical:

Back-to-back SCR pairs shall be the only power-switching semiconductor means acceptable. Diode-SCR combinations shall not be acceptable.

There shall be separate power sections to operate from 200V to 525 V and 200Vto 690V, 50/60 Hz. Soft starter should be built for continuous operation without need of by pass for any reason.

4.7 ENVIRONMENTAL RATINGS

a) Temperature Ratings

The Controller shall deliver its rated current in ambient temperature ranging from 0 °C to +40 °C.

The Controller should be able to operate up to 50 °C operating conditions and shall be de-rated for this temperature as per soft starter manufacturer's recommendations.

The ambint storage temperature shall range from 25 °C to 70 °C. b) Humidity Range. The controller shall be operatable in relative humidity of 5 to 95%, non-condensing.

c) Altitude Rating

The controller shall be suitable for operation up to altitudes of 1,000 metres without derating.

4.8 CONTROLLER'S FEATURES AND MODES

A) Following **Starting modes** required for controller:
Linear Torque control for Start

Pump Control

Current Limit Start

i) Voltage ramp Start

ii) Voltage ramp with current limit Start iii) Full Voltage DPL Start

iv) Remote analogue control

v) Soft Start with Selectable Torque Boost vi) Slow Speed time controlled

vii) Slow Speed external controlled

Viii) Dual Ramp Start Bypass control

Bypass contactor mode with all the protection parameter working

B) Following **Stopping modes** required for controller: Linear Torque control for Stop

Quadratic Torque control for Stop. Pump Control

i) DOL/Cost to stop

ii) Remote analogue control Stop iii) Slow Speed time controlled

v) Slow Speed external controlled vi) Dual Ramp Stop

vii) Bypass control

C) Following **Additional features** also required for controller:

a) Analog output

c) Built in Display (LCD)

D) Following **Operational features** required for controller:

Keyboard

Remote Connectivity

E) Following **Protection features** required for controller:

Motor Thermal Overload – selectable for starting class 10A, 15A, 25A under load protection (to avoid dry run)

Soft Start thermal overload

PTC input

Phase imbalance
Phage reversal Over
voltage Under voltage
Locked Rotor

Excessive Starts per hour for application

Phase loss input / output

F) Following **Viewing functions** required for controller:
Motor Current

Three Phase Voltage

Shaft Power in kW / HP (selectable)
Motor thermal capacity

Motor Energy consumption (kWh)
Power factor

Run time in hours

G) Following **Fault Indication** functions required for controller, as offered by vendor:

Line failure

Phase imbalance

Over temperature – motor

Over temperature – Soft Starter

Shorted Thyristior Open
Thyristior Locked Rotor
Motor output loss

Overload – Shaft Torque Under
load – Shaft Torque Phase
imbalance

Over voltage Under
voltage Excessive
Starts Phase reversal

Event List of 15 latest fault indications/occurrence

5 DRAWINGS AND DATA

The following shall be furnished as part of the Tender:

5.1 General arrangement showing plan, elevation and typical sectional views.

5.2 Technical literature on the Microprocessor based Electronic Soft starter offered along with authorization letter from the company stating the service back up confirmation during warranty period & there after

5.3 The following shall be furnished after award of contract for Purchaser's approval: General arrangement showing plan, elevation and typical section views. Foundation plan showing location of fixing channels, floor opening etc., Schematic wiring drawings for each feeder.

4.13 INTERNAL AND EXTERNAL ILLUMINATION.

General

The illumination system shall consist of lighting poles, lighting distribution boards, lighting panels / power panels complete with FSU/ELCB/MCB, Fixtures, Cables, Junction Boxes, terminal blocks, cable glands, 3 pin 5A/15A convenience socket outlets, conduits and accessories and supporting and anchoring materials, lighting fixtures with fluorescent tubes, sodim vapour lamps, wires, etc. All materials, fittings and appliances use in electrical installation shall conform to the relevant IS specifications, required area classification and environmental conditions and shall be anticorrosive painted / FRP enclosures.

The wiring for lighting circuits shall be done by wires run in PVC conduits for indoor areas. For outdoor lighting, wiring shall be done by armoured cables.

Illumination Level

The lighting fixtures offered shall comply with the following requirements. a)

Luminaries shall have high efficiency Lumen Output/Watts

b) Enclosures shall preferably be FRP / Cast Aluminium with corrosion resistance paints.

c) All ballasts provided with outdoor lighting fixture as applicable shall include capacitor for power factor improvement (to 0.95). For all the fluourescent fittings the ballast shall be of High Frequency and Warm Start type Electronic Ballast only (less than 10% Total Harmonic Distortion). Fittings shall preferably have integral ballasts.

d) Flouresent fittings shall be used for indoor areas. HPSV type for outdoor and Yard areas.

All lighting fixtures shall be supplied complete with control gear and lamps. Special fixtures, wherever required to meet operational requirements, aesthetics etc. shall also be provided by the bidder. Make of lighting fixture shall be embossed on each lighting fixture.

Lighting wiring between LDB / SB and lighting fixtures shall be done by PVC insulated, copper wire (phase, neutral and earth) for non-plant buildings which shall be through surface run / concealed conduit. All lighting cables shall be 3C x 2.5 sqmm, 660 / 1100 V grade, copper conductor, PVC insulated, armoured type. Conduit wiring shall be done in 25mm dia minimum 16 gauge black enamalled steel structure conduit or PVC concealed conduit, with 1100V grade PVC insulated copper wire of min. size 2.5 sqmm for fixtures / 5A receptacles and 4 sqmm for power sockets. Not more than 7 wires shall be accommodated in each conduit. All lighting fittings / convenience outlets shall be earther through the third wire / separate core in conduit/cable.

On walkway, platforms and other outdoor areas, lighting fixtures shall be nearer to landing of stairs or ladders, gauges, flow meters, panel boards or other equipment requiring good illumination. In outdoor equipment area at ground level, lighting fixtures shall be mounted preferably 4m above floor level. Where this is impracticable, the minium height of any lighting fixture shall not be less than 2.5m. Socket outlets in process plant areas shall be approximately 1200mm above floor level and 300mm above floor level in office area. Lighting/Power panels shall be

mounted such that the top of the panel is 1800mm above finished grade. Control grears of lighting fixtures with separate control gear shall be mounted at suitable height from ground / platform for easy access / maintenance.

All lighting circuits and convenience receptacles shall be fed from lighting / power panels. Main/Lighting Distribution Board (MDB/LDB) shall be dust and vermin proof and shall be provided with SFUs (HRC) / MCCB as incomer and outgoing feeders where fault level is more than 9kA.

Main and Branch Distribution Boards: Each Main DB should be provided with 4 Pole Isolator as Incomer and DP ELCB+MCB as Out going circuit in each phase and all sub DBs should be with Isolator+ ELCB as in comer and MCB as Outgoing to control and for protection of lighting circuits. All DBs should be Double Door type – a hinged door to cover the operations knobs shall be provided. MCBs shall not be loaded beyond 80% of rated capacity. A minimum of 20% MCB in each panel shall be kept as spare. Power and lighting panel shall be of 16 gauge sheet steel construction and shall be suitable for surface or flush mounting.

All outdoor lighting shall be automatically controlled by means of synchronous timers with manual override control. Normally about 8-10 fixtures shall be wired in each circuit. Lighting feeders requiring automatic control shall be provided with contactors of suitable rating.

Sufficient number of Three Pin type 5A/15A receptacles as per IS;1293 shall be provided. Flush mounting type receptacle shall be used where concealed wiring has been adopted and surface type shall be used for other areas. For exhaust fans and wall mounted air cirucaltors, socket and switch enclosure shall be separate where as for rest receptacle and controlling on/off switch shall be mounted in the same enclosure. In building such as Sub-station, D.G. Shed, Workshop, maintenance shop, etc. industrial type metal clad socket outlets and plugs shall be provided. The sockets shall be supplied complete with plugs.

Adequate number of ceiling fans of 1200mm sweep (with double ball bearing and regulator)shall be provided in offices and rooms allocated to operating and maintenance personnel etc. In places where ceiling fans are provided, lighting fixtures shall be suspended below fan level with the help of conduits / chains to avoid shadows on the floor.

Minimum 2 nos. or sufficient exhaust fans as required during detailed engg. / recommended by equipment manufacturer shall be provided at Battery room, laboratory room, Sub-station/Switchgear/MCC room, DG room, all pump houses etc. The exhaust fans shall be provided with louvers / net to prevent insects. For pump house below ground level, suitable GI ducts for exhaust shall be provided as decided during detailed engineering and instructed by Engineer-in-charge.

Lux Levels shall be maintained at various Locations as indicated above and shall be backed up by Calculations from Manufacturer.

Switch Box :

Switch Box shall be made of metal on all sides, except on the front.

In the case of cast boxes, wall thickness shall be at least 3 mm and in case of welded mild steel sheet boxes the wall thickness shall not be less than 18 gauge for boxes, upto a size of 20 cm x 30 cm and above this M.S. boxes having minimum sheet thickness of 1.6mm shall be used. Switch boxes shall be galvanized after fabrication. Except where otherwise stated 3 mm thick phenolic laminaged sheets like summica shall be fixed on the front with brass screws. Clear depth of the box shall not be less than 60 mm and this shall be increased suitably to accommodate mounting of fan regulators inflush pattern. All fittings shall be flush pattern. It shall be provided with adequate number of knock outs on all sides for ease of wiring either with conduits or without conduits.

Wiring / Conduit System

Surface Conduit Wiring System

PVC conduits pipes of approved minimum 1.6mm wall thickness shall be used. The maximum number of The minimum PVC conduit diameter shall not be less than 25 mm. Maximum number of wires permissible in a conduit shall be seven/nine for wire size of 2.5 sqmm/1.5 sqmm respectively.

In long distance straight run of conduit, inspection type junction box at reasonable intervals shall be provided.

Fixing of Conduit

Conduit pipes shall be fixed by heavy duty G.I. pressure saddle with screws in an approved manner at an interval of nore more than one metre but on either side of the couplers bends, or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings. The saddle should not be less than 20 gauge for conduits .

Where conduit pipes are to be laid along the trusses, steel joints etc. the same shall be secured by means of ordinary clips or girder lips as required by the Engineer-in-Charge. Where it is not possible to drill holes in the truss members, suitable clamps with bolts and nuts shall be used. The width and the thickness of the ordinary clips or girders clips and clamps shall not be less than as stated below :

Recessed Conduit Wiring System.

Recessed PVC conduit wiring system shall comply with all the requirements of surface conduit wiring system specified in clauses above and in addition to the requirements specified in the following clauses.

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of buildings under construction, fixed work, specials care shall be taken to fix the conduit and accessories in position along within the building work, to avoid damage to the finished wall etc.

All outlets such as switches, wall sockets etc. shall be flush type

The outlet box shall be same as above and shall be mounted flush with the wall. The metal box shall be efficiently eathed with conduit by an approved means of each attachment.

To facilitate drawings of wire in the conduit. GI mesh wire of 10 SWG shall be provided while laying of recessed conduit.

Lightng Poles

Street light poles shall be steel tubular swaged type 106.6 mm, 80 mm dia. 4.5, 4.5, 2.65 mm thick (4 x 2.25 x 4.25), 8.5 metres long with M.S. base plate with pipe cap and over hung 2 meters long having dia to suit the socket of 70/150 watts. 240V, High Pressure sodium vapour lamp or metal halide fitting, conforming to IS : 2713 – 1969.

Balancing of Circuit

The balancing of circuits in three phase installations shall be arranged before hand to the satisfaction of Engineer in charge.

Drawings

All wiring diagrams shall indicate clearly in plan, the main switch board, the distribution fuse board, the run of various mains and sub-mains and the position of all points with their classification.

Rating of Lamp, Fans, Socket Outlet Points and Exhaust Fans

Incandescent lamps installed in pump house & other means shall be CFL Type only.

Table fans and ceiling fans shall be rated at 60 watts. Exhaust fans shall be rated according to their capacity.

5 Amps. Socket outlet points and 15 amp. Socket outlet points shall be rated at 100 watts and 1000 watts respectively, unless the actual values of load are known or specified.

Capacity of Circuits

Lights and fans may be wired on a common circuits, such circuit shall not have more than a total of ten points of light, fan and socket outlet or a load or 800 watts whichever is less.

Power circuits on buildings shall be designed with a maximum of two outlets per circuit, based on the loading.

Where, not specified the load shall be taken as 1 kW per outlet. Wherever the load to be fed is more than 1 kW it shall be controlled by an isolator switch or mini ature circuit breaker.

Indoor Decorative Luminaires

Luminaire shall be suitable for use with twin T. L. 40 watt 1200 mm (4'). 240 V fluorescent lamps, comprising of CRCA sheet steel channel stove enameled grey which incorporates all electrical accessories like quick fit lamp holder, starter holder, polyester filled ballast, power factor correction capacitor and duly pre wired upto the terminal block, with earthing arrangement facility, cover made for channel from CRCA sheet stove white enameled covering the channel fixed by twin screw, suitable for ceiling or pendent mounting suitable for 19 mm dia conduit, reflector plate for acrylic diffuser and end covers, complete in all respects ready for use. The luminaire shall conform to IS : 1913.

Industrial Luminaire

Lumnair shall be suitable for use with twin T.L 40 watts 1200 mm (4') 240 V fluorescent lamps comprising of Rail made of CRCA sheet steel stove enameled white, incorporates all electrical accessories like quick fit lamp holders, starter holder, polyester filled ballast and power factor correction capacitor and duly provided upto the terminal block with earthing arrangement facility suitable for ceiling or pendant mounting suitable for 19 mm conduit with stove enameled reflector gray outside and white inside which can be installed without aid of any; tools, complete in all respects and ready for use. The luminaire shall conform to IS ; 10322

Emergency Light

Emergency light unit working on 230 volts. A.C. supply shall be self containing unit with 20 watts 600 mm long florescent lamp type 'SWITCH ON MAIN FAILTURE. It shall be electronic automatic fluorescent type which incorporates a unit trickle charge circuit, which shall prevent over charging or battery The battery shall be maintenance free. The unit shall provide 4 hours illumination following power failure. The units shall generally conform to IS ; 9583.

Gate Lights

The gate lights shall be post top lantern type, weather proof, and suitable for H.P.S.V. metal halide lamp 70 watts and shall conform to IS ; 2149.

G.I. Pipes of suitable dia. Shall be provided at gate concrete pillar as conduit for wiring and fixing post top lantern luminaire.

The post top lantern shall be suitable for use with one number 70 watt S.P.S.V./metal halide lamp.

The luminaire shall comprise of a single self contained dia cast alumiuium housing M.B.V. treated, incorporating the ballast, power factor improvement capacitor and ignitor, non-hygroscopic lamp holder all pre-wired upto terminal block. The housing shall be suitable for 60 mm O.D. mounted on post-top.

Opel white one piece double conical dome made of vandal proof high density

polyethylene resistant to ultra violet radiation and heat shall be provided. The degree of protections shall be 43. The housing shall be die cast aluminium MEV treated. The pressure ring shall be dia cast aluminium M.B.V. treated.

Outdoor Yard Lighting

Outdoor Luminaire

The luminaire shall be 1 x SON – 70/150 watt H.P.S.V. or Metal Halide Lamps complete with all accessories and shall be Deep drawn aluminim reflector stove enameled grey outside and brightened and annodised inside lined with felt gasket to prevent insect entry.

Die cast aluminum housing covered with a lid shall be provided to accommodate all electrical assessories, such as independent ballast, powers factor improvement capacitor, wired upto terminal block.

A clear acrylic cover shall be fixed to the reflector by means of 4 toggles.

The luminaire shall be mounted on the mast arm of 50 mm O.D. – Mirror compartment and tray compartment shall have minimum degree of protection IP-43 aluminium sheet and be painted to stove enamel grey outside and brightened and annodised inside.

The housing shall be die cast aluminium – A6 Grade MBV treated covered with acrylic sheet clear.

Flood Lights.

Flood lights luminaire shall be H.P.S.V. SON – 250 W / 240 V lamp complete with all accessories.

The luminaire shall comprise of:-

Housing made of aluminmuim alloy of low copper content for greater corrosion resistant, cooling firns shall be provided for effective heat designs. The housing shall accommodate reflectors made form, high purity aluminium electrochemically brightened and anodised.

The housing shall be closed from the front by heat resistant toughened glass with silicon gaskets and held in a ring.

The rear cover also made of cast aluminium alloy of low copper content shall be provided with cooling fins. The rear cover shall accommodate a lamp holder, a lamps support internal earthling terminal, reflector stup. The lamp holder should be duly wired upto or terminal block. The luminaire shall be using in conduction with the suitable control gear box. Minimum Degree of protection shall be IP – 54.

The housing shall be of cast aluminium LM 6 Grade (High Silicon and low copper) M.B.V. treated. The housing bracket shall be M.S. hot dip galvanised.

The reflectror casing shall be high purity aluminum electrochemically brighened and anodized.

The front cover glass shall be heat resistant and toughened provided with gasket silicon rubber.

4.14 EARTHING SYSTEM

1 Earthing system design and installation shall generally be as per IS:3043. All metallic non current carrying parts of electrical apparatus, current and potential transformer secondaries, columns, vessels, towers, stacks, storage tanks, etc. shall be earther atleast by two distinct separate earth conductors from the earth plate connected to main earthing loop.

2 The main grid conductor shall be hot dip galvanized MS flat. The amount of galvanizing shall be minimum 610 gm per sqm. The main earth loop shall be laid at a

depth of 500mm below grade level.

Earthing conductor shall be laid around the battery limit of the plant. Horizontal conductors shall be laid in both longitudinal and transverse direction to facilitate earthing of various equipment in most economical and reliable manner.

Cable Trays in process areas shall be earthed with the help of risers emerging from main earthing conductors laid below/adjacent to structures carrying calbe trays. Trays shall be earthed at an interval of approx. 30m and in any case shall be connected to the earthing grid at minimum two points.

Joints and tappings in the main loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade shall be welded and suitably protected by giving two coats of bitumen and covered with hessian tape.

3 Adequate number of min. 65mm dia. or higher size as per IS:3043, 3m long GI pipe earth electrodes with earth pit shall be provided. All earth electrodes shall preferably be driven to a sufficient depth to reach permanently moist soil.

4 Multiple earth connection shall be taken from suitably located earth plates connected to earth loop. All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections of equipment. Unless otherwise specified, earthing connections to individual equipment shall be done in accordance with standard equipment earthing schedule.

5 Lightening protection shall be provided for equipment, structures and buildings as per IS:2309. Self-conducting structures may not be provided with aerial rod and down conductors but shall be connected to the earthing grid at minimum two points of the base. An independent earthing network shall be provided for lightening protection and this shall be bonded with the main earthing network minimum at two points at the buried electrodes.

6 The resistance value of an earthing system to the general mass of earth for the electrical system and equipment shall be as follows:

a) For the electrical system and equipment a value that ensure the operation of the protective device in the electrical circuit but not in excess of 5 ohms. However, for generating stations and sub-stations this value shall not be more than 1 ohm.

b) For lightening protection, the value of 5 ohms as earth resistance shall be desirable, but in no case it shall be more than 10 ohms.

7 Connection

The earth system connection shall generally cover the following:

Equipment earthing for personnel safety

System neutral earthing

Static and lightning protection

System neutral

Current and potential transformer secondary neutral

Metallic non-current carrying parts of all electrical apparatus such as transformers, switchboards, bus ducts, motors, neutral earthing resistors, capacitors, UPS, battery charger panels, welding receptacles, power sockets, lighting/power panels, control stations, lighting fixtures, etc.

Steel structures/columns, etc.

Cable trays and racks, lighting mast and poles

Storage tanks, vessels, and all other process equipment

Fence and Gate for electrical apparatus (e.g. transformer, yard, etc.) Cable shields and armour Shield wire

All main earthing shall be used for earthing of equipment to protect against static electricity.

All medium (LT) and high voltage (HT) equipment (above 250V) shall be earthed by two separate and distinct connections with earth.

Plant instrument system clean earthing, UPS system clean/safety earth shall be separate from the electrical earthing system.

All earthing connections for equipment earthing shall preferably from the earth plate mounted above ground wherever provided. Equipment foundation bolts shall not be used for earthing.

Earth connections shall be made through compression type cable lugs / by welded lugs.

All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections and all connections adequately locked against loosening.

Lighitng fixtures and receptacles shall be earthed through the extra core provided in the lighting circuit/cable for this purpose.

The reinforcements of sub-station building and sub-station floor shall be connected to main earth grid.

The earth electrodes shall be situated at a distance not less than 3.0 m from the building fencing structure and equipment foundations. The earth pit shall conform to IS:3043. The surrounding the electrodes, soil shall be treated up with salt, coke and charcoal. The distance between two electrodes shall not be less than twice the depth of electrode.

Minimum requirement of earth pits as per I.E. rules are as under.

Two numbers independent for transformer netural

Two numbers independent for four pole structure. One number for lightning arrestors.

Two numbers for L.T. panel at sub-station and at pump house.

The main earth electrodes after being driven into the ground shall be protected at the top by constructing a concrete or block masonry chamber of size 300 mm x 300 mm x height 300 mm shall be provided with CI cover. The resistance of any point in the earth continuity system of the installation to the main earth electrode shall preferably not exceed 1.0 ohm. The remaining space in the bore hole shall be filled with bentonite. The bentonite will hold the earth road in position., The neutral conductor shall be insulated throughout and shall not be connected at any point to the consumers earthing system.

It shall not be allowed to use the armour of the incoming feeders cable to the sub-distribution board as the only earthing system.

Sheathed lugs of ample capacities and size shall be used for all underground condutors for sizes above 3 mm^2 whenever they are to be fitted on equipment of flat copper conductor.

The lugs shall be fitted on equipment body to be grounded or flat copper only after the portion on which it is to be fixed is scrubbed, cleaned or paint or any oily substance on a subsequently tinned.

No strands shall be allowed to be cut in case of stranded ground round conductors. GI embedded conduits shall be made electrically continuous by means of good continuity fixing and also rounding copper wires and approved copper clams.

8 Earthing of Lighting Poles

All external poles are to be looped together with continuous 8 SWG GI earth wire clamped a dollies provided on every fuse box of poles and looped onwards to the other pole. Every fifth pole shall be connected to earth through an earth electrode.

9 Recommended Size of Earthing Conductors

Below are the recommended minimum sizes of earth conductors. However, Earthing Strips/conductors, if required of higher size as per Ground Fault Calculations, should be laid.

Type of Equipment Earth conductor size (See Note-1)

Motors upto 3.7kW	8 SWG solid GI wire
Motors from 5.5kW to 30kW and welding receptacles	10mm dia GI wire rope
Motors above 3 kW	16mm dia GI wire rope
or	
	40 x 5 mm GI strip Building
columns	40 x 5 mm GI strip Storage
Tanks (Vert./Hor.) / Vessels	40 x 5 mm GI strip Small
equipment and instrument	8 SWG GI solid wire
Lighting, Power and Instrument Panels	10mm dia GI wire rope
Main Earth Bus / LT & HT Switchgear	75 x 8 mm GI strip
Interconnections / Power Transformer	
HV Sub-stations	75 x 8 mm GI strip
Push Button Stations (LCS)	8 SWG GI solid wire
Street Light Poles	8 SWG GI solid
wire Lighting Transformer	16mm dia GI
rope Pipe Rack	40 x 5 mm
GI strip Bonding of pipe	25 sqmm
insulated	
	Flexible Cu cable

Note-1: Earth connection to individual equipment from nearest earth plate / grid may also be done alternately using aluminium/copper conductor PVC insulated core of size note less than half the cross section of the respective power cable to equipment (motor, panel, etc.). Connections shall be made using crimpt type lugs.

4.15 SAFETY EQUIPMENTS TO BE PROVIDED

The contractor shall provide the following safety equipments as per IE rules, on the HV panels, Generator panels, Control panels and main MV panel rooms. Rubber mat conforming to IS 5424 in front of all the HT and MV panel for their entire length – 1000 m. wide. Sufficient pairs of electrically tested rubber gloves. These are to be kept in a suitable wooden box.

A shock treatment instruction chart in Gujarati and English duly framed as detailed in IS:1355. The nearest medical facility available with phone number shall also be kept. First aid box containing full compliments of medicines for treatment of electrical burns in the main switch room. Adequate number of portable fire extignuishers of dry powder (Store type) as per IS : 935 to suit the individual substation, panel rooms, pumping station requirement. Adequate number of caution notices in Gujarati and English shall be fixed permanently on the equipment to comply the requirement of IE rules. Safety posters for vigilance against electrical accidents as detailed in IS : 255. Adequate number of fire buckets with MS angle stand.

4 Sets each comprising of 4 Nos. round bottom fire buckets marked fire with reuired stand shall be provided in the HT sub station. 2 Nos. folding aluminium ladders for safe

maintenance of lighting system, etc.

4.16 DIESEL GENERATOR SET ALONGWITH AMF & SYNCH. PANEL

Supply, Installation, Testing and Commissioning of required kVA at 0.8 PF, 415 V ± 1 % and 50 ± 1% Hz or better, 3 Phase, 4 Wire Diesel Generating Set complete with AMF cum synchronizing control panel and necessary controls and safety devices in panel confirming to relevant IS specification. The set must be continuous rating with a speed regulation of ± 1% or better.

Diesel engine shall be complete with necessary controls and safety devices conforming to relavant ISS/BSS with latest amendments. Diesel Engine shall be suitable for continuous operation of generator set duty inclusive of fly wheel, single bearing, air cleaner, radiator fan with guard, fuel pump, fuel filter, Electronic governor, electrical starting system with starter, 12/24 V battery, Voltage regulator, instrument panel, Exhaust silencer, protections against low lubrication oil pressure, high water temperature. Alternator shall be 415V, 3 Phase, 50 Hz, 4 Wire, 0.8 power factor self excited, self regulated, brushless type, drip proof confirming to IS : 4722 with latest amendments. The engine and alternator shall be coupled over a sturdy common base frame. Floor mounted, dust & vermin proof, indoor type control panel shall be consisting of ACB/MCCB of suitable normal current rating, with combined overload and earth fault protective relays / release, voltmeter with selector switch, ammeter of suitable range with selector switch, frequency meter, Energy meter, CTs indicating lamps with fuse and switch control, complete with necessary interconnections, fuses, labels and other accessories Day fuel tank with necessary fuel hoses to the engine, all as per detailed specifications completes as required.

GENERATING SET:

The generating set shall comprise diesel engine of adequate capacity directly coupled to an alternator mounted on a common base frame and with floor mounted AMF control panel as per details given below. DG set is required to function at places situated at an altitude upto 1000 M, ambient temperature upto 45^0 C and relative humidity upto 95%.

(A). ENGINE:

Diesel Engine shall have constant speed, water cooled, suitable for generating set application 1500 RPM, powered by multicylinder, turbo charged after cooled, cold starting, heavy duty type rated in accordance with BS 649 / IS – 10002 – 1981 with latest amendments and equipped with the following accessories:

a) Fly wheel to suit flexible coupling with guard b) Dry type air cleaner

c) Corrosion inhibitor liquid

d) Fan blower type with guard e) Radiator with guard

f) Water pump, centrifugal type, engine mounted g) Fuel pump PT type

h) Fuel filter

i) Governor – electronic type to meet test requirements class 'A' confirming to IS – 10,000 (Pt – VII) – 1980 j) Fuel injection equipment

k) Exhaust silencer, residential type with spark arrestor. Height of exhaust pipe above DG room height shall be as per pollution control regulation and supported with M S angle iron supports and stay wires. The exhaust pipe to be lagged with asbestos rope till the point.

l) Electric starting equipment comprising starting motor on 24 V DC supply m) Lub oil cooler

n) Lub oil pump o) Lub oil filter p) Turbo charger

q) Solid state potentionater for increase or decrease of speed which can be wired with remote operation.

r) Any other as required.

INSTRUMENT PANEL COMPRISIG OF:

a) Starting Switch

b) Lub oil temp. indicator

c) Lub oil pressure indicator d)
Water temperature indictor e)
Battery Voltmeter

f) Safety control for low lub oil pressure

g) Safety control for high water temperature h)
Hour meter (Mech) and RPM indicator

The above metering shall be fixed in control panel or on Engine mounted panel.

(B). BASE FRAME:

The Engine and Alternator should be perfectly aligned and assembled on a sturdy fabricated, adequately machined base frame, made out of high quality MS channels the base frame should be provided with lifting facilities and drilled foundation holes suitable for installation in concrete foundation with anti-vibration mounting. DG set is to be supplied with anti- vibration mountings pad suitable for the D.G. Set load..

(C). BATTERIES:

Set of staring batteries consisting of required nos. of 12/24 V, and of AH capacity as recommended by vendor, VRLA SMF (Valve regulated lead acid, sealed maintenance free) batteries connected in series with first charge of electrolyte with leads, lugs and terminals etc duly installed on MS frame near the Engine.

(D). FULE TANK:

Fuel tank of adequate ltrs capacity with inlet and outlet pipe connections, filling cap, drain plug, level indicator and floor mounting pedestal along with hand operated fuel transfer pump and suitable hose. Fuel tank capacity with each DG Set shall be adequate for 8 hrs continuous subject to maximum 990 Ltr capacity.

(E). ALTERNAOR:

Alternator shall be for 0.8 p.f, 415 V +/- 1 % 3 phase, 4 wire, 50 HZ +/- 1% or better frequency 1500 RPM, self regulated and self excited, brushless, double bearing AC generator in accordance with IS:4722 with latest amendments with screen protected drip proof enclosure and damper winding on pole faces.

(F). AMF CONTROL PANEL:

Automatic Mains failure panel, shall be floor mounting, dust and vermin proof and consisting of the following accessories.

1. 4 pole MCCB /ACB of suitable current capacity 50 kA breaking capacity for alternator
2. 0 – 500 Volts Digital Voltmeter with Selector switch
3. 0 – 630 Amp Digital Ammeter with selector switch
4. 630 / 5A current transformers for metering and protection
5. digital frequency meter
6. Trivector Meter of suitable capacity with provision of indicating Maximum demand in

kVA

7. Earth fault relay

8. Power factor meter.

9. BATTERY CHARGER CONSISTING OF:

(a) Transformer & rectifier with surge protection network

(b) D C Voltmeter

(c) D C Ammeter

(d) Selector switch for Trickle, off & boost

(e) Selector switch for current adjustment

10 ELECTRONIC AMF LOGIC – (NB2 OR EQUIVALENT) TO COVER THE FOLLOWING FUNCTIONS:

(a) Mains supply failure monitor

(b) Supply failure timer

(c) Restoration timer

(d) 3 impulse Automatic engine Start / Stop attempts

(e) Failure to start indication

(f) Off / Manual / Auto / test Selectors

(g) Power On / Off Switch

	CONDITION	INDICATION	TRIP ANNUNCIATION
(a)	Mains on	Yes	----
(b)	Generator on	Yes	----
(c)	Load on Mains	Yes	----
(d)	Load on generator	Yes	----
(e)	Low Lub Oil Pressure	Yes	Yes
(f)	High water temperature	Yes	Yes
(g)	Set fails to start (with alarm)	Yes	Yes

Note:

a) ACB shall have inherent overload and short circuit protection

b) Voltmeter, Ammeter, frequency meter and P.F. Meter shall be digital type.

c) AMF panel shall be fabricated from 14 SWG CRCA sheet

d) Current density of aluminium busbar shall be 0.8 A/mm2 and max. 1 A/mm2

e) AMF panel shall undergo anticorrosive treatment by 7 tank process and paint with 2 coats of base primer and then powder coated on outside and inside of panel.

f) AMF panel shall be got fabricated from panel fabricator having CPRI test certificate for short circuit test.

(G) ACOUSTIC ENCLOSURE : shall be provided.

SPECIAL NOTES:

1. Engine shall be water cooled type and shall have turbo charged aspiration, reverse power relay in the control panel & electronic goverfning system.

2. Above 500 kVA, the engine shall have turbo charger with after cooling.

3. The diesel engine generator set shall be with acoustic enclosure up to 1000 kVA.

4. The fuel tank shall be inbuilt part of the Genset with acoustic enclosure. Hence, no separate fuel piping is required. The fuel tank shall be suitable for about 8 hours of operation of DG Set on full load. However, maximum fuel tank capacity shall be 990 litres.

5. The diesel engine can be naturally aspirated, turbocharged type or turbocharged with after cooler arrangement type as per respective manufacturer's standards.

6. AMF control panel shall be suitable for auto start/auto changeover functions.

7. Up to 400 kVA Genset rating, the AMF panel shall have 2 x 4-polew type MCCBs of suitable rating + 2 x power Contactors (AC-3 duty, 4 – pole type) for Genset & Mains Power incoming.

8. However, from 500 kVA & above rating Gensets, the AMF panel shall have 1 x 4- pole type EDO type ACB of suitable rating.

9. The panel shall have microprocessor controller for AMF function + alternator protections. The type of AMF controller should be either BERNINI make BE-42 or WOODWARD make NDC-1. Even if the engine has its own controller having AMF features as inbuilt part, this controller should be used for taking care of alternator protections.

10. The panel fabrication should be 7-tank processed & powder coated.

11. The ACB/MCCBs should have short circuit & over load protections.

SPECIFIC REQUIREMENT

1. Bidder shall submit the following drawings for approval before manufacturing as a minimum:

a) General arrangement drawing.

b) Foundation drawing.

c) Termination details of cable.

d) Power and Control wiring drawing of AMF control panel of DG Set. e) Fabrication drawing of AMF control panel.

INSPECTION & TESTING

All the equipment shall be tested and inspected at vendor works before dispatch to ensure compliance with the specifications/requirements mentioned herein and applicable codes and standards and agreed quality assurance/testing plan.

The owner or his authorized representative may visit the works during manufacture of various electrical equipment/materials to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given full assistance to carry out inspection. Owner's representative shall be given minium two weeks advance notice for witnessing of final testing. Field tests as per approved procedures / procedures available with engineer-in-charge or his authorized

representative shall be performed on the electrical system / equipment before it is being put into service. All test equipment shall be arranged by the vendor. Test reports shall be approved by the engineer-in-charge before acceptance of the comlete plant and equipment.

5.0 ELECTRICAL INSTALLATION

This specification covers the technical requirements for equipment, materials, and installation methods, testing and commissioning of electrical system.

The contractor shall possess a valid contractor's license for the state in which site is located and shall ensure it's validity during the duration of the contract. The contractor shall furnish authenticated copies of certificates to the Engineer for himself and his workmen before commencement of work.

The contractor shall employ adequate skilled and unskilled labour to complete all work accoriding to programme of work. Skilled workers shall possess the minimum qualifications stipulated by statutory or competent authorities.

The contractor shall employ adequate numbers of supervisor to control the labour force and to carry out the work as per schedule. Supervisory staff shall also possess the minimum qualifications stipulated by statutory and competent authorities.

Various types of equipment shall be installed in accordance with drawings and / or manufacturer's instructions and good engineering practice. Particular attention shall be paid to lubrication of moving parts and bearings, alignment, tightness of all connections (mechanical and electrical) and wiring.

The transformers shall be moved to its location and shall be correctly positioned on it's base.

All parts of the transformers, which are supplied loose, such as conservator, radiator banks, buchholz relays, dial thermometers, bushings, etc. shall be fitted onto the transoformers.

Transformer oil if supplied in drums shall be filled into the transformer after duly testing/filtering, upto the correct level required. The transformer may have to be dried out and oil filtered.

The contractor shall place the switchgear correctly on the base of foundation prepared for the same. If the switchgear consists of a switchboard with number of panels bolted together, he will place all the sections of the switchboard correctly, align them and bolt the sections together to form one continuous switchboard. The switchgear shall then be secured to the foundation by means of nuts and bolts or foundation bolts grouted in the base. The contractor shall also make inter-section bus/wiring connections.

In case of wall/structure mounted equipment, boards, the contractor shall fabricate and install the structural steel frame work suitable for mounting the various equipment boards. The contractor may have to prepare drawing showing the proposed general arrangement, of the structural frame which shall be subject to the approval of the Engineer. The fabrication and installation of the framework shall be recommended only after the approval of drawings. Various items of the equipment, board shall be mounted in accordance with the approved drawings.

Motor shall generally be installed by others, along with the driven equipment. The contractor may, however, be asked to install motors in specific instances.

Cable routes and mode of installation shall generally be as shown in the construction drawings.

Identification tags indicating cable designation, shall be affixed to each cable at ends and at an interval not exceeding 15 mtrs or at the location where cables change direction or elevation. Signboards with necessary indication/arrow mark with necessary structure/foundation shall be also be installed, of edquate size as approved by Engineer, for the enture cabling system buried underground.

H.V. XLPE / PVC armoured cables shall be terminated or jointed by means of cold setting epoxy based cast resin jointing system or heat shrinkAble or push on type cold setting kit.

All cable glands should be of nickel plated brass, double compression type. All

Alu/Cu cables shall be terminated through crimping type Alu/Cu lugs respectively.

All electrical ewuipment viz. transformers, switchgear, motor control centres, motors, control stations, switches, lighting, fittings and other electrical apparatus shall be connected to the main earth loop by means of two separate and distinct external earth conductors. The material, type and size of earth conductors will be as shown in the drawings or as specified.

Electrical installation in hazardous areas if applicable as defined in IS:5571 shall be carried out with utmost care and special precautions shall be taken to ensure operational safety.

All personnel, especially supervisory staff, working on such installations shall be fully conversant with the applicable National Standards and Code of Practice and shall have previous experience of such work.

The contractor shall take all reasonable safety precautions during construction and testing of the works. Particular attention shall be paid to the following:

a) To prevent any conductor or apparatus becoming accidentally or inadvertently charged.

b) Prior to electrical installation (or part there of) being connected to the main supply, the Contractor shall ensure that uncommissioned or incomplete circuits cannot be inadvertently energized and completed circuit cannot be used without the Engineer's consent.

c) No hot work is carried out without work-permit issued by the Engineer in FLP zones

(if stipulated by process application).

The tests specified below/elsewhere as part of this tender document shall be carried out on the electrical equipment and installation before commissioning the same. The tests shall be performed by or under the direct supervision of a competent person, qualified to carry out the tests. All tests shall be carried out in the presence of the authorized representative of the Employer/Owner and/or the Engineer, unless this stipulation is waived in writing.

6.0 PAINTING

All surfaces of equipment/structural steel shall be sand blasted, degreased and pickled in acid as required to provide a smooth & clean surface, free of rust / scale / grease.

After cleaning the surface shall be given one coat of high quality red-oxide or yellow chromate and baking in the oven (for equipment only).

All surfaces shall be then finished with 2 (two) coats of finished Synthetic Chemical paint of shade 631 of IS : 5 or with a paint shade of purchaser's choice unless otherwise specified.

7.0 DETAILS OF TESTS

I POWER & DISTRIBUTION TRANSFORMERS

i) Check HV & LV cable terminations, ground connections, fittings and accessories, oil level and oil leaks at various joints. Check breather, thermometers & buchholz relay for proper functioning and operation. Check junction box, marshalling box etc. for correct wiring.

ii) Oil Test

Crackle test and dielectric test as per Clause 7.11 of IS 10028. The oil shall withstand at

least 40 kV with a gap of 4 mm.

iii) Insulation Resistance Test

This may be carried out on new transformer without drying out the transformer, provided the transformer has not been idle or stored for a long period. Otherwise, this test shall be carried out during drying out of transformers. Insulating resistance test shall be carried out between primary & secondary to ground as well as between primary and secondary. Windings not under test shall be grounded during the test.

A megger rated 1000 volts or higher shall be used for the test.

iv) Polarity & Phasing Out Test

Check external connection of the transformer in accordance with diagram of connection and phase sequence (anti-clockwise)

II HV & MV SWITCH GEAR

i) Check proper mechanical operation of circuit breakers including alignment of trolleys in case of draw–out type circuits breakers, smooth operation of all mechanical parts, lubrication, mechanical interlocks etc.

ii) Check contact alignment and wipe, proper sequence of closing and opening of main and arcing contacts.

iii) Check electrical relays, instruments & controls for correct wiring.

iv) Insulating test on bus bars – phase to phase and phase to ground. This test will be carried out with circuit breakers in service position, but contacts remaining open.

v) Insulation test on relays & control wiring including current and potential transformers and wiring of CT & PT secondaries.

vi) Insulation test on circuit breakers in withdrawn position – phase to phase and phase to ground with contacts closed.

vii) Adjust correct settings of relays and/or direct acting trips - as specified.

viii) Operation test

Energise only control circuits and carry out closing and tripping operations (where AC supply derived from main supply is used for operation, the switch–gear bus may be energised). Check operations of electrical interlocks. Check tripping of circuit breakers by manual operations of protective relays contacts. Check operations of mechanical closing and tripping devices. Check lockout conditions for closing of circuit breakers by simulating the required conditions. Check control, indications, sequence interlocks and alarms.

ix) Polarity and connections of instrument transformers – Check for correctness of CT & PT connections provided. Check electrical continuity of secondary with ELV tester.

x) Check operation of instruments, meters, relays and tripping of circuit breakers by primary / secondary injections as specified.

xi) Check continuity of power circuits and earth continuity of all non current metallic parts with a low voltage a (6 volts or less) continuity tester.

III MOTOR CONTROL CENTRES, SWITCHGEARS

i) Check equipment, internal wiring, smooth mechanical operation, interlocks, etc.

ii) Check continuity of power circuits and earth continuity of all non-current carrying metallic parts with a low voltage continuity tester.

iii) Insulation test for power & control circuits between phases, between phases and neutral and between phase / neutral and ground.

iv) Check operation by energizing control circuits (without energizing power circuits) for correct functioning. Simulate eternal controls and interlocks for the same. Note chatter or humming of contactor and rectify, in necessary.

v) Check fuse ratings and adjust relay setting (overhead, single phasing preventers etc) in accordance with load ratings.

vi) Polarity and connections of instrument transformers – Check for correctness of CT & PT connections provided. Check electrical continuity of secondary circuits with ELV tester.

IV MOTORS & ROTATING EQUIPMENT

i) Check equipment for free movement of rotor, and play, lubrication and for any other visual checks.

ii) Insulation test of motors – between winding and ground. Use 500 volts megger for M.V. motors and 1000 volts megger for HV motors.

iii) Check electrical continuity with ELV tester.

iv) No load running of motor noting down no load current and voltages in all three phases.

V CABLES

i) Insulation Test between each phase and neutral and between each phase / neutral and ground.

ii) D.C. High Voltage Test on HV cables in accordance with the relevant Indian Standards and Code of Practice. This test shall be carried out on cables installed in final positions, and all joints and terminations have been made. The cables, however, may not be connected to the equipment, so that the equipment may not be subject to the test voltage.

iii) In case of lighting wiring, insulating test shall be carried out on lighting feeders with branch circuits open. Branch circuits shall be tested separately with lamp holders, plug receptacles and lighting fittings in position, but without lamps. In case of lighting circuits will lamp ballasts and glow starters, insulation resistance may be measured between phase and ground only.

iv) In case of directly buried cables, insulate resistance of cables shall be measured before and after the back-fillings.

v) Test all receptacles for correct phase sequence.

VI EARTHING SYSTEM

i) Measure earth resistance of each electrode separately. If a number of earth electrodes are interconnected with one another, combined earth resistance shall also be measured. The earth resistance of each electrode and/or a group of electrodes shall not exceed the values specified.

ii) Carry out line earth loop impedance test. The loop comprises the line conductor from the point of fault, back to the supply transformer, the path through transformer winding, the earthed neutral point of the transformer and path for that point to the point of fault through the earthing system.

iii) Continuity test for earth continuity conductors with ELV tester.

8.0 STATUTORY APPROVAL

The Contractor shall be totally responsible for obtaining statutory approval from the

electrical inspector or any other statutory authority for the entire installation carried out by him unless otherwise specified and agreed. Necessary test reports shall be submitted by him to electrical inspector. Any statutory fees for the same shall be paid by client.

9.0 ACCEPTANCE OF INSTALLATION

On completion of the work the Engineer, together with the Contractor, will carry out an inspection of the Installion. The Engineer will issue a completed copy of the Purchaser's Acceptance of Electrical Installation to the Contractor as confirmation that the work has been accepted, subject to any matters noted on the form being attended to.

10.0 APPROVED VENDOR LIST – ELECTICAL EQUIPMENT / COMPONENT

Sr.	Item Description		Approved Makes
1	11kV Switchgear	-	Siemens / Crompton / Areva (Alstom) / ABB
2	Transformer	-	CGL / Voltamp / Kirloskar Elec. / Areva /Transformers & Rectifiers (I) Ltd.
3	LT Panels(PMCC / MCC / PCC)	-	L&T / Siemens / Schneider / Alstom / PatelBrothers / Alpha Nippon / Industrial Control / Positronics or app by eic
4	Lighting & Power Panels(DBs)	-	Controls & Switchgear / Havells / Indo Asian /MDS Switchgear / Standard Electricals
5	Cables	-	Universal / CCI / Fort Gloster / RPG / Ravin(Primecab) / Finolex
6	MV Motors	-	Siemens / BBL / ABB / Alstom / KEC
7	Air Circuit Breaker	-	L&T / Siemens / Schneider / ABB
8	HRC / Control Fuses	-	L&T / Siemens / Schneider / ABB
9	Contactor	-	L&T / Siemens / Schneider / ABB
10	Protection Relays	-	L&T / ABB / Easun Reyrolle / Alstom
11	Bi-metal Relays	-	Siemens / L&T / Schneider / ABB
12	Meters	-	GEC / SIMCO
13	Earth Leakage Circuit Breaker	-	Indo-Asian / GEC / S&S / Datar / MDS
14	Miniature Circuit Breaker(MCBs)	-	Siemens / MDS / Indo Asian / L&T / ABB/Merlin Gerin / Siemens
15	MCCB	-	L&T / Schneider / ABB / Siemens
16	Lighting Fixtures / Luminaires	-	Philips / Crompton / Wipro / Bajaj
17	Lighting Transformer	-	Voltamp / Automatic Electric / Indcoil
18	Power Capacitor	-	Crompton / Universal / Asian / Meher (L&T) /Schneider / Khatau Junker / ABB / Madhav
19	APFC Panel	-	L&T / Crompton / Asian / ABB / Schneider /Patel Bros. / Positronics / Datar / Alpha Nippon
20	Energy Meter	-	Jaipur / BHEL / G.E.C / I.I.T. / Universal
21	Digital Energy Meter	-	Enercon / Secure / Schnieder / Krykard / L&T
22	Control / Selector Switches	-	Siemens / L&T / Alstom / Havells / Kaycee
23	Push Button & Indicating Lamps	-	Siemens / L&T / Raas / Teknic / Schneider
24	Timers	-	Siemens / L&T / BCH / Teknic
25	Instrument Transformer (CT/PT)	-	Siemens / Kappa / AE / L&T / Control & Swgr /Gilbert & Maxwell / Silkaans
26	Indicating Instrument (Meters)	-	Automatic Electric / IMP / Meco / Alstom /(Digital / Analogue) Enercon / L&T
27	Vacuum Circuit Breaker	-	Areva / Crompton / Siemens / ABB
28	Cable Jointing Kit	-	CCI / Raychem / M. Seal
29	Variable Frequency Drive /Soft Starter	-	ABB / Schneider / Danfoss / Siemens

30	D.G. Set (with AMF Panel)	-	
	a) Engine	-	Kirloskar Oil Engine / Greaves / Caterpillar /Cummins
	b) Alternator	-	NGEF / KEC / Crompton / Jyoti / Stamford
	c) AMF Panel	-	Reputed CPRI approved vendor
31	Ceiling / Exhaust Fans	-	Bajaj / Crompton / Orient / Havells
32	Control Station (Local PB Stn)	-	Baliga Lighting / Bhartia / Ex-Protecta /Schneider / Pustron (Shrenik & Co.)
33	Fuse Switch Combination	-	Siemens / L&T / Schneider / ABB
34	Heavy Duty Switches	-	Siemens / Schneider / L&T / ABB
35	Ni-Cd Battery & BatteryChargers	-	Amara Raja (Ch) / Amco Power (Batt.) /HBL Nife (Batt + Ch) / Automatic Electric (Ch.)
36	Junction Boxes	-	Ex-protecta / Sudhir Swgr / Equi.
38	Numerical Relays	-	Siemens / L&T (P&B, U.K.) / ABB / Alstom
39	Cable Glands (Double Comp.)	-	Braco / Ex-protecta / Comet / Connectwell/Dowells
40	Accessories of wiring	-	Anchor / Jainex / Clipsal
41	Terminal Blocks	-	Phoenix / Wago / Elmex / Connectwell
42	Lugs	-	Dowell / Jainsons or Equi.
43	APFC Relay	-	Enercon / Siemens / L&T / Asian / Datar
44	GI / FRP Cable Trays	-	Indiana / Sharda / M.M. Engineering / Equi.
45	PVC Conduits & Accessories	-	Precision / Clipsal
46	Flexible Wire (FRLS)	-	Finolex / Anchor / Havell's / RR Kabel
47	Miniature Relays	-	Omron / Phoenix / OEN

Note: Any item whose make is not given or other equivalent make will be subject to approval by the Engineer in Charge before supply.

The contractor shall distinctly understand that it will not be their perogative to insist on a particular brand from the list, and final selection will be done with the approval of Client / Engineer in charge.

02 CHAPTER INSTRUMENTATION SPECIFICATIONS

APPLICABLE NATIONAL/INTERNATIONAL STANDARDS

AGA American Gas Association, Gas Measurement Committee ANSI/ASME American National Standards Institute/American Society of Mech. Engineers

B 1.20.1	Pipe Threads
B 16.5	Steel Pipe Flanges and Flanged Fittings
B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges

ANSI/FCI American National Standards Institute/Fluid Controls Institute

70.2 Control Valve Seat Leakage Classification

API American Petroleum Institute

RP 520	Sizing, selection and installation of pressure relieving systems in refineries.
	Part-I - Sizing and selection
	Part-II - Installation
RP 521	Guide for pressure relieving and depressurising systems
RP 526	Flanged steel safety relief valves
RP 527	Seat tightness of pressure relief valves
MPMS	Manual of Petroleum measurement standards
RP 551	Process measurement instrumentation
	Part - I Process Control and Instrumentation
RP 552	Transmission Systems
S 2000	Venting atmospheric and low pressure storage tanks
S 670	Vibration, Axial-Position and Bearing Temperature Monitoring Systems

ASTM American Society for Tests and Materials BS British Standards

BS-1042	Measurement of Fluid Flow in Closed Conduits
BS-5308 Part-II	Specification for PVC insulated cables
BS-7244	Breather Valves

DIN-43760 Temperature Vs. Resistance curves for RTDs

DIN-19234 Electrical Distance Sensors; DC interface for distance sensors and signal converter

DIN-50049 Document on Material Testing

IEC International Electro technical Commission

IEC 79 Electrical apparatus for Explosive Gas atmosphere

IEC 85 Thermal evaluation and classification for electrical insulation

IEC 332 Test on bunched wires or cables

Part III Cat. A

IEC 529 Classification of degree of protection provided by enclosures

IEC 534-2 Industrial Process Control Valves - Flow capacity

IEC 584-2 Thermocouples - Tolerances

IEC 751 Industrial Platinum Resistance Thermometer Sensors

IEC 801 Electromagnetic compatibility for industrial process measurement and control equipment

IS Indian Standard

IS-5 Colours for ready mixed paints

IS-319 Specification for free cutting brass bars, rods and sections IS-1239 Mild Steel tubes, tubulars and other wrought steel fittings IS-1271 Specification of Thermal Evaluation and Classification of

Electrical Insulation

IS-1554 Part-I PVC insulated (heavy duty) electrical cables – working

Voltage upto and including 1100V

IS-2074 Ready mixed paints, air drying, red oxide - zinc chrome

IS-2147 Degree of protection provided by enclosures for low voltage

switch gear and control gear

IS-2148 Flame proof enclosures for electrical apparatus IS-3624 Specification for Pressure and Vacuum gauges IS-5831 PVC insulation and sheath of electric cables

IS-7358 Specification for Thermocouples

IS-8784 Thermocouple compensating cables

ISA Instrument Society of America

S-5.2 Binary logic diagrams for process operations

S-7.3 Quality standard for instrument air

S-75.01 Flow equations for sizing control valves

ISO 5167	Measurement of fluid flow by means of orifice plates, nozzles and venture tubes inserted in circular cross-section conduits
NACE	National Association of Corrosion Engineers - MR-01-75
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
	ICS-6 Enclosures for industrial control and systems
NFPA	National Fire Protection Association

NFPA-496 Purged and pressurised enclosures for electrical equipment

OSHA Occupational Safety and Health Authority

1. GENERAL:

The Contractor shall obtain all instruments from manufacturers of international standing.

The design and quality of all instruments shall be fully suited to the conditions which will be met in service. The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC-801.

The instrumentation and control system shall be designed, manufactured and installed to ensure highest standard of operational reliability. Major instrumentation shall be electronic type. Panel mounted receiving instruments shall be electrically operated miniature flush mounting type unless otherwise specified. All instruments shall be installed in accordance with the recommendations or instructions of the instrument manufacturer for particular application.

All instruments shall be capable of carrying their full load currents without undue heating. They shall not be damaged by the passage of fault currents within the rating of the associated MCB or through the primaries of their corresponding instrument transformers. All instruments shall be back connected and the cases shall be earthed. Approved means shall be provided for zero adjustment of instruments without dismantling.

All voltage circuits to instruments shall be protect by MCB's in each unearthed phase of the circuit placed as close as practicable to the main connection.

Analogue signals shall be 4-20 mA according to BS 5862:Part I 1986 or its latest edition. They shall operate over two wires and be isolated from earth. 1-5V DC signals shall only be permitted within the main instrument inclosure.

Analogue signals shall be so connected that the failure of a remotely transmitted signal to another panel can not affect other readings on instruments operated by the same signal.

The contractor shall furnish technical details / catalogues / drawings for the instruments and panels offered for monitoring and control of the entire plant to client/consultant for their approval prior to procurement of the same. Contractor shall offer inspection for the instruments/panel offered by him and in case of waiver of inspection by the client / consultant, necessary test certificates shall be submitted for approval of client / consultant before clearing the material for despatch. Contractor shall submit their inspection plan to client/consultant for their approval for this purpose.

All instruments procured by the contractor as per the Engineer's approval, and those which perform similar duties shall be of uniform type and manufacture throughout the scheme in order to facilitate maintenance and the stocking of spare parts. Moving parts and contacts shall be adequately protected from the ingress of dust, and all instruments shall be protected by moisture and dust-proof cases including those mounted in panels. All equipment shall be suitable for its environment.

Panel mounted receiving instruments shall be of the electrically operated miniature flush mounting type unless other wise stated.

Scales shall be clearly marked with black lettering and graduations on a white background. Instruments of the same type and range shall have identical scales.

Instrumentation System shall be designed as per good engineering practice.

2. POWER SUPPLY TO PACKAGE:

A) Power Supply shall be made available by the bidder at the following voltage levels,

unless otherwise specified.

For Instruments, Control Systems, Analysers : 230V AC ± 10%, 50 Hz

± 3 Hz

Solenoid Valves, Relays, Lamps : 24V DC Input Interrogation Voltage : 24V DC Panel/Cabinets Lighting : 230V AC ± 10%

Contractor shall make provision for a separate feeder in the Plant MCC of suitable current rating to provide 230V AC ± 10%, 50 Hz ± 3Hz supply to Instrument Panel(s).

24V DC required for Input Interrogation, relays and lamps etc., same shall be generated by the bidder using dual redundant power supply. Power shall be suitably conditioned by providing UPS /Isolation Transformer-Voltage Stabilizer-CVT to prevent damage to instruments against power fluctuation / disturbances.

B) Instrument power circuits shall be individually protected from fault with the help of fuses. Power supply to the individual instrument shall be disconnected with the help of fuses. Miniature circuit breakers (MCB's) may be selected in place of switch fuse unit in case protection is provided for overload protection.

3. EARTHING :

Vendor shall provide separate earth bus bar connections for shield and panel electrical earthing.

Any special earthing requirements, if required, shall be provided by vendor during detailed engineering.

Necessary earth pits shall be provided for the same by the vendor.

4. ENCLOSURE :

All instruments enclosure mounted in the field shall be weatherproof to IP-65 / NEMA4 as a minimum.

5. INTERLOCKS / LOOPS :

All plant interlocks shall be carried out using PLC / electromagnetic relays to be supplied by vendor for fail safe and reliable operation. Vendor to indicate all process interlock requirements on the P&IDs.

Loop integrity must be maintained for each loop. No component of any loop shall be shared by other loop.

The system shall be designed fail safe and shall meet the following requirements, as a minimum :-

a) All initiating contacts shall be close under normal conditions and shall open under abnormal conditions.

b) All relays and solenoid valves shall be energised under normal conditions and shall de-energise under abnormal conditions.

The system shall be designed using PLC / electromagnetic relays unless specified otherwise and shall be located locally or remotely as per the operational requirements. The system shall meet the following requirements as a minimum :

a) The electromagnetic relays shall be low power continuously rated type and shall have LED for status indication.

b) The relays shall be plug-in type and their plug-in bases shall have screwed terminals

for interconnection. Lug type soldered connection shall not be acceptable.

c) Each relay shall have three numbers of 'NO' and three numbers of 'NC' contacts as a minimum each suitable to drive the connected. Out of these, one 'NO' and one 'NC' contacts shall not be used.

d) Each shutdown/interlock logic shall be individually protected using separate switch-fuse unit and shall have a lamp for indicating power healthy status.

Each shutdown circuit and solenoid valve shall be provided with a switch-fuse unit seperately.

6. INTRINSIC SAFETY BARRIERS : DELETED

7. CONTROL PANEL :

The Control Panel shall be free standing & enclosed cubicle type with backdoors. Instruments to be mounted on control panel shall be as per this bid document as a minimum.

Control Panel shall be constructed from 2/3 mm CRCA sheet steel reinforced with angle from frame of 50 x 50 x 4mm. Panel exterior shall be painted admiralty grey as per IS-5 No. 697. Panel interior shall be pale cream as per IS-5 No. 352. Panels shall be designed to ensure adequate ventilation without permitting entry of vermin and ingress of dust.

No process fluid of any kind, except instrument air, shall enter the instrument cubicle. All cable entry shall be from the bottom of the panel. Also power supplies greater than

230 V shall not enter the LCP.

The internal layout of the panel/cabinets shall be designed considering proper approach for each item for maintenance. Following point must be taken into consideration while deciding the internal layout :

a.) All wiring inside the panels shall be housed in covered non-flammable plastic raceways arranged to permit easy accessibility to various instruments for maintenance adjustment, repair and removal. No raceway shall be more than 70% full.

b.) Separate wiring raceways shall be used for power supply wiring, DC and low level signal wiring.

c.) Distance between terminal strips and side of the panel parallel to the strips up to 50 terminals : Min. 50 mm.

d.) Distance between terminal strip and top and bottom of cabinet : Min. 75 mm.

e.) Distance between two adjacent terminal strips : Min. 100 mm.

f.) Distance between cable gland plate and the bottom of strips : Min. 300 mm.

g.) 20% spare terminals shall be provided as a minimum.

Overall height of Control Panel shall not exceed 2100 mm. Panel mounted instruments and controls shall be such mounted that they are accommodated between

800 mm and 1300 mm from floor vel.

Control Panel shall be provided with fluorescent type lighting fixtures controlled from totally enclosed door operated switches for internal illumination of the panel cabinets.

Contractor shall provide with necessary cooling fans and cut-outs covered with appropriate filters for necessary air changes to limit temperature rise within panel to 5 deg C over ambient temperature.

Contractor shall consider necessary power conditioning unit (UPS / Voltager Stabolizer-CVT etc.) to prevent power fluctuation and surge to damage the instruments as well as other electronic components.

For cases where PLC is to be mounted, panel shall be deisnged suitably as per PLC manufacturer's recommendation. Necessary marshalling boxes may be considered if required as per design.

8. RECEIVING INDICATORS/CONTROLLERS :

All indicators/controllers shall be electronic (microprocessor based) programmable

Notes :

Indicating instruments shall indicate various process parameters as per following measuring units, in general :

Flow	M^3/Hr or MLD or LPS	as per process requirement
Level	m	Meters
Pressure	Mt. head of water or	as pr process req.
Temperature	C	Degree Celsius
Concentration	ppm or mg/l	Parts per million or Milligram per litre.
Current	A	Amperes
Voltage	V	Volts
Power	W	Watts
Electrical Energy	Whr	Watt-hours
Frequency	Hz	Hertz
Speed	r.p.m.	Revolutions per minute.

Multiplying factors for flow scales shall be specified on manufacturer's name plate.

9. FIELD MOUNTED INSTRUMENTS

Field mounted instruments shall, where possible, be hermetically sealed. If this is not possible, they shall be of weatherproof construction with heavy cst cases. Transmitters and similar equipment shall be further enclosed in purpose made weatherproof, glass reinforced fire-retardant polyester resin cabinets.

Particular regard shall be paid to the case of access to all instruments. Serial number/calibration plates shall be visible when the instrument is in its cabinet.

Locally mounted indicating instruments shall be mounted in viewable positions.

Field mounted instruments shall be complete with all mounting brackets, pillars, fittings and fixings to complete the installation.

FIELD TRANSMITTERS :

All field transmitters shall have accuracy of 0.25% of span and shall be provided with output meter / output gauge at the signal output.

Smart transmitters when used shall be used in analog mode only. Smart transmitters when specified shall have accuracy of 0.1% of span, as a minimum.

DP Type Flow Transmitter if used for congealing, corrosive and highly viscous services shall have Diaphragm Seal element with Capillary.

Transmitter shall be capable of delivering rated current into external load of atleast 600 ohms when powered with 24V DC nominal voltage.

10. PUSHBUTTONS AND SWITCHES

Pushbuttons for operational circuits shall be provided with a shroud, guard or

other suitable means to prevent inadvertent operation. They shall be in accordance with the high standard generally required by the specification as a whole and by the equipment with which they are associated.

Illuminated pushbuttons where used shall be of a design that allows easy replacement of the lamps from the front of the panel.

If legends are engraved on the pushbuttons they shall be clear and concise and shall be approved by the Engineer – In charge before manufacture.

Control switches shall be in accordance with the high standard generally required by the specification as a whole and by the equipment with which they are associated.

11. INSTRUMENT CONNECTIONS:

Electrical cable entry shall be ½" NPT(F). Suitable cable gland shall be used.

End connections shall meet the following unless, otherwise specifed:

Threaded end connection shall be NPT as per ANSI / ASME B.1.20.1

Flanged end connection shall be as per ANSI / ASME B16.5

12. INSTRUMENTS:

Instruments as per following details and specifications shall be provided by vendor as a minimum. Quantities mentioned, if any, are indicative only and contractor shall provide all necessary instruments described inthis section or as required for proper operation of the plant as described else where in this tender or found necessary during detailed engineering in addition to below mentioned instruments and their locations. Bidder choosing to supply instrument with communication port suitable for process / diagnostic data transfer with PLC/SCADA need not consider analog signal and alarm contacts inputs to PLC.

All instruments, gauges and control equipment shall be strictly procured as per the list of approved vendors enclosed herewith as part of the tender documents.

c) LEVEL SWITCHES – FLOATTYPE :

A.	**GENERAL**	
1	Type	Float Type
2	Max. Temperature	Ambient / 45ºC
3	Max. Pressure	Atm. + Liq Depth, Max. 1 Bar
4	Specific Gravity	1.0 to 1.1
B.	**Float**	
1	MOC of Float	Polypropelene
2	Construction	Circular / Tubular / Bioconical
3	No. Of Float	As per table below
4	Size of Float	1
5	Protection	Min IP-65
6	Switch Type	Micro Switch, SPDT
7	Contact Rating	8A @ 230V AC (1 NO + 1 NC)
8	Cable	Inbuilt cable from Float upto Terminal Box
9	Cable Material	Suitable for Fluid application as specified in below table
10	Cable Length	As per table below
11	Process Connection	Flanged 4" NB
12	Counter Weight (Ballast)/	Required to ensure stable vertical position of the Float
	Support pipe for Clamping cable	
13	Adj. Stopper	As Applicable
14	Stopper / Ballast MOC	Rubber
15	Float Installation Hardware Material	SS 316

C.	**Junction Box**	
1	Mounting	On Top of tank & sump,Flanged
2	Junction Box – MOC	Cast Alu.
	Prot. Class	IP-55
3	Connection Size	1/2" NPT / 3/4" ET or to suit cable dia.
4	Electrical Area Classification	Safe
5	Process Connection	Through Flange
D	**Accessories**	
1	Cable gland	Required
2	Mounting accessories	Required
E	**Locations / Service**	At Raw collection sump, Equalization Tank,Acid Dosing tank, Lime Dosing Tank, Alum Dosing Tank,PE Dosing Tank,Primary Sludge Sump,Return sludge Sump, Thickner Sludge Sump and Treated Water Sump shall be provided for Dry Run Protection of Pump with necessary alarms at SCADA.

d) RECEIVING INDICATORS MOUNTED AT ICP/LCP:

All indicators/controllers shall be electronic (microprocessor based) type programmable indicator and shall be mounted on the control panel located in the control room. Multiplying factors, shall be specified on manufacturer's nameplate, if applicable. Specifications, as applicable are as follows:

Process Indicator:

Type : Microprocessor based, programmable

Input : 4-20 mA

Display : 4 ½ Digit, 7 Segment LED display

Display Units : % or Engg. Units, user programmable at site

Alarm Setpoint : Two nos., Pot. free relay contact rated at 5A @230V AC resistive load, adj. over entire range

Transmitter Supply : Required, 24V DC @30mA

Retransmission Output: Required, 4-20 mA in 600 ohm load

Accuracy : ± 0.25% of FSD

Terminals : suitable for up to 2.5 sq.mm. wires

Mounting : panel flush mounting

Power : 110/230 V AC, 50 Hz

Flow Indicator cum totaliser shall also have following in addition to above:

Totalising Counts/Hr : User Programmable at site

Totaliser Display : 6/8 Digit Digital Display with Battery Backup to retain totalized data in the event of power failure for a minimum period of 24 hours.

i) PRESSURE GAUGES:

All pumps, compressors and air blowers shall have PG at their discharge lines. Pressure Gauges for process fluids containing sludge/solids and corrosive chemicals shall be of diaphragm type.

PG dial face shall be marked with pressure element material. Ranges shall be so specified that the gauge normally operates in the middle third of the scale and shall confirm to IS-3624 standard dials, wherever possible.

Diaphragm seals, filled type or mechanical type shall be furnished where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be of clean out type with flushing connection.

Pressure Gauge Dial Size shall be of minimum 150mm and of white with balck engraving, shall be provided with blow out disc, toughened/safety glass window, bayonet type bezel ring, case material of SS304, Boudron Element / Socket of SS316, movement parts of SS, weather proof to IP-65, offering accuracy of ±1% of FSD. Micro-zero adjustment at the pointer, bottom process connection shall be 1/2" NPT, over-range protection of 130% of FSD.

In case of Diaphragm type Pressure Gauge, Diaphragm / Lower Chamber Wetted Parts shall be os SS316, Upper Chamber of SS304 / SS316, with silicon oil sealing fluid, 2" ANSI B16.5 flanged process connection

j) DIFF. PRESSURE GAUGES:

A.	**GENERAL**	
1	Type	Direct
2	Mounting	Yoke
3	Dial – Size	150 mm Dia..
	Colour	White back Ground with Black Letters
4	Case Material	Die Cast Aluminium
5	Bezel Ring	Fixed Through 4 Screws
6	Window Material (Lens)	Toughened Glass
7	Enclosure Protection	Water proof to IP 65
8	Pressure Element	Bellows
9	Element Material	SS316
10	Socket Material	SS316
11	Seal Material	BUNA'N'
12	Accuracy	± 1.% OF FSR
13	Zero Adjustment	Through Dial Adjustment after Removing Front Bezel
14	Process Connection -Size	1/2" NPTF-Through SS316 Adapter (1/4" NPTM X 1/2" NPTF)
	Location	Across PSF and ACF
15	Pointer Movement	Jewelled Brass
16	Over range Protection	For Max. Static Pressure upto 103 BAR (1500
		PSIG)
17	Blow Out Protection	Provided
18	Temperature - Oper. /Max., °C	Ambient / Max 65°C
19	Mounting	2" Pipe Mounting with "U" Clamp
B	**Accessories**	
1	Mounting accessories	Required
C	**Locations / Service**	Across PSF and ACF

k) DIFF. PRESSURE SWITCH

1	Type	Blind Diff. Pressure
2	Mounting	Yoke
3	Dial Size/Colour	-
4	Case Material	Die Cast Aluminium
5	Window Material	-
6	Area Classification	Safe Area
7	Enclosure Type	Weather Proof to IP 65
	SWITCH	
	Output :-	
	Electric:	
	Contact – Qty.	Two
	From	SPDT
	Type	Environmentally sealed Micro Switch

	Contact Plating	Gold Plated
	Rating Amps.	24 V DC 1 AMP
	Load Type	Inductive
	Cable Entry	1/2" NPTF
	No. Of Entries	Dual
	Set Point Adjustment	Internal with Ind. Scale
	Diff..	Fixed Less than 204 mBAR
	Accuracy	± 1% Of FSR
	Repeatability	± 1%
8	**MESURING UNIT**	
9	Element Type	Diaphragm
10	Element Material	SS 316L
11	Process Connection	1/2" NPTF Through SS316 Adapter
12	Diphragm Seal	-
13	Over Range Protection	Max. Static Pressure upto 110 BAR
14	Blow out Protection	-
15	Temperature-Oper./Max,°C	Ambient / 65°C
16	Mounting	For 2" NB Pipe Mounting With "U"Clamp

e) ELECTRO MAGNETIC FLOW MEASURING SYSTEM

Generally, the flow meter shall be as follows:

Flow metering System

Each flow metering system shall consist of the primary transducer (Sealed to IP-67 for above ground / non-submerged application and IP-68 for below ground within chamber for submerged application), earthing rings, the necessary signal converter and power supply unit and all cabling between the primary transducer and signal converter and power supply unit.

Each of the signal converts / power supply units shall be supplied for remote mounting, unless otherwise specified.

The signal converts / power supply units shall be provided with a 4-20 mA output signal, linear with flow and suitable for retransmission to remote instrumentation. The above units shall operate from a 240V 50 Hz supply.. The supply voltage may vary by ± 15% and frequency between 47 and 53 Hz.

The signal converter supply shall have modulated direct current excitation and inherent total zero stability.

The contractor shall provide sufficient suitable cable to allow for the primary transducers to be situated up to 10 metres from their signal converters, unless a longer length is specified.

The Contractor shall provide full details of the cable, he proposes to use. The general

specifications for electromagnetic flow meter shall be as under:

Service		Effluent / Effluent Sludge Application
Function		To measure & indicate Instantaneous Flowand Totalised Flow / Transmit (Flow)
Fluid Conductivity		> 5 µS/cm
Installation		Indoor or Outdoor, Below or Above Groundas per piping / site conditions
Overall Accuracy of Measuring Loop		± 1% of Flow Rate / Meas.Value or better
Flow Sensor / Tube /Element		
Type of Sensor		Full Bore type

Flange Materials		CS or SS 304 or better as per mfr. Std.
Tube Material		SS304 or SS 316
Liner Material		Hard Rubber
Body Material / CoilHousing		SS304

Electrode Material		SS316L or Ha-C
Power Supply		From Transmitter
Grounding	Type / Material	Earth Ring Only / SS316
Protection Class	Above GL or Indoor within Pump House / Bldg.	IP-67 for flowmeters installed above Ground Level or if installed indoor within pump house / building below ground level.
	Below GL outdoor	IP-68 for flowmeters installed outdoor below Ground Level (shall be ounted ithin RCC / Brick Masonry Chamber)
Cable Entry (for separated / remote version) & Glands		Shall be as per mfr. Std. and suitable to maintain the specificed protection class at site
Cable Length	Sensor to Transmitter	Min. 10m, dual shileded cable
Painting, where applicable	CS / other	Chemical Resistant, Epoxy Painted
TRANSMITTER		
Function		Transmit and Indicate
Type		Remote (Non-Intergral) type, Microprocessor based, User Programmable,
Flow / Velocity Measurement Range	Max. Flow Velocity	Flowmeter shall be capable to measure flow with velocity up to max. 10 m/sec.
Accuracy	Flow Vel. >= 0.5 m/s	± 0.5% of Flow Rate / Measured Value or better
	Flow Vel. < 0.5 m/s	as per mfr. Std. for flow velocity up to 0.3 m/s
Analogue Output Signal	For Flow	Isolated, 4 -20 mA DC
Instrument Power Supply		100 to 240 VAC ± 10%, 50 Hz ± 5% or 24V DC as per mfr. Std.
Cable / Conduit Entry		1/2" NPT.
Local Indicator / Display	Inst. & Total Flow	Backlit LCD Display (Inst. Flow and 8/9 digit internal totalized flow)
Enclosure	Type & Protection	Weather Proof to IP-65 as a minimum or Better

	MOC	Cast Alu. or equi. as per mfr. Std. suitable for withstanding harsh environment with chemical resistant / epoxy coating
	Type	Wall mounting / Pipe mounting
Vibration Conditions		Conformity with IEC 60068-2-6 or equi., shall be able to endure vibration, when in service, without any degradation in rformance
Pipe not Full Detection / Empty Pipe Detection		Required
Canopy for Analyzer / Transmitter	To prevent from direct sun and rain	Required. MOC: FRP - min. 4mm thick / G.I. - min. 2mm thick
Expansion Bellows	SS 304	Required at suitable location to enable ease of removal / insertion of flow meter for maintenance

The flowmeters are envisaged at following locations: Common Discharge header of Primary sludge pumps header of Return sludge pumps Treated water outlet header

Common delivery header of raw sump pump

Flow (Instantaneous and Totalised) readings shall be continuously displayed at PLC SCADA in main control room.. Real time and histroical trend shall be available for last 60 days.

Flow meter mounting locations shall be such for ease of monitoring and operation of the plant and also ease of maintenance of instrument and shall be finalized during detailed engineering and as directed by engineer-in-charge.

Flow meter shall be mounted above ground level / HFL as far as possible. In case of flowmeter mounted below ground level / HFL shall be provided with suitable water proof chamber constructed in RCC elevated sufficiently above GL of sufficient size for ease of operation and maintenance as decided during detailed engineering and provided with brick masnoanry cabin / covering arrangement to avoid submergence in water.

Flowmeter shall be mounted as per manufacturer's recommendation and good engineering practices and each flow meter shall be provided with a bellows at suitable location to enable ease of removal / insertion of flowmeter for maintenance. For flowmter mounted below ground level, chamber shall be sized suitably to accommodate flwometer and bellows in the same chamber.

13. PROGRAMMABLE LOGIC CONTROLLERS

PLC shall comply with International standards such as NEMA, IEC, ANSI, ISA, IEEE, DIN and VDE

DESIGN AND CONSTRUCTION REQUIREMENTS

PLC H/W & S/W shall be from the same family and should be sourced from approved Vendors only.

Programmable logic controller (PLC) shall be microprocessor based with 32 bit processor and be fully programmable and capable of performing control relay logic, including timing, counting, sequencing, and interlocking.

The PLC shall be high performance processors suitable for real time process application. High inherent reliability, self checking, error-recovery and trouble-shooting features shall be some of the features of PLC.

The PLC shall have a modular / modular chassis design which allows for ease of future expansion. The processor module shall be easily removed from the I/O chassis for service or repair. The I/O chassis shall have slots for installing I/O cards, communications, or other special function modules. All I/O cards and modules shall be capable of being installed in any open slot in the chassis or DIN rail mounted. Module and channel level diagnostics should be standard feature.

The PLC shall have a suitable power supply and can be easily serviced or replaceable. The system shall be capable of being powered on 120VAC / 230VAC / 24V DC as per mfr. Std..

The PLC shall be rated to operate from 0 to 60 Degrees C, with a humidity rating of 5 to 95% (non-condensing). All module circuit boards shall be encased and protected such that, when properly installed, they are not exposed to accidental contact by personnel or other objects.

Basic Processor Functions

Real-time control of output points for turning on and off digital devices such as motor starters and solenoids.

Read the status of real world digital inputs from limit switches, float switches, and other field devices.

Real-time control of analog process control variables.

Read the status of real world analog set points and feedback values.

Perform timing, counting, sequencing, and interlocking functions for pump/equipment control.

Process local alarm handling functions

Math and Advanced Functions

Four function math in floating point or signed integer format

Convert to/from BCD

Data comparison and manipulation

Scaling from integer data into engineering units such as flow, level and pressure

Full PID Instructions for control of process control variables such as flow, level and pressure.

ASCII instruction set for interfacing to ASCII devices

Compute Instruction which executes a mathematical expression and can be used for totalizing functions

Trigonometric and Exponential math functions

Real-Time Calendar Clock for time stamping alarms and events. Automatic restart of the

system on resumption of power shall be provided.

The processor shall have solid state RAM memory to store the application program, process data, and alarm status. This memory shall have both capacitor and battery backup in the event that input power to the processor is lost. It shall also have the capability of EEPROM backup which automatically reloads the memory on a power cycle. The processor shall have the ability to automatically control the process on a power cycle, provided there are no major or unrecoverable processor faults.

Processor RAM memory shall be adequate and selected with at least 25-30% spare capacity for application program storage over the actual requirement, and also should be expandable for future expansions. Bidder shall demonstrate the spare capacity at the time of commissioning and after completion of entire logic development for the plant controls and monitoring as per the logic write-up to be

furnished by client / consultant to the successful bidder after award of work.

Sufficient program memory and data memory space shall be provided. System initialization and application software shall be stored in EEPROM or EPROM with necessary hardware. Running data shall be stored in a RAM with internal battery back-up

No Analog re-transmission shall be used to feed PLC analog input. Analog output of PLC shall only be used to provide analog signal to panel mounted indicators. All process parameters and electrical parameters as specified in the tender shall be monitored at SCADA and necessary controls actions shall be initiated.

Specific Requirements for PLC

(a) Expandability in future : 50% of installed capacity at main control room (ICP) / main location and 25% of installed capacity at distributed location / local control panel, overall 50% of installed capacity as per present requirement

(b) Weather Protection : IP-20 for PLC hardware and shall be IP-54 of IS 13947 when mounted in ICP

(c) Power Supply : 230V AC / 24V DC

(d) Interrogation Voltage : 24V DC

(e) CPU, communication module and power supply module

: Required , high performance 32 bit CPU Module having modular configuration suitable for real time process application. CPU shall be of same family if provided at different locations.

(f) Scan time : 0.5 Milliseconds or better for 1K instructions

(g) Key Switch for Processor : Shall be as per mfr. Std.

(h) Mounting Inside the main instrument/local instrument control panel with viewing glass on the door

(i) I/O Capacity of CPU : 50% expandability in future over present I/O requirement (actual + spare I/O)

(j) Inputs and Outputs : As required for process operation with an intention to maximise the automatic operation of equipment/plant and ease of operation and maintenance of the plant.

Bidder shall submit the proposed I/O list along with their technical bid. However, the proposed I/O list shall not be limiting and bidder shall provide for I/O for the explained purpose.

(k) System Loading : Max. 60% under worst loading conditions

(m) Power supply to sensor / transmitters : Required

(n) Type of input : NO/NC – Contacts field selectable from programmer

(o) Outputs : Relay outputs for driving MCC starter coils, driving motorized valves etc.

(p) Spare I/O (Wired) : Min. 2 nos. or 10% of each type

		of I/O, whichever is higher, at each panel/location, wired to terminal block
(q)	Accessories	: One set each of Licensed Software, for MMI & Application Programming (Ladder Programming S/W supporting LD/IL/ST AND SFC language as per IEC 61131) shal be supplied. Shall be installed at engineering cum operatro station at Main Control Room.
(r)	Interposing Relays	: Shall be provided for all the Digital Output (DO) including spare DO & for Digital Input where ever required

(s) Interface (Hardware and Software) to SCADA

(t) Printers for alarm, status, report generation

(u) Operator cum Engg. Work Station at Main Control Room

: Required (plug and play) ready to use type

: 2 Nos. each, 1 no. 24 Pin/80 Col Dot Matrix type or equi as per PLC/SCADA mfr. requirement & 1 no. A4 size Laser Jet Printer required at main control room

: 1 NO. PC each at Main Control Room of any approved make with Min. 3.0/3.2 GHz CPU, 19" Flat Panel Colour monitor / 1 GB MB RAM / 160 GB SATA HDD/ 48 X CD- RW - DVD ROM COMBO DRIVE / PS/2

Keyboard / Scroll Mouse / Audio and Network Interface / External I/O Port - Front: Headphone, microphone, and 2 USB

2.0, 1 IEEE 1394; Rear: Min. 2 USB 2.0, 1 standard serial port, 1 parallel port, PS/2 keyboard and mouse, 1 RJ-45, 1 audio in, 1 audio out, 1 IEEE 1394; Internal: 1 USB 2.0

/ Licensed Windows XP Professional or higher version software as required / Licensed Software for latest version of Microsoft Office / licensed version of Norton or Mcafee anti-virus software package

(v) Type of Protocol on communication port : Standard Min. 10/100 MBPS speed for SCADA and 12MBPS speed for Distributed I/O.

(w) Tests : Functional test (simulated) for complete system Test for monitoring function
Voltage variation test (at ±10% of rated voltage.

Factory acceptance test (to be witnessed by Purchaser / purchaser's representative
Simulation test for all logic / loops (to be witnessed by Purchasers / purchaser's representative

Vendor to submit all Test Certificates for purchaser / consultant's review.

Input / Output Modules

(a) Standard DIN Rail / rack mounted I/O modules with plug-in cards shall be provided. Field wiring shall be terminated in screwed terminal blocks and interconnected to the processor I/O system with preferably pre-fabricated cables and plug in card type connectors.

(b) Min. 2 nos. or 10% of each type of I/O, whichever is higher, extra I/O's of installed capacity for each type at each location shall be provided as spares and shall be wired to the terminal block of the control panel. Provision shall be made for future expansion of extra I/O modules of the installed capacity.

(c) Discrete Input Cards: Solid-state input circuits rated for 10-30VDC operation.

Cards must be available in 8 or 16 or 32 point configurations and shall source current to the field device. Each input point shall have a status LED which indicates the ON or CLOSED condition for that field sensor or switch. Cards must have removable terminal strips so that module can be easily replaced without disturbing the field wiring online while system is running.

(d) Discrete Output Cards: Solid-state output circuits rated for 24VDC operation.

Cards must be available in 8 or 16 or 32 point configurations and shall be able to operate a control relay. Each output point shall have a status LED which indicates the ON condition of the output. Cards must have removable terminal strips so that module can be easily replaced without disturbing the field wiring. The control Relay-contact shall be rated for 5A @240VAC or 5A @125VDC. The control relay shall have a LED indication to show the status of the control relay.

(e) Analog Input Cards: Analog inputs shall capable of reading in 0 to 20mA or 4 to 20mA signal. The A/D converter shall provide a minimum 16 bit resolution over the full range from module minimum to module maximum.

(f). Analog Output Cards: Analog Outputs shall be capable of outputting 0 to 20mA or 4 to 20mA signals. The A/D converter shall provide a minimum 13 bit resolution over the full range from module minimum to module maximum.

(g) All cards shall have optical isolation between digital and field side circuitry.

(h) Some of the common features of the I/O modules shall be as follows:

1) Filters for noise rejection.

2) Surges withstand facility as per standards.

3) All the modules shall be of addressable type.

Communications

(a) Minimum nne port for High performance Ethernet communication at 10/100

Mbps network for program upload / download, on-line editing, peer- to –peer messaging, data acquisition and man machine interface.

(b) PLC system shall have one port for remote/distributed I/O communication to communicate with distributed I/O's @ Min. 12 MBPS.

(c) One RS 232C/RS485 port for connecting devices over network for data acquisition from Energy analyzers/soft starters /temp. scanners etc.

(d) Any other communication ports / modules (Profibus-DP, HART, Modbus, etc.) as necessary for connecting devices over network for communication / data acquisition from field instruments as per specifications / bidder's selection of communication facility with field instruments, variable AC drives, energy analyzers, etc. required to be monitored as per this tender scope / specifications.

SCADA Software

SCADA Software shall be of Server-Client architecture and One full development

Runtime License is required.

The operator interface software, herein described as the SCADA shall be common for engineering and as operator works station. - an integrated package for developing and running automation applications and also to be just running the automation application.

The SCADA shall be designed for use in Microsoft Windows NT /WINDOWS

2000/WINDOW XP and shall use OLE, ODBC, DDE, OPC and ActiveX

technologies for optimal performance and integration with other software systems.

The SCADA shall have several Methods (relying on DDE server / OPC server / etc.) for collecting data from programmable controllers.

The tag database shall be organized in a hierarchy, each level represented by a folder that can be expanded or collapsed.

The SCADA shall have the ability for the current value of a tag to be updated from the device it is connect to and stored in RAM so it is immediately accessible to all parts of the SCADA.

The tag database shall provide the ability to generate tag names of up to 40 characters long. The tag names shall be able to contain the following characteristics: A through Z, 0 through 9 underscore (_) and dash (-).

The SCADA shall have the ability to create a tag whose value is the result of an expression. The expression can be made up of mathematical operations, tag values, if- then-else logic and other special functions. The current value of the derived tag shall be stored in an analog, digital or string tag in a value table.

The SCADA shall provide a Macro capability that will execute system commands, user defined commands and other macros.

The alarm system shall have the ability to monitor any analog or digital tag for alarms, up to a maximum of 10,000 tags.

The alarm system shall have the ability to define up to eight different severity classes to visually and audibly distinguish alarms.

The alarm system shall have the ability to use system default messages or create unique messages to describe an alarm log messages to a file, to a printer or to both suppress alarms for maintenance and tuning purposes and set up global alarm monitoring.

The alarm system shall provide a means of displaying up to 1000 tags that are in alarm. This alarm summary display shall be fully configurable.

The alarm system shall have the ability to create alarm log files periodically, at specified times and on event. This alarm log system shall have the ability to automatically purge old files after a specified time.

The SCADA shall have the ability to trigger actions based on an event that has an expression applied to it. An expression is an equation containing tag values, mathematical operations, if-then-else logic, or other functions. An action shall have the ability to produce a variety of functions including, but not limited to, initiating a snapshot of tag values, displaying an error screen and changing a tag value.

The SCADA shall have the ability to allow certain users or groups of users to access only certain parts of the system. The security shall be based on a series of codes. Each code shall allow the users, or groups of users, with security privileges for that code to access the SCADA commands allowed by that code. Users shall be allowed to be assigned combinations of security codes, allowing for each user to access a different set of features.

The security system shall assign each person a user account with a login name, password, and any desired macros. The SCADA shall have a minimum of 17 different security codes.

The SCADA shall provide a graphics display editor for creating displays using graphic objects. The graphics display editor shall have the ability to drag and drop objects from a pre-configured graphics library, paste objects that are copied to the clipboard from another Windows application, and insert objects created by another Windows application using OLE. The graphic display editor shall allow the user to create libraries of graphic objects.

The graphic display editor shall have the ability to attach, as a minimum, the following control to objects: blinking colors, visibility, rotation, horizontal and vertical movement, resizing (width and height), fill and touch.

Additional requirements

The SCADA package shall provide the following features:

Display status of Plant in a graphical and tabular format (i.e. running, stopped, fault etc.)

Display Analog values on the appropriate graphic screen.

Annunciator alarms associated with the area of the plant concerned including details of the time the alarm occurred

The SCADA package shall also provide following facilities for the operator Station

Adjust process set points

Select process modes

Acknowledge alarms

View a journal of unacknowledged alarms

View a journal of the last 200 alarms acknowledged and unacknowledged. Display process set points

Provide real time and historic trending of local analogue values

Provide data archiving of all local analogue values

Prepare daily and weekly reports (providing details of daily and weekly throughputs against numbers of pump running hours, power usage, etc.)

Display a total running hour's log of local transmission pump drives. Display preventive / planned maintenance schedules

Any additional features required to assist in the effective and efficient operation of the Treatment Plant.

Graphic screens shall be provided as follows but not limited to this: Main and subsystem menus

Plant / Process overview (i.e. providing details of Nos. of pumps / blowers / equipment running, Flow, totalized flow, levels, process parameters / power supply status, etc.) for STP

Overview of power system

Overview of control system

Screens to permit viewing of process set points

Tabular screen of Pumping / Treatment Plant status and values

Running hours log for Pumping Station and treatment plant process pumps, etc.

The screens shall display data commensurate with their size and the area of and number of Plant items covered. In addition to the specific screen requirements stated above, any additional screens to ensure comprehensive coverage of the Works needs to be provided.

A comprehensive screen navigation system shall be provided giving access to all screens via a system of menus and short cuts (i.e. it shall be possible to follow the process from one screen to another by clicking the mouse cursor on screen 'hotspots' to effect the move from one screen to another).

The sample rates required for the displaying of trends shall typically be one sample every 15 seconds for flow values and one sample every 30 seconds for levels. The system shall be capable of storing real time data for one day and historic data for 90 days.

The sample rates for archiving shall be the same as for trending. The archives shall be stored in daily files. The system shall provide capacity to store archives for 90 days. A warning alarm shall be provided to the operator to advise that archiving to disk should take place or archived data will be overwritten.

The data derived from archiving to the MMI and the archived data viewed using the trend facility.

The SCADA shall have the ability to record specific tag values under certain conditions. Several models shall define these conditions. This data that is collected

shall be stored in MS SQL format for displaying in trends, archiving for future processing or analysis, and/or using with third-party software, such as FoxPro, Crystal Reports, and Microsoft Excel, for display or analysis .It shall be possible to log historical data directly to an ODBC compliant database

The Contractor shall provide a disc drive with the MMI in order to download archive data or to upload previously stored archive data onto electronic storage media.

Contractor shall provide minimum of 3 sets of as-built control panel wiring drawings, PLC logic write-up, I/O Schedule/assignment, ladder diagram and other relevant documents in hard copy format and 3 sets in soft copy form on CDs. Soft copy format shall be in editable form to enable incorporating any changes in future.

3 sets of application program as back-up shall also be provided in soft form on CDs.

Uninterruptible power Supply

UPS of suitable capacity as per following specifications for 30 minutes back-up shall be supplied for entire load of instrument control panel including PLC and essential / critical instrument supply for necessary shut-down in case of power failure.

(a) The UPS shall be floor mounted, self contained and metal clad and shall be suitable for supplying a non linear load.

(b) It shall be possible to open the enclosure front door when the unit is in use without exposing any live contact touch.

(c) The UPS shall be on-line type incorporating a six-pulse rectifier and pulse width modulation inverter technology with microprocessor control. It shall incorporate a static bypass switch that shall operate in event of UPS failure, overload or manual initiation in order to transfer the output supply to mains without disturbance to the output supply.

(d) The UPS shall incorporate a DC under voltage trip circuit to Electro-mechanically trip the UPS output in order to protect the batteries.

(e) The noise level of the unit shall not exceed 60 dB(A) at 1 m from the UPS cabinet.

(f) The output of the inverter shall be a sine wave having less than 2% THD for linear loads and less than 4% for 50% non linear loads. It shall be suitable for load power factors 0.7 lag to 0.9 lead.

(g) The unit shall have a dynamic response such that 100 % step load causes an output voltage transient of less than ±4% with a recovery of less than 4ms. The load crest factor shall not be less than 3:1.

(h) Indicators shall be provided for the following

i. UPS status

ii. PS alarm conditions

(i) The UPS shall provide volt free contact outputs for the following purpose:

i. Warning, (viz., low battery voltage)

(j) The UPS shall have an overloaded capacity of 150% for 30 seconds and shall be protected in the event of a short circuit of the output.

(k) The batteries shall be housed, within a separate matching battery cubicle suitable for location adjacent to the UPS. The batteries shall be of the rechargeable, sealed maintenance free lead acid type. The battery supply to the UPS shall be via a fused load break switch disconnecter circuit breaker. The battery recharge time to 90% of full charge shall be approximately ten times the discharge time at full load.

(l) Terminals shall be shrouded to prevent accidental contact

The Uninterruptible Power Supply (UPS) System with SMF Lead Acid battery shall conform to the minimum following specifications:

i. Input

Input Voltage : 230 V, 5% Frequency

: 50 Hz 5%

Nominal DC input (Battery)

: Bidder to design and submit calculations

ii. Output

Output : 230 V AC,applicable KVA with 25 % margin as per Load Calculation

Regulation mode : 1%

Load power factor : 0.8 to unity Duty :

Continuous Ripple on DC : < 2%

iii. General

Principal of operation : Shall be solid state, pulse with Modulation (PWM) Cable entry : Bottom

Cooling method : Forced air

Type of Battery : Sealed Maintenance free

14. **AUTO SAMPLERS**

03 (Two) Nos. Portable type each having configuration of 1 ltr x 24 Bottles (PE) and 20 ltr x Single Bottle (PE) for collection of composite untreated (at inlet chamber) and treated effluent samples shall be supplied. The sampler shall be battery as well as electrically operated and battery shall be included in the supply. Sampler shall be located at operating platform level only and accordingly suitable length (7-8m) of suction pipe shall be considered.

15. **DIAGNOSTIC INSTUMENTS**

Contractor shall supply below mentined diagnostic instrument as a minium and other instruments as necessary for efficient and effective O&M of the plant:

a) **Other Tools**

a) Digital Multifunction Multimeter - 01 Nos.
(AC/DC Voltage / Ohms / AC-DC Current, etc.)

With one set of spare probe and 10 nos. fuse

b) mAmp Source / Calibration meter - 01 No. c)

Digital 4 ½" Digit Tong Tester - 02 Nos.

(AC Voltage, Current, Resistance, etc.) With one set of spare probe

16. **INSTALLATION MATERIALS:**

Vendor shall supply all erection hardeware required for the installation of complete instrumentation forming part of this tender.

This includes items like cables, cable glands, junction boxes, instrument valves and manifolds, mounting accessories, impulse piping / tubing, pipe/tube fittings, pneumatic signal tubes, air line pipes and fittings, filter regulator, insulation material, cable duct and trays, conduits, identification tags, structural material required for instrument supports and trays etc.

A) CABLES:

Vendor is fully responsible for the sizing of all cables in their scope of supply considering factors like maximum distance between Control Room and the Unit.

Specifications for cables for analog signals, digital signals and instrument power cables shall be as follows:

Cables for analog signals:

Cables shall be of 660V/1100V grade, single or multi-pair cables, annealed, tinned, high conductivity 1.0 sq.mm stranded copper conductor, PVC insulated two cores twisted into pair, laid up collectively, individual pair shielded and overall shielded with aluminium mylar tape, ATC drain wire running continuously in contact with aluminium side of the tape, PVC inner sheath, armoured with galvanised steel wire overall sheathed with PVC, conforming to IS:1554 & IEC:189 Part II shall be used for analog signals. Multi pair cables shall be of 6 pair or 12 pair.

Cables for digital signals:

Cables of 660V/1100V grade, multi-core cables, multi-stranded high conductivity annealed 1.0 sq.mm stranded, tinned copper conductor, PVC insulated, overall shielded with aluminium mylar tape, PVC inner sheath, armoured with galvanised steel wire overall sheathed with PVC, conforming to IS:1554 & IEC:189 Part II shall be used for digital signals.

Cables for instrument power supply:

Cables of 660V/1100V grade, multi-core cables, multi-stranded high conductivity annealed 1.5 sq.mm, stranded, tinned copper conductor, PVC insulated, PVC inner sheath, armoured with galvanised steel wire overall sheathed with PVC, conforming to IS:1554 & IEC:189 Part I & II shall be used for instrument power supply.

Laying of Cables:

Cables shall be laid on trays, in trenches, conduits, ducts as necessary. Instrument cables shall not be buried in ground as far as possible. Cable joints in instruments signal and power supply cables shall not be permitted. In case if some of the instrument cables are to be buried in the ground, it shall be as per standard/good engineering practice and shall be subject to client's/consultant's approval.

The contractor shall also supply necessary materials such as junction boxes, glands, lugs etc. required for termination of cables. Each cable shall be terminated to individual panel/terminals box. Cable glands shall be of Nickel plated Brass and of Double Compression Weather proof type.

A distance of minimum 300 mm shall be maintained between the cables carrying low voltage AC & DC signals and a distance of minimum 600 mm shall be maintained between cables carrying HT & LT cables.

Identification of each cable shall be by proper ferrules at each junction as per cable schedule to be prepared by contractor. All cables shall be identified close to their termination point by cable numbers as per cable interconnection schedule. Identification tags shall be securely fastened to the cables at both ends.

B) CABLE GLANDS:

Cable glands shall be nickel-plated brass and shall be of double compression type suitable for armoured cables.

Flame proof gland swherever required shall be with Ex(d) certification.

C) INSTRUMENT VALVES (MINIATURE TYPE) AND MANIFOLDS:

Body rating shall be as per piping class or better. Valve body and Trim material shall be SS316 as a minimum. Packing material in general shall be PTFE. Valves and Manifolds shall be of forged type only.

D) PIPE AND TUBE FITTINGS:

Tube fitting shall be flareless compression type and of three piece construction of Swagelok / Parker Hannnifen make. Ferrule shall be os SS in general.

Socket Weld type forged pipe fitting of suitable material and rating shall be supplied for pipe fittings. The minimum rsating shall be 3000 lbs. Weld neck fittings shall be used where socket weld is not allowed by piping class.

For air service instrument brass fittings suitable for use on copper tubes conforming to ASTM B 68 / B 68M shall be used. It shall be manufactiured from Bar Stock or equi and shall be nickel plated.

E) CABLE TRAYS:

All branch cables/tubes, cables on various civil units/structures shall run on cable trays only Cable trays shall be made out of galvanized mild steel sheets of 2.5 mm thickness. The width shall be so selected that 40-50% space is available for future use. Suitable cable clamps shall be supplied for binding cables / tubes at every 500mm.

F) JUNCTION BOX:

Junction Box material shall be Cast Aluminium (LM-6) only and shall be weather proof to IP-65. Flame proof junction boxes shall be supplied with Ex(d) certification in addition.

The boxes shall have terminals suitable for a minimum of 4 mm2 cable termination mounted on rails. 20% spare terminals shall be supplied in junction boxes.

Each junction box shall have 10% or minimum 2nos., whichever is higher, spare entries of each size. Spare entries shall be provided with plugs.

G) CABINETS FOR FIELD INSTRUMENTS

A Cabinet shall be provided for enclosing instruments and associated accessories which are mounted outside the control panel such as transmitter, LPU, terminal blocks etc. at all measurement locations.

It shall be fabricated from cold rolled steel with powder coating sheet of standard gauge and shall be suitable for wall mounting or pedestal mounting as required.

The cabinet shall be properly painted from inside and outside by paint shade RAL 7032.

The cabinet shall conform to IP-65 protection and shall have built in locking facility. The cabinet shall be earthed properly. A steel plate/pipe, as per the requirement, shall be provided in the cabinet for mounting the instrument and accessories.

17. **DELETED**

18. **INSPECTION :**

All instruments shall be inspected / TC shall be reviewerd for calibration and operation prior to despatch.

Unit shall be operationally checked for its proper operation along with the job instruments, panels and shutdown system before despatch in this material requisition.

VENDOR DATA REQUIREMENT (INSTRUMENTATION)

Sr. No.			**Info. /**	
1	Piping & Instrument Diagram		*	*
2	Instrument index		*	*
	Vendor List for Instruments & accessories			
4	Sizing Calculations		*	
5	Utility requirements		*	
	Instrument Specifications and data sheets			
7	Detailed loop drawings		*	*

8	Panel front arrangement		*	*
9	Wiring diagram for panels		*	*
10	Cable Schedule		*	*
11	Instrument Installation drawings		*	*
12	Bill of Material for installation items		*	*
13	Inspection and Test procedures		*	
	Test Certificates and certific. from statutory bodies			
	Complete catalogues with part list for all vendor supplied instruments, controls etc.			
	Installation, Operation and maintenance manuals			

NOTE:- This list indicates the minimum drawing and document list. However vendor shall also furnish any other drawing or document required to be furnished during the course of job execution.

LIST OF APPROVED VENDORS FOR INSTRUMENTATION SYSTEM

Process Analysers Hach, Emerson, E+H, Chemitec, Yokogawa

(pH, DO, UVSAC COD/BOD, Colour, SS / MLSS)

Ultrasonic Transmitter Endress+Hauser, Siemens - Milltronics, Krohne

Level / Diff. Level / flow

Electromagnetic Flow Meter E+H, Siemens, ABB, Yokogawa, Krohne

Field Transmitter Emerson, ABB, Yokogawa, Honeywell

(P, DP, F, L, T)

Pressure Gauges Wika, General Instruments Consortium, Manometer (India) P. Ltd., Waaree Instruments

Diff.Pressure Gauges Switzer, Wika, GIC, AN Inst., equi.

Panel mounted Process Masibus, Nishko, Nivam, Selectron, Radix, equi.

Indicator & Flow Integrator

Float Type Level Switch Waaree, E+H,Levcon, Nivo/Toshbro, Pune Techtrol, SBEM

Pressure Switch Danfoss, Indfoss, Switzer

Diff.Pressure Switch Indofoss, Switzer, Danfoss, equi. **Auto**

Sampler ISCO, Hach, E+H

Programmable Logic Controllers Rockwell (Allen Bradeley) / Siemens / Schneider

Control Panel ICA, Positronics, Prima, equi. reputed

Alarm Annunciator Aplab Ltd., Minilec, IIC

Control Panel Accessories / Components :

Miniature Relay Omron, Phoenix, equi.
Indication Pilot Lamps (LED Type) Teknic, Schneider, Siemens

Push Button/ Selector Teknic, Schneider, Siemens

Switch (with NO/NC Element)	
DC Power Supplies	Phoenix, Omron, Aplab, equi.
(DIN Rail mounted)	
Terminals	Elmex, Phoenix, Wago, Connectwell
Panel Wires	Finolex, Havell's, R R Kabel
Instru. and Control Cables	Associated Cables, Associated Flexible and Wires P. Ltd., Brooks Cables, Delton, equi.
Cable Glands	Ex-protecta, Braco, Sudhir, Comet, Connectwell, equi.
Junction Box	Ex-protecta, CEAG, Sudhir, Baliga, equi. **Cable**
Tray	M.M. Engineering / Globe / Jacinth / equi. **Computer**
System	HP-Compaq / Dell / Acer / IBM - Lenovo

The contractor shall distinctly understand that it will not be their prerogative to insist on a particular brand from the list, final selection will be done with the approval of Engineer in charge.

Note: Any item whose make is not given or other equivalent make will be subject to approval by the Engineer in Charge before supply.

SCOPE OF WORK – OPERATION & MAINTENANCE OF SEWAGE TREATMENT PLANT

Operations

a. Daily Operations of Sewage 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 Sewage Treatment Plant to maintain the quality of treated sewage within the standards prescribed in the Tender, operate electrical equipment during power failures by operating generators (avg. 2 hrs. per day), operate the Centrifuge for sludge drying and treat incoming sewage at prescribed standards through optimal dosing.

Disposal of Sludge/Screenings/Debris

The screenings/debris/dried sludge cakes from the sludge drying beds of the STP shall be disposed off by the Contractor to a suitable location which is away from the residential area. The place of sludge disposal shall be as per the decision of the Executive Engineer, within a radius of 5 kms from the plant. The responsibility of sludge withdrawal and disposing off lies with the Contractor within the operation and maintenance period. The Contractor should explore the possibility promoting it as manure. 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 & untreated sewage and recording the same online / offline. Collecting samples of influent and analyzing them monthly and samples of effluent and analyzing them weekly or as mutually decided by bidder and EIC to determine the quality of sewage and performance of the treatment plant and Providing security for facilities and system at all times.

b. Contingency Plan

Developing and implementing contingency plans in respect of responses to natural disasters, periods of power failure, storm water inflow into sewers during monsoon, de-silting of units of treatment plants, constraint operations or other similar emergencies to maintain the quality of treated sewage.

C. Repairs and Maintenance (in STP premises)

The Contractor shall carry out preventive, routing maintenance and break down maintenance Operations for proper upkeep of plant in accordance with good operating practices. The following items shall be included in such maintenances.

i) Machinery and Treatment Plant Equipment

Dewatering and de-silting of sludge Sump, chlorination Tank, 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 Contractor shall arrange the labour, tools and plant, spares. The following spares shall be the respective responsibility of the Contractor and the Employer during preventive routing and breakdown maintenance.

2. 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.

3. 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 Sewage Treatment Plant – A daily report of operation of the diffuses, agitators, decanter and other equipment at the sewage treatment plants providing information on the quantity of sewage treated, hours of operation of equipment, energy consumed and use of chemicals.

Sewage Quality Monitoring – A daily report monitoring the quality of raw and treated sewage through the analysis of samples.

Sewer / Storm Water Drains / wet well & other units etc. Monthly cleaning report sewer / storm water drain de-silted and record of silt disposed at disposal sites.

4. 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 preview 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 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:

Energy charges and treated effluent testing charges from State PCB if required.

Maintaining administrative control over the personnel, facilities and system.

5. Contractors Responsibilities

The Contractor shall maintain properly and keep intact all assets / 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 best quality 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 skillfully 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.

6. Staff & Labour:

A. 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. Minimum nos. of skilled personnel to be employed during 3 years of O & M at STP excluding labours are as follows: 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.

Sr. No.	Man Power	Nos. (for each STP)	Minimum Qualification	Experience
1.	Chemist	1 (for three STP,s)	M.Sc./B.Sc. Chemistry/Microbiology	Min. 2 years
2	Plant Operators	3 (1 nos. per shift)	I.T.I.	Min. 3 years

3	Helper	3 (1 nos. per shift)		
4	Electrician	On call	I.T.I. Electrician course	Min. 3 years

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 sub-contractors 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.

B. 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 of by the Engineer which approval may at any time be withdrawn. 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.

C. Contract Performance Review and Progress

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.

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 one (1) day the Employer shall be entitled as invoke the Security deposit and carry out the operations through a another Contractor or departmentally. The Employer shall then proceed as per Tender conditions

D. Liquidated Damages and Penalties for O/M works:

Basis of Penalty	Penalty Benchmark	Penalty Value
Failure to maintain pH/BOD/COD/TSS/Facel coliform level within prescribed limits (as mentioned in Clause	Up to 2 Occurrence/month/STP	10% of O & M contract value of the month
	3 to 5 Occurrences/month/STP	20% of O & M contract value of the month
no. 2.3.3, Volume-I, Part-II) Detected as per reports of samples sent to PCB/lab approved by EIC r and outlet quality to be achieved as per Tender provisions	6 to 10 Occurrences/month/STP	50% of O & M contract value of the month
	Above 10 Occurrences/month	100% of O & M contract value of the month (more than 3 instance in a year will be eligible for termination)

The basis for applying penalties is to restrict Contractor from deviating from disposing all raw/treated waste water efficiently from the service area – as per fixed schedule and as per stipulations prescribed in the Tender.

The Contractor is also expected to carry out the instructions of the Engineer or its representative from time to time, maintain the System in accordance with good Operating Practices attend to Customer complaints, refrain from offering operations without due authorization where so required and follow other requirements under this Contract.

Any penalty charged by JVVNL on account of power factor shall recovered from the contractor.

PENALTY FOR NON-COMPLIANCE OF EMPLOYMENT OF KEY PERSONNEL

If the successful bidder does not recruit / depute the key personnel identified as per the clause no. 6, then liquidated damages will be deducted at double the rate of applicable scale or the rate quoted, whichever is higher.

7. 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 labor 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

1. Sewage 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.

2. 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:

i. Weekly

Screens/ Grit Channels

Moving parts of screens and grit removal equipment, Blowers /Agitators / Pumps/ Agitators /Return Sludge pumps/ Chemical mixer/Centrifuge/Decanter

Stuffing box

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

ii. Monthly

Screens and Grit channels

Chains in mechanically operated components

Screens performance

Transformer

Oil in transformer

Relay alarm circuit

Load (Amperes) and

Voltage

iii. Quarterly

Transformer

Bushing and

Dehydrating breathers

iv. 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

v. 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 sewage treatment plant.

3. Buildings and Civil Structures:

Carry out routine maintenance and minor repairs including cleaning, repairs to plaster, doors, windows and painting.

i. 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

ii. Half - Yearly

Repair damaged floor, plaster, roof, leakages and

Repair damaged doors, windows and other fixtures.

Signature of Contractor :		Executive Engineer (PHE-I)
Name	:	Jaipur Development Authority
Company's Seal	:	Jaipur
Date	:	Date :

Section A-4

Specifications of DI & UPVC pipe line Work

SUPPLY OF UPVC, DI, SPECIALS, VALVES AND LAYING OF PIPES FOR WATER SUPPLY

General

Standards

Except as otherwise specified in this technical specification, the Indian/International Standards and Codes of Practice in their latest version shall be adhered to for the design, manufacturing, inspection, factory testing, packing, handling and transportation of product. Should any product be offered conforming to other standards, the equipment or products shall be equal to or superior to those specified and the documentary confirmation shall be submitted for the prior approval of the Engineer in Charge.

This specification requires a reference to the following standard specifications

IS: 4985	Unplasticized PVC pipes for potable water supplies
IS: 10151	PVC and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals, and drinking water
IS: 10500	Drinking water specification
IS: 12235	Methods of test for unplasticized PVC pipes for potable water supplies
IS: 4669	Methods of test for PVC resin
IS: 12818	Unplasticized PVC screen and casing pipes for bore/tubewell
IS: 3400	Methods of test for vulcanised rubber (part-1 to 22)
IS: 1387	General requirements for the supply of metallurgical material
IS: 210	Grey iron casting
IS: 1536	Centrifugally cast (spun) iron pressure pipe for water, gas and sewage
IS: 1537	Vertically cast iron pressure pipe for water, gas and sewage
IS: 1538	Cast iron fittings for pressure pipes for water, gas and sewage
IS: 5531	CI specials for Asbestos cement pressure pipes for water gas & sewage
IS: 1363	Hexagon head bolts, screws and nuts of product grade A and B (part:1-5)
IS: 1367	Technical supply conditions for threaded steel fasteners
IS: 780	Sluice valve for water works purposes
IS: 2906	Specifications for sluice valves for water works purposes
IS: 318	Leaded tin bronze ingots and casting
IS: 8543	Methods of testing plastics: Determination of density of solid plastics
IS: 7181	Horizontally cast iron double flanged pipes for water, gas and sewage.
IS: 8794	CI detachable joints for use with Asbestos cement pressure pipes
IS: 5382	Rubber sealing rings for gas mains, water mains and sewers
IS: 5531	Cast iron specials for asbestos cement pressure pipes for water, gas and sewage
IS: 779	Water meters
IS: 3624	Pressure and vacuum gauges
IS: 341	Black japan, types A, B and C
IS: 9862	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and chlorine resisting
IS: 1239	Mild steel tubes, tubular and other wrought steel fittings
IS: 7328	High density polyethylene materials for moulding and extrusion
IS: 4984	Specification for high density polyethylene pipes for potable water supplies; sewage and industrial effluents

IS: 554	Dimensions for pipe threads where pressure tight joints are required on the threads
IS: 1592	Asbestos cement pressure pipes - Specifications
IS: 778	Specifications for copper alloy gate, globe and check valves for water works purposes
IS: 12820	Dimensional requirements for rubber gaskets for mechanical joints and push on joint for use with cast iron pies and fittings for carrying water, gas and sewage.
IS: 9523	Specification for DI fittings for pressure pipes for water, gas, and sewage.
ISO: 2045	Single socket for uPVC and uPVC pressure pipes with elastic sealing ring type joints - Minimum depth of engagement
ISO: 2507	PVC pipes and fittings- Vicat softening temperature - Test method and specification
ISO: 3603	Fittings for PVC pipe with elastic sealing ring joints pressure test for leak profanes
ISO: 1167	Thermoplastics pipes for the transport of fluids - Resistance to internal pressure - Test method and basic specification
ISO 3451-5	Determination of Ash: Part-5 - Poly vinyl chloride
ASTM: D 2152	Standard test method for degree of fusion of extruded PVC pipe and moulded fittings by Acetone immersion
MTNL	Mahanagar Telephone Nigam Limited; Technical specifications for cable ducts.
BS: 4772	Specification for DI fittings
IS: 7634- Parts 1-3	Code of practice for plastic pipe works for potable water supplies
IS: 8329	Centrifugally cast (spun) ductile iron pressure pipes for water, gas and sewage.
IS: 12288	Code of practice for use and laying of ductile iron pipes
CPHEEO	Manual on Water Supply and Treatment, III edition, Ministry of Urban Development, New Delhi- May 1999.

Specifications for UPVC Pipes

PVC Pipes

This section of the document specifies the required properties of the pipes made of unplasticized polyvinyl chloride (uPVC) with socket(s) suitable for elastomeric sealing ring type joints for conveyance of water under pressure for supply of drinking water. The pipes are intended to be used for buried water mains with ambient atmospheric temperature reaching up to 50℃ and soil surface temperature rising more than 65℃. The stipulations given in this document for uPVC pipe which are not covered by any other code/standard, shall be governed by the provisions of IS 4985

The pipes will be supplied with one end plain with chamfer and other end socket suitable for elastomeric sealing ring type joints in accordance with IS: 4985.

Each pipe shall be supplied along with a rubber ring suitable for the socket for elastomeric sealing ring type joints.

Material

The material from which the pipes are made shall consist substantially of unplasticized polyvinyl chloride conforming to IS: 10151, to which may be added only those additives that are absolutely needed to facilitate the manufacture of the polymer, and the production of sound, durable pipes of good surface, finish, mechanical strength and opacity. The total quantity of additives like plasticizers, stabilisers, lubricants and fillers shall not exceed more than the percentage specified in IS 4985.The bulk density of uPVC pipe shall be 1.39 to 1.44 g/ cm^3.PVC resin of suspension grade K-66/K-67 shall be used for extrusion of uPVC pipe.

Classification

The pressure rating of pipes shall be of class-3 and class-4 in accordance with IS: 4985 with a maximum continuous working pressure at 27 ^{0} C of 6 and 8 kg/cm^2

Dimensions of the pipes and the sockets

The dimensions and tolerances of pipes shall comply to clauses of IS: 4985.
The tolerance on outside diameter and wall thickness of pipe shall be as per Table-1 given in IS: 4985.

The dimensions of the socket for elastomeric sealing ring type joint shall be in accordance with Clause 7.2.1.2 and Tables 4 and 5 of the IS 4985

The pipe shall be supplied in straight lengths of 6 m with tolerance of + 20 mm and -0 mm. The effective length of socket pipe shall be considered as shown in Figure-3 of IS: 4985.

Physical & chemical properties
The pipe shall confirm to the Clause 10 of IS 4985-2000 for its physical and chemical properties except for the density and ash content provisions which shall be as per the stipulations of Clause 1.2.2 of this chapter.

The colour of the pipes shall be dark grey.

Influence on water intended for human consumption shall be governed by IS: 12235.

All plastic and non plastic material for components of the uPVC piping system e. g. Elastomeric sealing ring, lubricants, when in permanent or in temporary contact with water which is intended for human consumption, shall not adversely affect the quality of the drinking water.
Mechanical properties
Hydrostatic strength of the pipes

The pipes and integral sealing ring will confirm to internal hydrostatic pressure in accordance with Clause 11.1 and sampling as per annex D of IS 4985
Tests and conformity criteria
quality assurance from the manufacturer

The following in house tests shall be carried out on the raw material:

grade (K-value)

particle size distribution

bulk density of resin

bulk density of compound

The manufacturer will also have the following tests conducted from Standard Test Laboratory

Effect on water quality

Internal Hydrostatic Test (Type)

Acceptance Test

All uPVC pipes of the same size and class manufactured on a particular machine shall be considered as a lot for quality control inspection. However, the maximum size of a lot shall not be more than 1000 pipes.

The sampling procedure and scale of sampling for visual inspection and dimensional requirements shall be as per given in Annexure-D of IS: 4985.

The pipes shall be tested for lot acceptance.

The following acceptance tests shall be conducted in accordance with IS: 4985 and IS: 12235.
Visual and dimensional check

Reversion test.

Vicat Softening test

Ash Content

Bulk density

Resistance to external blows

Internal hydrostatic pressure test for pipes and joints

Opacity

Markings
Each pipe shall be clearly marked as indicated below:
Manufacturers name and trademark

Outside diameter in mm.

Class of pipe and pressure rating

Month and year of manufacturing

Length of pipe

Marking of insert depth of spigot

Each pipe shall also be marked in centre strip as circumference 1" wide at intervals not more than 3 meters to show the class of pipe.

Class 3 – Green

Class 4 – Brown

Packing and transport

The socket and spigot end of all the pipes shall be provided with tightly fitted end caps, protecting the inside of the pipes effectively against dirt etc. The end caps shall be of suitable high density (HD) plastic material in any colour other than black. They shall be fitted to the pipes prior to packing and transportation.

The pipes shall be transported to the store and site by trucks in pre packed bundles to ensure adequate protection during transport. At the time of packing and stacking of pipes the sockets shall be alternated within the pile and shall project sufficiently for the pipes to be correctly supported along their whole length. The pipes shall rest uniformly on the vehicle bed over their whole length during transport, carefully placed and firmly secured against unwarranted movement during transportation to the satisfaction of Engineer In charge.

Supply of uPVC Pipes:-

The Contractor will have to supply uPVC pipes manufactured by manufacturers having ISO 9000-2000 certification and who has been in the business of supply of uPVC pipes with elastomeric rubber ring joints and have proven record of successful supply and testing for minimum one year. The Contractor will have to present a certified photocopy of this certification for manufacturer he propose to procure his material from before starting supplies.

Rubber Rings for PVC Pipes and Specials
Scope
This section prescribes the requirements for materials used for vulcanized solid rubber sealing rings for water supply at ambient temperature. It covers rubber rings for uPVC pipes.
Material
The rubber shall be free from extractable substances which impart taste, odour or toxicity to water. The rubber or its compound shall not content toxic materials, such as compounds of mercury, antimony, manganese, lead or copper.

The rubber rings shall be vulcanized from Ethylene propylene (EPDM). The colour of material shall be black.

The rubber ring shall be long term termite resistant.

The sealing ring shall have no detrimental effect on the properties of the pipe and shall not cause the test assembly to fail the functional requirements

Appearance and homogeneity

The rings shall be homogeneous, free from porosity, grit, excessive blooms, blisters, or other visible surface imperfections. The fin or flash shall not exceed 0.4 mm and width 0.8 mm.

Rubber rings shall be made of a properly vulcanized virgin rubber compound containing no scrap or reclaim.

The surface of the rubber rings shall be smooth, free from pitting cracks, blisters, air marks, and any other imperfection that may affect its behavior in service. The body of the rubber ring shall be free from porosity and air pockets.
Dimensions and tolerances.
The profile and dimensions of the rubber ring shall be such that under normal circumstances efficient sealing can be expected for the socket dimensions.

The nominal measurements and the tolerances shall be in accordance with the figures stated by the manufacturer and they shall be laid down in a drawing.

Physical requirements.

The rubber ring shall have the ISI mark and will confirm to IS: 5382 and comply with the following physical properties when tested in accordance with IS: 3400

Properties	EPDM
Tensile Strength	11 MPa
Hardness	50, +5, -4 IRHD
Elongation at break	Min. 400%
Compression Set Test condition 27degree C., 72h, Max. permanent deformation	12%
Water absorption Test	Max. 10%
Accelerated ageing Test Hardness Tensile Strength Elongation at break	 -5 to +8 IRHD ± 20% -30% to +10%

Marking

Each sealing ring shall be permanently marked with:

The Manufacturer's name or trade mark.

The month and year of manufacture

Diameter of pipe for which the ring is suitable.

Type of rubber material

Testing

The scale of sampling and criteria for conformity shall be in accordance with IS: 5382. The following tests shall be conducted for conformity.

Hardness

Tensile strength

Elongation at break

Compression set

Accelerated ageing

Water absorption

Stress relaxation

The test pieces shall be cut from the finished product. Where this is not possible because the sample would be too small, the manufacturer shall provide test slabs from the same batch of rubber and vulcanised to the same degree and in the same manner as that of the rubber from which the rubber rings have been manufactured.

Wherever it is not possible to cut standard test piece from the rings, for determination of tensile strength and elongation at break, test piece in the shape of dumb bell as shown in Figure - 2 of IS: 5382 shall be used with the rate of traverse of moving grip as 15 cm/min.

Packing

Maximum 10 pieces of rubber ring shall be packed in one polyethylene bag. The colour of the polyethylene bags shall be preferably black or dark grey. The rubber rings packed in polyethylene bags shall be supplied in bituminised polyethylene lined jute bags to protect them from undue exposure to light and heat.

The rubber rings should also be supplied by the manufacturer of the pipes. They should preferably be manufactured by the manufacturer of the pipes. In case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under its own supervision and have it tested at his/sub contractors premises as per the contract. The pipe manufacturer will however be responsible for the compatibility and quality of the products.

Specials for uPVC Pipe System

uPVC specials

Manufacturing and type of sealing joint

All the uPVC fittings shall be fabricated from class-4 uPVC pipes only.

The socket dimensions shall be in accordance with the pipe sockets. The rubber sealing rings for pipe/specials shall be in accordance with the specifications .

Type of specials

Double sockets

The double socket special shall be suitable for elastomeric sealing ring type joint as per the enclosed drawing. The dimensions of the fitting shall be as given in Table below.

Table for dimensions of Double Sockets

S No.	Suitable for pipe OD (mm)	Min. length of fitting (h) mm	Min. spacer (I) mm
1	63	235	20
2	90	266	20
3	110	288	20
4	140	314	20
5	160	334	20
6	225	404	30
7	280	460	30
8	315	485	30

Double Socket Bends:

The fabricated bends shall be suitable for elastromeric sealing ring type joint as per the enclosed drawing. The dimensions of the double socket bends shall be as given below:

S.No.	Outside diameter in mm	Radius (r) mm	Angle of bend in degrees	L1 = L2
1	63	221	90	359
		221	45	230
2	90	315	90	469
		315	45	285
3	110	385	90	551
		385	45	326
4	140	490	90	674
		490	45	387
5	160	560	90	756
		560	45	428
6	225	788	90	1023
		788	45	562
7	280	980	90	1268

		980	45	674
8	315	1100	90	1410
		1100	45	746

Quality control tests
All the fitting shall be tested for socket dimension, workmanship/surface finish and leak tightness in accordance with for uPVC pipes.

Supply of specials

All the PVC fittings shall be supplied along with necessary rubber rings. The rubber rings shall be supplied in black coloured polyethylene bags. The fittings shall be packed and supplied in jute bags or in cardboard or wooden boxes according to their size.
The fittings should also be supplied by the manufacturer of the pipes. They should preferably be manufactured by the manufacturer of the pipes. In case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under it's own supervision and have it tested at his/sub contractors premises as per the contract. The pipe manufacturer will however be responsible for the compatibility and quality of the products.

Specifications for DI Pipes

Ductile Iron Pipe:-

The pipes will be centrifugally cast (spun) Ductile Iron pipes for Water and Sewage confirming to the IS 8329: 2000. The pipes used will be either with push on joints (Rubber Gasket Joints) or Flanged joints. The class of pipe to be used shall be of the Class K-9 and Class K-7.

The pipes shall be coated with bitumen as per appendix C and have factory provided cement mortar lining in the inside as per the provisions of Appendix B of the IS 8329: 2000.

The pipes will be supplied in standard length of 5.50 and 6.00 meters length with suitably rounded or chamfered ends. Each pipe of the push on joint variety will also be supplied with a rubber EPDM gasket. Any change in the stipulated lengths will be approved by the Engineer – in charge. The gaskets will confirm to the IS 5382:1985.

The gaskets should also be supplied by the manufacturer of the pipes. They should preferably be manufactured by the manufacturer of the pipes. In case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under its own supervision and have it tested at his/sub contractor's premises as per the contract. The pipe manufacturer will however be responsible for the compatibility and quality of the products.

The flanged joints will confirm to the **Clause 6.2** of IS 8329. The pipe supply will also include one rubber gaskets for each flange.

Inspection and Testing:

The pipes will be subjected to following tests for acceptance:

Visual and dimensional check as per Clause 13 and 15 of IS 8329

Mechanical Test as per Clause 10 of IS 8329

Hydrostatic Test as per Clause 11 of IS 8329

The test reports for the rubber gaskets shall be as per acceptance tests of the IS 5832 and will be in accordance to **Clause 3.8**

The sampling shall be as per the provisions of the IS 8329

Marking
All pipes will be marked as per Clause 18 of IS 8329 and show as below:

Manufacturer name/ stamp

Nominal diameter

Class reference

A white ring line showing length of insertion at spigot end

Packing and Transport:
The pipes should be preferably transported by road from the factory and stored as per the manufacturer specifications to protect damage.

Specials for Ductile Iron Pipes
General

This section covers the general requirements for Ductile Iron (DI) fittings suitable for Tyton joints to be used with Ductile Iron pipes with flanged and Tyton jointing system.

Types of specials
The following types of DI fittings shall be manufactured and tested in accordance with IS: 9523 or BS: 4772.

flanged socket

flanged spigot

Double socket bends (90^0, 45^0, 22 1/2 ^{0}, 11 1/4 ^{0})

Double socket branch flanged tee

All socket tee.

Double socket taper.

All Flanged Tee.

All Flanged taper.

Supply
All the DI fittings shall be supplied with one rubber ring for each socket. The rubber ring shall conform to IS: 12820 and IS: 5382 as described in the preceding chapter. Flanged fittings shall be supplied with one rubber gasket per flange and the required number of nuts and bolts.

General
This section covers the requirements for lubricant for the assembly of Ductile Iron pipes and specials suitable for Tyton push-in rubber ring joints

Specification
The lubricant has to have the following characteristics:

must have a paste like consistency and be ready for use

has to adhere to wet and dry surfaces of DI pipes and rubber rings

to be applied in hot and cold weather; ambient temperature 0 - 50 °C, temperature of exposed pipes up to 70 °C

must be non toxic

must be water-soluble

must not affect the properties of the drinking water carried in the pipes

must not have an objectionable odour

has to inhibit bacterial growth

must not be harmful to the skin

must have a shelf live not less than 2 years

Acceptance tests

They shall be conducted in line with the provisions of the IS 9523

Packing
All the DI fittings shall be properly packed with jute cloth. Rubber rings shall be packed in polyethylene bags. Rubber rings in PE bags and nuts, bolts etc. shall be supplied in separate jute bags.

The fittings should also be supplied by the manufacturer of the pipes. They should preferably be manufactured by the manufacturer of the pipes. In case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under its own supervision and have it tested at his/sub contractor's premises as per the contract. The pipe manufacturer will however be responsible for the compatibility and quality of the products.

Laying and jointing of DI pipes

Pipes should be lowered into the trench with tackle suitable for the weight of pipes. For smaller sizes, up to 200 mm nominal bore, the pipe may be lowered by the use of ropes but for heavier pipes suitable mechanical equipment have to be used.

All construction debris should be cleared from the inside of the pipe either before or just after a joint is made. This is done by passing a pull-through in the pipe, or by hand, depending on the size of the pipe. All persons should vacate any section of trench into which the pipe is being lowered

On gradients of 1:15 or steeper, precautions should be taken to ensure that the spigot of the pipe being laid does not move into or out of the socket of the laid pipe during the jointing operations. As soon as the joint assembly has been completed, the pipe should be held firmly in position while the trench is back filled over the barrel of the pipe.

The designed anchorage shall be provided to resist the thrusts developed by internal pressure at bends, tees, etc.

Where a pipeline crosses a watercourse, the design and method of construction should take into account the characteristics of the watercourse to ascertain the nature of bed, scour levels, maximum velocities, high flood levels, seasonal variation, etc. which affect the design and laying of pipeline.

The assembly of the pipes shall be made as recommended by the pipe manufacturer and using the suitable tools.

The socket and spigot ends of the pipes shall be brushed and cleaned. The chamfered surface and the end of the spigot end has to be coated with a suitable lubricant recommended by the manufacturer of the pipes. Oil, petroleum bound oils, grease or other material which may damage the rubber gasket shall not be used as lubricant. The rubber gasket shall be inserted into the cleaned groove of the socket. It has to be checked for correct positioning.

The two pipes shall be aligned properly in the pipe trench and the spigot end shall be pushed axially into the socket either manually or with a suitable tool specially designed for the assembly of pipes and as recommended by the manufacturer. The spigot has to be inserted up to the insertion mark on the pipe spigot. After insertion, the correct position of the socket has to be tested with a feeler blade

Deflection of the pipes -if any- shall be made only after they have fully been assembled. The deflection shall not exceed 75 % of the values indicated by the pipe manufacturer.

Anchoring of the pipeline

Thrust blocks shall be provided at each bend, tee, taper, end piece to prevent undue movements of the pipeline under pressure. They shall be constructed as per design of ENGINEER- IN- CHARGE according to the highest pressure during operation or testing of the pipes, the safe bearing pressure of the surrounding soil and the friction coefficient of the soil.

Leakage Test

Maximum hydrostatic test pressure for DI K-9/K-7 pipes shall be as per the provisions of the IS code

All pressure testing at site should be carried out hydrostatically. The pipes shall be accepted to have passed the pressure test satisfactorily, if the quantity of water required to restore the test pressure as per the latest Codal provisions does not exceed the amount ‘Q’, calculated by the above formula.

If it is required to test a section of a pipeline with a free end, it is necessary to provide temporary support against the considerable end thrust developed by the application of the test pressure. The end support can be provided by inserting a wooden beam or similar strong material in a short trench excavated at right angle to the main trench and inserting suitable packing between the support and pipe end.

The pipeline stretch will pass the test if the water added during the test period is not exceeding the admissible limits. No section of the pipe work shall be accepted by the Engineer in charge until all requirements of the test have been obtained.

On completion of a satisfactory test any temporary anchor blocks shall be broken out and stop ends removed. Backfilling of the pipeline shall be completed.

Failure to pass the test

All pipes or joints which are proved to be in any way defective shall be replaced or remade and re-tested as often as may be necessary until a satisfactory test shall have been obtained. Any work, which fails or is proved by test to the unsatisfactory in any way, shall be redone by the Contractor.

Flushing and disinfecting of pipelines

After testing and commissioning the contractor shall flush the pipes with a velocity not less than 1 m/s or as approved by the Engineer in Charge. Disinfection of drinking water pipelines shall be made by engineer- in charge.

Supply of Ductile Iron Pipes:-

The Contractor will have to supply DI pipes manufactured by manufacturer who has been in business of supply of DI pipes rubber ring jointed and have proven record of successful supply and testing of pipeline for minimum one year.

General
Standards
Except as otherwise specified in this technical specification, the Indian/International Standards and Codes of Practice in their latest version shall be adhered to for the design, manufacturing, inspection, factory testing, packing, handling and transportation of product. Should any product be offered conforming to other standards, the equipment or products shall be equal to or superior to those specified and the documentary confirmation shall be submitted for the prior approval of the Engineer in Charge.

This specification requires a reference to the following standard specifications

BS: 4772	Specification for DI fittings
IS: 7634- Parts 1-3	Code of practice for plastic pipe works for potable water supplies
IS: 8329	Centrifugally cast (spun) ductile iron pressure pipes for water, gas and sewage.
IS: 12288	Code of practice for use and laying of ductile iron pipes
CPHEEO	Manual on Water Supply and Treatment, III edition, Ministry of Urban Development, New Delhi- May 1999.

VALVES AND LAYING OF PIPES

Valves
General
The sluice valve will confirm to IS: 780/ IS: 2906.

The material to be supplied under this sub-section shall include but not be limited to the following:

All necessary fittings including bolts, nuts, gaskets, backing rings, counter flanges, jointing material, strainers etc. as required.

Sluice Valves

Scope

This section covers the requirements for non rising stem type sluice valve from 50 mm to 600 mm size. The valves will be used for water supply on line installations in upright positions, up to 450 C working temperature, with double flange and cap or hand wheel, for manual operation.

Nominal pressure and dimensions

The working pressure of the valves shall be 10 kg/cm2 (1 MPa)

The dimension and mass of the sluice valves shall be in accordance with IS: 780 for sizes from 50 to 300 mm and IS: 2906 for sizes 350 to 600 mm.

The flanges and their dimensions of drilling shall be in accordance with IS: 1538 (part-I to XXII).

Material
The material for different component parts of sluice valve shall conform to requirements given below:

S No.	Component	Material	Ref. to IS	Grade / designation
1	Body, bonnet, wedge, stuffing box, gland, thrust plate, hand wheel cap. etc.	Grey cast iron	210	FG 200
2	Stem	Stainless steel	6603	AISI 431, AISI 410
3	Wedge nut	Leaded tin bronze	318	LTB 2
4	Body seat ring, wedge facing ring	Leaded tin bronze	318	LTB 2
5	Bolt	Carbon steel	1363	Class 4.6
6	Nut	Carbon steel	1363	Class 4
7	Bonnet gasket	Compressed fiber	2712	C

		board		
8	Gland packing	Asbestos	4687	Nil

Coating

All sluice valves shall be coated by dipping in a bath of tar base composition as given in Clause 7 of IS: 780 for sizes from 50 mm to 300 mm and Clause 8 of IS: 2906 for sizes from 350 mm to 600.

All components susceptible to corrosion attack shall be coated internally and externally. Protective coating shall always be applied to the individual components before they are assembled, following shot blasting to give good adhesion.

Marking, testing and inspection

The standard marking and packing of the valves shall be done as per Clause 10 and 11 of IS: 780. The direction of rotation for OPEN, CLOSE position shall be marked on the hand wheel and on the bonnet of the valve.

Testing of sluice valve shall be done for close end in accordance with IS: 780 for sizes from 50 mm to 300 mm and IS: 2906 for sizes from 350 mm to 600.

All the valves shall be inspected for flaw detection test in accordance with IS: 780. for sizes from 50 mm to 300 mm and IS: 2906 for sizes from 350 mm to 600.

The design, construction material, manufacture, inspection, performance and testing shall comply with all applicable Indian Standards and Codes. Nothing in the specification will be construed to relieve the supplier of this responsibility.

Air valves

Scope and general design feature

This section covers the requirements of automatic double ball air valves to be used for evacuation of accumulation of air in water mains under pressure, for the exhaust of air when such mains are being charged with water and for inlet of air when they are emptied of water.

The Air Valves shall conform to IS14845. The design shall be such that higher the rate of flow the greater the resultant down thrust keeping the ball 'glued' to its seat until the last drop of air is expelled from the pipe system.

The valves shall have an integrated sluice valve. If required, they shall be installed on a flange welded on the MS pipe / special. The possible air velocity (inflow and outflow) must be at least 10 m/s. The working pressure of the air valves shall be 10 kg / cm^2 (1Mpa).

Construction feature

The flow of air should be as unobstructed as possible. The low-pressure orifice shall be in the same axis as the main discharge/incoming airflow and must have a diameter sufficiently large.

The cone angle in the low-pressure (large orifice) chamber should be carefully calculated and there should be adequate height to allow for free movement of the vulcanite ball in the low chamber. The annulus around the low-pressure vulcanite covered ball is to be generously proportioned for discharge of air under various differential pressures.

The orifice shall be carefully profiled to allow the requisite flow of air under varying differential pressure. It shall be in moulded synthetic rubber such that even after extended contact the vulcanite covered ball does not stick to it when the line pressure becomes zero.

In the high-pressure chamber the orifice shall be in profiled in such a manner that the rubber-covered ball is not damaged even after extended contact. There should be machined guide in the chamber, which ensures that the ball travels vertically and makes contact with the nipple and seals off the orifice without fail.

Material

The material for different component parts of the air valve shall conform to requirements given below:

S No.	Component	Specifications
1	Body	Cast Iron conforming to IS: 210 GR FG 200
2	High Pressure Cover	Cast Iron confirming to IS 210 GR FG 200
3	Low Pressure Cover	Cast Iron confirming to IS 210 GR FG 200
4	Cowl	Cast iron confirming to !S 210 GR FG
5	High Pressure Orifice Plug	Stain less steel conforming to AISI 410
6	Low pressure ball	Vulcanite covered seasoned timber
7	High pressure ball	Rubber covered seasoned timber

8	Lower pressure seat ring	Dexine (Nitrile rubber)
9	Isolating sluice valve	Conforming to IS: 780 – 1984
10	Spindle for sluice valve	Stainless steel conforming to AISI 410
11	Bolts and nuts	Mild steel

The body and seat of the valve shall withstand a working pressure of 10 kg/cm^2 for at least 15 minutes.

Inspection

Third Party Inspection:

The following items of supply will be got inspected from approved inspecting agency (CEIL, SGS. RITES) at manufacturers premises before dispatch at his own cost.

1. Ductile Iron pipes, rubber gaskets & specials
2. CI Joints, Sluice valves, Air valves

Acceptable Makes :-

Sluice Valves	Kirloskar Brother Ltd., IVC, IVI, Fouress, Audco , Inter Valve, H. Sarkar, B.E.W
Air Valves	Kirloskar Brother Ltd, IVC, IVI, Univalves, B.E.W

Specifications for Laying and Jointing of Pipe Line System for Water Supply

Preparatory work

The contractor will inspect the route along which the pipe line is proposed to be laid. He should observe/ find out the existing underground utilities/ construction and propose an alignment along which the pipeline is to be laid. He should make all efforts to keep the pipe as straight as possible with the help of ranging rods. Wherever there is need for deviation, it should be done with the use of necessary specials or by deflection in pipe joints (limited to 75% of permissible deflection as per manufacturer). The alignment as proposed should be marked on ground with a line of white chalk and got approved from Engineer In-Charge. The Contractor will than prepare an L-Section along this alignment showing the location of proposed pipeline. The L-section should be got approved from the site Engineer. The position of fittings, valves, should be shown on the plan.

Alignment and the L-Sections

The alignments, L-section (depth of laying) and location of specials, valves and chambers may be changed at site in co-operation with and after approval of the Engineer in Charge. The minimum cover to the top of the pipe shall be 1 m.

Standards

Except as otherwise specified in this technical specification, the Indian Standards and Codes of Practice in their latest version, National Building code, PWD specification of the state of Rajasthan and Manual of water supply of GOI shall be adhered to for the supply, handling, laying, installation, and site testing of all material and works.

Tools and equipment

The contractor has to provide all the tools and equipment required for the timely, efficient and professional implementation of the work as specified in the various sections of the contract and as specified by the instructions of manufacturers of the pipes and other material to be handled under this contract. On demand he shall provide to the Engineer in Charge a detailed list of tools and equipment available. If in the opinion of the Engineer in Charge the progress or the quality of the work cannot be guaranteed by the available quantity and type of tools and equipment the contractor has to provide additional ones to the satisfaction of the Engineer in Charge. The Contractor will always have a leveling instrument on site.

Handling and laying of pipes

Transportation of pipes and specials & Storage:-

The Contractor has to transport the pipes and other materials from manufacturer to the site of laying as indicated by the Engineer in Charge. Pipes should be handled with care to avoid damage to the surface and the socket and spigot ends, deformation or bending. Pipes shall not be dragged along the ground or the loading bed of a vehicle. Pipes shall be

transported on flat bed vehicles/trailers. The bed shall be smooth and free from any sharp objects. The pipes shall rests uniformly on the vehicle bed in their entire length during transportation. Pipes shall be loaded and un-loaded manually or by suitable mechanical means without causing any damage to the stacked pipes.

The transportation and handling of pipes shall be made as per IS 12288. Handling instructions of the manufacturers of the pipes shall be followed. All precautions set out shall be taken to prevent damage to the protective coating, damage of the jointing surfaces or the ends of the pipes.

Whatever method and means of transportation is used, it is essential that the pipes are carefully placed and firmly secured against uncontrolled movement during transportation to the satisfaction of engineer in charge.

Cranes or chain pulley block or other suitable handling and lifting equipment shall be used for loading and un-loading of heavy pipes. However, for pipes up to 400 mm nominal bore, skid timbers and ropes may be used. Where using crane hooks at sockets and spigot ends hooks shall be broad and protected by rubber or similar material, in order to avoid damage to pipe ends and lining. Damage to lining must be repaired before pipe laying according to the instructions of the pipe manufacturer. Pipes shall not be thrown directly on the ground or inside the trench.

When using mechanical handling equipment, it is necessary to employ sufficient personnel to carry out the operation efficiently with safety. The pipes should be lifted smoothly without any jerking motion and pipe movement should be controlled by the use of guide ropes in order to prevent damage caused by pipes bumping together or against surrounding objects.

Rolling or dragging pipes along the ground or over other pipes already stacked shall be avoided.

The pipe should be given adequate support at all times. Pipe should be stored on a reasonably flat surface free from stones and sharp projections so that the pipe is supported through out its length. In storage, pipe racks should provide continuous support and sharp corners of metal racks should be avoided. Socket and Spigot pipes should be stacked in layer with sockets placed in alternate ends of the stack to avoid lop sided stacks.

Pipes should not be stored inside another pipe. On no account the pipes should be stored in stressed or bent condition or near the sources of heat. Pipes should not be stacked more than 1.5 m high and pipes of different sizes and classes should be stacked separately. The ends of the pipes should be protected from abrasion. The pipes should be protected from U.V. rays and excessive heat at all times. Their storage facility should be well ventilated.

The Contractor shall provide proper and adequate storage facilities to protect all the materials and equipment's against damage from any cause whatsoever and in case of any such damage/theft, the Contractor shall be held responsible.

The contractor will lay the pipelines along the alignments as per the layout given by the Engineer in Charge. The layout shall be given keeping in view the information available regarding existing services like water lines, sewers, telephone and electric lines/ cables. In the event some services fall in the alignment of lines to be laid, the contractor shall have to shift such services for which a provision has been made in the BOQ. The contractor shall take all due care to avoid damage to any such services and, in case of any damage occurring to them in progressing the work, the Contractor shall make good the same at his own cost. No additional time shall, however, be allowed on this account.

Stringing of pipes along the alignment

The pipes shall be laid out properly along the proposed alignment in a manner that they do not create any significant hindrance to the public and that they are not damaged.

Stringing of the pipe end to end along the working width should be done in such a manner that the least interference is caused in the land crossed. Gaps should be left at intervals to permit the passing of equipment across the working area. Pipes shall be laid out that they remain safe where placed and that no damage can occur to the pipes and the coating until incorporated in the pipeline. If necessary, pipes shall be wedged to prevent accidental movement. Precautions shall be made to prevent excessive soil, mud etc. entering the pipe.

Generally, the pipes shall be laid within two weeks from the date of their dispatch from the manufacturer/store.

Pipe trench

Trench excavation

The trench excavation of pipeline shall be in accordance with IS 12288. Pipe trenches shall be excavated to the lines and levels shown on the drawings or as directed by the Engineer in Charge. The depth of the excavated trench shall be as given in the drawings or as directed by the Engineer in Charge. The width of the trench at bottom between the faces of sheeting shall be such as to provide 200 mm clearance on either side of the DI. No pipe shall be laid in a trench until the section of trench in which the pipe is to be laid has been approved by the Engineer in Charge.

The depth should be sufficient to provide a cover not less than 1000 mm. It may be necessary to increase the depth of pipeline to avoid land drains or in the vicinity of roads, railways or other crossings. Care should be taken to avoid the spoil bank causing an accumulation of rainwater.

The bottom of the trench shall be trimmed and leveled to permit even bedding of the pipes. It should be free from all extraneous matter, which may damage the pipe or the pipe coating. Additional excavation shall be made at the joints of the pipes, so that the pipe is supported along its entire length.

All excavated material shall be stacked in such a distance from the trench edge that it will not endanger the work or workmen and it will avoid obstructing footpaths, roads and driveways. Hydrants under pressure, surface boxes, fire or other utility controls shall be left unobstructed and accessible during the construction work. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.

To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, torches, red lanterns and guards, as required, shall be placed and maintained during the progress of the work and until it is safe for traffic to use the roadways. All materials, piles equipment and pipes which may serve as obstruction to traffic shall be enclosed by fences or barricades and shall be protected by illuminating proper lights when the visibility is poor.

As far as possible, the pipe line shall be laid below existing services, like water and gas pipes, cables, cable ducts and drains but not below sewers, which are usually laid at greater depth. Where it is unavoidable, pipeline should be suitably protected. A minimum clearance of 150 mm shall be provided between the pipeline and such other services.

Trees, shrubbery fences, poles, and all other property and surface structures shall be protected. Tree roots shall be cut within a distance of 50 cm from pipe joints in order to prevent roots from entering them. Temporary support, adequate protection and maintenance of all under ground and surface structures, drains, sewers and other obstructions encountered in the progress of the work shall be provided. The structures, which will be disturbed, shall be restored after completion of the work.

Where water forms or accumulates in any trench the Contractor shall maintain the trench free of water during pipe laying.

Wherever necessary to prevent caving, trench excavations in soils such as sand, gravel and sandy soil shall be adequately sheeted and braced. Where sheeting and bracing are used, the net trench width after sheeting shall not be less than that specified above. The sides of the excavation shall be adequately supported at all times and, except where described as permitted under the Contract, shall be not battered.

The Engineer in Charge in co-operation with the Contractor shall decide about the sheeting/ bracing of the trench according to the soil conditions in a particular stretch and taking into account the safety requirements of the Contractor's and Engineer- In- Charge's staff. Generally, safety measures against caving have to be provided for trenches with vertical walls if they are deeper than 2.0 m.

Trench excavation to commensurate with the laying progress

The work of trench excavation should be commensurate with laying and jointing of the pipeline. It should not be dug in advance for a length greater than 500 m ahead of work of laying and jointing of pipeline unless otherwise permitted by the Engineer in Charge. The Contractor has to ensure the following:

- safety protections as mentioned above have to be incorporated in the work process
- hindrances to the public have to be minimized
- the trench must not be eroded before the pipes are laid
- the trench must not be filled with water when the pipes are laid
- the trench must not be refilled before laying of the pipes

The bed for the laying of the pipes has to be prepared according to the L-Section immediately before laying of the pipes.

Bedding of the pipes

The trench bottom shall be even compact and smooth so as to provide a proper support for the pipe over its entire length, and shall be free from stones, lumps, roots and other hard objects that may injure the pipe or coating. Holes shall be dug in the trench bottom to accommodate sockets so as to ensure continuous contact between the trench and the entire pipe barrel between socket holes.

Laying and jointing of pipes

General

The pipes will be cleaned in the whole length with special care of the spigot and sockets on the inside/ outside to ensure that they are free from dirt and unwarranted projections. The whole of the pipes shall be placed in position singly and shall be laid true to profile and direction of slope indicated on longitudinal sections. The pipes shall be laid without deflection in a straight alignment between bends and between high and low points. Vertical and horizontal deflections between individual pipes need the approval of the Engineer in Charge. In no case the deflection shall be more than 75 % of those recommended by the manufacturer.

Before pipes are jointed they shall be thoroughly cleaned of all earth lumps, stones, or any other objects that may have entered the interior of the pipes, particularly the spigot end and the socket including the groove for the rubber ring.

Pipes and the related specials shall be laid according to the instructions of the manufacturers and using the tools recommended by them.

Cutting of pipes shall be reduced to a minimum required to conform to the drawings. Cutting has to be made with suitable tools and according to the recommendations of the manufacturer. The spigot end has to be chamfered again at the same angle as the original chamfered end. Cutting shall be perpendicular to the Centre line of the pipe. In case of ductile iron pipes the cut and chamfered end shall be painted with two coats of epoxy paint. If there is no mark for the insertion depth on the spigot end of the (cut) pipe it shall be marked again according to the instructions of the manufacturer.

Before pipes are jointed they shall be thoroughly cleaned of all earth lumps, stones, or any other objects that may have entered the interior of the pipes, particularly the spigot end and the socket including the groove for the rubber ring. End caps are removed only just before laying and jointing

All specials like bends, tees etc. and appurtenances like sluice or butterfly valves etc. shall be laid in synchronization with the pipes. The Contractor has to ensure that the specials and accessories are ready in time to be installed together with the pipes.

At the end of each working day and whenever work is interrupted for any period of time, the free ends of laid pipes shall be protected against the entry of dirt or other foreign matter by means of approved plugs or end caps.

When pipe laying is not in progress, the open ends of installed pipe shall be closed by approved means to prevent entrance of trench water and dirt into the line.

No pipe shall be laid in wet trench conditions that preclude proper bedding, or when, in the opinion of the Engineer in Charge, the trench conditions or the weather are unsuitable for proper installation.

The pipeline laid should be absolutely straight unless planned otherwise. The accuracy of alignment should be tested before starting refilling with the help of stretching a string between two ends of the straight stretch of pipes to rectify possible small kinks in laying.

Special Cast Iron fittings and Accessories

Normally when pipeline is laid, a certain number of cast iron fittings such as tees, bends, reducers, etc, and special fittings such as air or sluice valves are required.

Laying of Fittings – All cast iron fittings shall be plain ended to suit the outside diameter of Asbestos cement pressure pipes and to the class and diameter of pipe manufactured. When using such cast iron fittings, they are jointed by cast iron detachable joints only. For cast iron specials having flanges, they are jointed in the pipeline with cast iron flange adaptors having one end flanged and the other plain ended.

Anchorages - It should particularly be noted that the cast iron joints do not hold pipe ends within it firmly. During working or test pressure, there will be tendency for the pipe ends or special ends to slip out of the joint, more so with the case of blank end cap used for closure of pipeline and all degree bends and tees. In order to keep them firmly in the pipeline, anchoring of these specials are necessary against the direction of thrust.

The anchorage shall consist of either concrete cast-in-situ or masonry built in cement mortar. The anchors shall be extended to the firm soil of the trench side. The shape of the anchors will depend on the kind of specials used. They shall be spread full width of trench and carried vertically by the side and over the special to about 15 cm. The bearing area on sides of the trench will be proportional to the thrust and to bearing capacity of the sides of the trench.

Back filling and tamping

The soil under the pipe and coupling shall be tamped in order to provide a firm and continuous support or the pipeline. Tamping shall be done either by tamping bars or by using water to consolidate the back fill material.

The initial back fill material used shall be free of large stones and dry lumps. In stony areas the material for initial back fill can be shave from the sides of the trenches. In bogs and marshes, the excavated material is usually little more than vegetable matter and this should not be used for bedding purposes. In such cases, gravel or crushed stone shall be hauled in.

The initial back fill shall be placed evenly in a layer of about 100 mm thick. This shall be properly

Consolidated and this shall be continued till there is a cushion of at least 300 mm of cover over the pipe.

If it is desired to observe the joint or coupling during the testing of mains they shall be left exposed.

Sufficient back fill shall be placed on the pipe to resist the movement due to pressure while testing.

Balance of the back fill need not be so carefully selected as the initial material. However, care shall be taken to avoid back filling with large stones, which might damage the pipe when spaded into the trench.

Pipes in trenches on a slope shall have extra attention to make certain that the newly placed back fill will not become a blind drain in effect because until back fill becomes completely consolidated, there is a tendency for ground or surface water to move along this looser soil resulting in a loss of support to the pipe. In such cases, the back fill should be tamped with extra care and the tamping continued in 100 mm layers right up to the ground level.

Anchoring of the pipeline

Thrust blocks shall be provided at each bend, tee, taper, end piece to prevent undue movements of the pipeline under pressure. They shall be constructed as per actual design and approval of Engineer in Charge according to the highest pressure during operation or testing of the pipes, the safe bearing pressure of the surrounding soil and the friction coefficient of the soil.

Testing of the pipelines
Sectional tests

After laying and jointing the pipeline shall be tested for tightness of barrels and joints, and stability of thrust blocks in sections approved by the Engineer in Charge. The length of the sections depends on the topographical conditions. Preferably the pipeline stretches to be tested shall be between two chambers (air valve, scour valve, bifurcation, other chamber). At the beginning, the Contractor shall test stretches not exceeding 2 km. After successful organization and execution of tests the length may be extended to more than 2 km after approval of the Engineer in Charge.

The water required for testing shall be arranged by the contractor himself. The Contractor shall fill the pipe and compensate the leakage during testing. The Contractor shall provide and maintain all requisite facilities, instruments, etc. for the field testing of the pipelines. The testing of the pipelines generally consists in three phases: preparation, pre-test/saturation and test immediately following the pre-test. Generally, the following steps are required which shall be monitored and recorded in a test protocol if required:

- Complete setting of the thrust blocks.
- partial backfilling and compaction to hold the pipes in position while leaving the Joints exposed for leakage control
- opening of all intermediate valves (if any)
- fixing the end pieces for tests and after temporarily anchoring them against the soil

(Not against the preceding pipe stretch)

- at the lower end with a precision pressure gauge and the connection to the pump for establishing the test pressure
- at the higher end with a valve for air outlet
- If the pressure gauge cannot be installed at the lowest point of the pipeline, an allowance in the test pressure to be read at the position of the gauge has to be made accordingly
- Slowly filling the pipe from the lowest point(s).
- the water for this purpose shall be reasonably clear and free of solids and suspended matter
- Complete removal of air through air valves along the line.
- Closing all air valves and scour valves.
- Slowly rising the pressure to the test pressure while inspecting the thrust blocks and the temporary anchoring.
- Keeping the pipeline under pressure for the duration of the pre-test / saturation of the lining by adding make-up water to maintain the pressure at the desired test level. Make up water to be arranged by Contractor himself at his own cost.
- start the test by maintaining the test pressure at the desired level by adding more
- Make-up waters; record the water added and the pressure in intervals of 15 minutes at the beginning and 30 minutes at the end of the test period.
- Water used for testing should not be carelessly disposed off on land, which would ultimately find its way to trenches.
- The testing conditions for the pipelines shall be as per the test pressures and condition laid out in IS 8329 for DI pipes.

The pipeline stretch will pass the test if the water added during the test period is not exceeding the admissible limits. No section of the pipe work shall be accepted by the Engineer in Charge until all requirements of the test have been obtained.

On completion of a satisfactory test any temporary anchor blocks shall be broken out and stop ends removed. Backfilling of the pipeline shall be completed.

Specification of OHSR

Special Conditions of Contract

CONTRACT

1.1 Type of Contract

NON BSR ITEMS RCC SR 2 NOS.

1.2 Priority of contract

The documents forming part of the agreement are to be taken as mutually explanatory documents of one another. In case of discrepancies they shall be explained and adjusted by the Engineer In Charge. The priority of the Contract documents shall be as follows:

1. Letter of award
2. Special Conditions of Contract Part A & Part B

Instructions to Bidders

3. General Conditions of Contract
4. Work description/ Scope of works
5. Technical specifications
6. Drawings
7. Bill of quantities

Design And Drawings

2.1 General Design Obligations

The Contractor shall be deemed to have scrutinized, prior to submission of bid, the JDA Requirements (including design criteria and calculations, if any). The Contractor shall be responsible for the design of the following works and for the accuracy of such designs-

1. RCC SR

JDA shall not be responsible for any error, in accuracy or permission of any kind in JDA requirements as originally included in the contract. Any data or information received by the Contractor, from JDA or otherwise, shall not relieve the Contractor from his responsibility for the design and execution of the works.

2.2 Contractor's Documents & Submission Procedure For Detailed Design & Execution Drawings

The Contractor's Documents shall comprise the Technical Documents specified in the JDA requirements, Documents Requirement to satisfy all regulatory approvals, As Built Documents and Operation and Maintenance Manuals. The Contractor's Documents shall be written in the language for communications defined in contract.

If errors, omissions, ambiguity, inconsistencies, inadequacies or other defects are found in the Contractors Documents, these and the works shall be corrected at the Contractor's cost, notwithstanding any consent for approval under this clause.

The contractor shall carry out the preparatory works such as Topographic survey, soil investigations, geo technical investigations etc to prepare the plans, designs, drawings etc.

The contractor is required to submit the detailed design and execution drawings such as site plan, general arrangement drawings, plans, structural drawings and all working drawing of all civil works stated in the above clause 2.1. He will also submit the detailed system and working drawings as well as performance curves and data for all hydraulic, mechanical, Electro-mechanical and electrical equipment.

The detailed design & execution drawings shall be submitted only after verification by MNIT/equivalent institute or agency approved by the Engineer In Charge or any authorized representative of the JDA.

2.3 Approval procedures

After submission of detailed designs, working drawings and documents etc., the competent authority or his authorized representative shall progressively review them and issue an approval within 15 days. The period of review will be counted after all quarries are replied satisfactorily. The schedule should be such so as not to obstruct the actual construction work.

The following shall be the procedure for submission and approval of detailed design and execution drawings:

The Contractor shall submit three copies of design/drawings and performance curves etc. to the Engineer in Charge. All the drawings are to be signed by the Contractor or his authorized representatives.

(a) The Engineer in Charge will review the design/drawings etc. and if found in order return one copy duly approved to the Contractor within 15 days.

(b) In case the design/drawings etc. are not found fit for approval, the Engineer in Charge will mark the comments on them and return two copies to the Contractor within 15 days and the same shall be repeated till drawings are finally approved as mentioned in the above clause. The contractor in such cases shall submit the revised and corrected design/drawings within 15 days to the receipt of comments from Engineer-In-Charge.

(c) On request of the Engineer in Charge, the Contractor shall depute the design engineer responsible for the particular design/drawing to discuss with the Engineer in Charge or his Representative.

(d) On receipt of approved designs/drawings as per sub-clause (b) above, the Contractor shall submit four (4) additional copies of the approved designs / drawings to JDA for reference and records.
No designs / drawings with corrections made after taking the prints will be accepted.

The approval of drawings/designs by the Engineer in Charge shall not relieve the Contractor of his responsibility in terms of the Contract for soundness of the designs. The Contractor shall be responsible for the structural safety of all the components of the Work.

2.4 Discrepancies between Drawings and Specifications

In case of discrepancies between drawings and specifications or data sheets arising from the meaning, dimensions or quality of the materials and equipment for the due and proper execution of the Work, the discrepancy shall be explained by the

Engineer in Charge. His explanation shall be the final decision and the Contractor shall execute the Work accordingly without any extra payment.

3. Pre – Construction, Inspection and testing and review of data for material, plant and equipment

- The contractor shall place order for the material and equipment only after approval of Engineer In Charge. The contractor shall submit the detailed drawings to the Engineer In Charge for approval.
- The contractor shall inform the Engineer In Charge about the likely dates of manufacture, testing and dispatching of the material. The contractor shall notify the Engineer In Charge for inspection and testing, at least twenty eight (28) days prior to packing and shipping and shall supply the manufacturers test results and quality control certificate.
- The inspection and test categories shall be applied prior to delivery of the equipment of various categories as indicated in the technical specifications for each type of equipment.

Category A: The drawing/data sheet has to be approved by the Engineer In Charge before manufacture and testing. The material has to be inspected by inspecting agency at the manufacturers premise before packing and dispatching.

Category B: The drawings of the equipment have to be submitted and to be approved by the Engineer In Charge prior to manufacture. The material has to be tested by the manufacture and the manufacturers test certificate are to be submitted and approved by the Engineer In Charge before dispatching of the equipment. Notwithstanding the above, the Engineer In Charge after examination of the test certificates, reserves the right to instruct the contractor for testing, if required, in the presence of the contractors representative.

Category C: The material may be manufactured as per standards and deliver to the site.

- For material/equipment under Category 'A' and 'B' the Engineer In Charges will provide an authorization for packing and shipping after inspection.
- The testing, approval for dispatching shall not absolve the contractors obligations for satisfactory performance of the plant.

Inspection Category

S.Nos.	Items	Category
	Related to Rising mains and Distribution System	
1.	Cast Iron specials	B
2	uPVC / DI pipes	A
3	Sluice Valves, Reflux valves, Air Valves, Water Meter, Bulk Meter and Pressure sensor, Magnetic Water Meter	B
4	C.I. Joints and rubber rings for joints & couplers	B

3.1 Third Party Inspection :

The contractor is to contact for third party inspection amongst the CEIL, SGS, RITES on his own. He shall deposit & bear the cost of inspection. The contractor should inform the JDA of the name of agency finalized by him for the contract. The agency finalized by him for the contract. The agency will be same for all items of supply in this contract requiring 3rd party inspection.

The manufacturer should be required to call for inspection to the agency under instructions of the Contractor and Engineer In Charge. The Engineer in Charge may depute a representative to witness the inspection. The inspection agency should furnish copies of Inspection Certificate to the manufacturer, Contactor and to the Engineer In Charge directly. All material tested and found satisfactory as per specifications shall be marked distinctly.

3.2 Cost for Inspection

The cost of inspection shall be borne by the contractor.

3.3 Approval of Material and Equipment

The fact that the Contractor has agreed to provide the material prescribed in the Tender Documents does not release him to ask for the final approval of the equipment and material to be used for the Work. The specifications and drawings of each item to be supplied shall be individually scrutinized and its conformity with the technical specifications and the standards shall be verified by the Engineer In Charge.

Prior to ordering any material and equipment such as pipes, specials, measuring equipment's, mechanical and Electro-mechanical equipment, electrical equipment, material for civil works and interior decoration, paints, etc. the Contractor has to supply the detailed specification, drawings, performance curves and data, operation instructions etc., to the Engineer In Charge. If the Contractor has any doubts about the required specifications as prescribed in the Contract, he has to clarify them with the Engineer In Charge.

The procedure for the submission of documents, verification, re-submission if necessary and approval of these items is the same as that for the drawings, described in clause 2.3. If equipment or material which the Contractor submitted first is refused in the approval process he has to submit documents of such equipment which corresponds to the specifications of the Tender Documents and which is likely to be approved.

Only after approval of the material and equipment, the Contractor can place the order or start the manufacturing or purchasing procedures.

Four weeks prior to packing and shipping the Contractor must inform the Engineer In Charge when the material/equipment is

ready for inspection and testing. At this date, the Contractor shall supply the results of all manufacturer's own tests made during or after manufacturing and his own quality control certificates. The Engineer In Charge will decide whether he or his representative will inspect and test the material/ equipment or whether he will approve it on the basis of the supplied documentation.

Inspection of bought out items i.e. Sluice valve, Air Valve, or any other Electro-Magnetic, Electrical and Mechanical equipment(s) and other items defined under Category 'A' shall done by third party selected by the JDA.

The Engineer In Charge will provide an authorization for packing and shipment after inspection and/or approval of the material/equipment.

If the Contractor packs and ships material/ equipment without approval or authorization of the Engineer In Charge-in-Charge, it can be refused if it is not matching with the specifications of the Contract. All costs resulting from this are to be borne by the Contractor. The Contractor has then to provide the material/ equipment, which is matching with the Contract.

4. COMPLETION OF THE WORK

4.1 Time for completion

The whole of the work, including mobilization, reconnaissance, construction, installation, testing, commissioning and trial runs, and demobilization has to be completed within a period of **9 months** calculated from the commencement date, which is 10 days after the written order to commence the Work.

4.2 Completion of work and fully commissioning

Once the entire system has been successfully tested and commissioned, and removal of all visible defects to the satisfaction of Engineer In Charge-in-Charge, the work shall be treated as **"Completed".**

Unless otherwise provided in the contract, after the successful completion Engineer In Charge shall issue a certificate of "Completion of Work". The date of Certificate notifying "Completion of Work" will be used for the final payment as per clause 6 and 7 of General Conditions of Contract. From this date of issue of certificate for "Completion of Work", the Operation and Maintenance period shall commence.

4.3 Defects liability period

The defect liability period shall be of 12 months, from the date of the completion. The Contractor shall be responsible for satisfactory performance of the work under all design and operation conditions for the duration of the defects liability period, except for damage due to unprecedented natural calamities.

In the case of delayed "Completion of Work" not caused by the Contractor, the defects liability period shall be extended accordingly but not more than two (2) years after the total completion of the entire Work, whichever is earlier.

4.4 Cost of water and electricity for testing

Water and electricity for construction and testing of scheme purpose shall be arranged by the contractor at his own cost. Electricity for trial and run period shall be provided by JDA. Electric connection and regular electric bill of TW shall be paid by JDA but liaison work shall be carried by contractor with JVVNL, Jaipur.

5 As-Built Drawings

The submission of the as-built drawings for the equipment is the precondition for the final payment. The final drawings shall be submitted in one reproducible set and 3 copies on linen bound in an album of an approved size. The contractor shall submit all the completion drawings and approved design calculations on CD ROM / DVD in two copies with proper directory structure. The scale of drawing and the size of drawing shall be as per the direction of the Engineer In Charge.

The contractor shall prepare, and keep up to date, a complete set of "as built" records of the execution of the works, showing the exact as built locations, sizes and details of the works as executive. The records shall be kept on the site and shall be used exclusively for the purpose of this sub clause. Two copies shall be supplied to JDA before the commencement of the tests on completion. The Contractor shall obtained the consent of JDA as to their size, the references system, and other relevant details.

6 Progress Of Work

All components of works shall ensure a logical sequence of supply, installation, testing, and commissioning. If any supply of a material is made, not in conformity to the logical sequencing of the work component, no payments will be entitled against such supplies and installations.

It will be the responsibility of contractor to maintain simultaneous pro-rata progress of civil work, pumping stations, RCC SR.

7 Documents Required For Payment:

The contractor shall submit the following documents in duplicate along with the invoice/bill.

(i) Invoice indicating details of equipment's, material manufactured, supplied and installed or work carried out, supply value of such material or equipment or value of such work carried out and amount claimed.
(ii) Inspection reports/ test reports/ reports certifying completion of activity with acceptable results.
(iii) Report/certificate of inspections /tests carried out by the supplier of the contractor or by the contractor himself.
(iv) Any other such details/documents as may be reasonably specified by the Engineer In Charge-in-Charge from time to time during execution of the contract.
(v) Certificates, as prescribed, regarding payment of Sales Tax, duties etc. legible on supplies made.
(vi) Other documents required by the Engineer In Charge-in-charge.

8 Payment Terms

9.1 Breakup of Payment for construction of SR

1	After excavation, laying PCC and casting of foundation tank staging upto GL	20%
2	After completion of first half staging	10%

	After completion of second half staging including bracing below the ring beam.	10%
3	After completion of bottom dome with ring beam, cone wall and balcony	25%
4	After completion of vertical wall and inside column if any.	10%
5	After completion of top dome, ventilator, stair case and fixing of pipes complete.	10%
6	After fixing of CI fittings, lightening conductor railing painting and miscellaneous works, and satisfactory testing as per standards	15%

9.2 Breakup of payment for Supply laying jointing, installation and testing of uPVC pipe line and specials, installation of sluice valve, Air Valves and dismantling joints.

1	After Supply laying jointing, installation and testing of uPVC pipe line and specials, installation of sluice valve, Air Valves and dismantling joints.	As per boq condition

10. Refund of Performance Guarantee & Security Deposit

11. The contractor/firm or company while executing the above work will adopt all safety measures on his cost to safeguard from any loss of life & damage of public & private property. if any loss & damage occurred then they will pay the full compensation from their own pocket. all the consequence will be born by them & JDA will not be responsible in any way.

12. The contractor/firm or company will display necessary signboards & lights from safety point of view during nights at site of work on his own cost as directed by the authorized Engineer In Charge.

13. The contractor shall not work after the sunset & before sunrise without specific permission of the Engineer In Charge in-charge

14. Contractor shall provide sufficient number of boards at site of work indicating 'JDA AT WORK" at his own cost as required by Engineer In Charge-In Charge.

15. The contractor will pay compensation to the house owner or to the owner of any adjoining property or any other works for the damaged sustained on account of this work while in progress or complete from his own pocket.

16. The prices shall be fixed & firm. No price escalation shall be admissible.

1. Contractor shall get the material inspected from the third party (CEIL, SGS, RITES) before bringing the material at site. The inspection charges shall be born by the contractor. No payment of these items shall be made before the third party inspection.

2. In case of pipe line testing shall be done as per the relevant Codal and the leakage level shall not be more than as per IS 8329.

3. The JDA shall be free to carry out the work from any participating agency on the rate of lowest bidder during the concurrency of rate contract.

4. The contractor shall submit the proof of ownership of suitable machinery for laying of pipeline in all type of strata.

5. The quantity of work can be increased or decreased. However, no guarantee is given about the actual quantity of work.

6. No extra payment shall be made to the contractor on account of excavation in collapsible strata or in hard or rocky strata. The tenderers shall have to make their own arrangement for completing the work and no claim in this respect will entertained.

7. On collection of complete material for each section the same shall be got checked by Engineer–in–Charge or his authorized representative. Such approval shall in no way release the contractor of his responsibility regarding completion of work, as per required specification until the contract is complete.

8. The electric connection, if required, for construction and testing purpose shall be arranged by the contractor at his own cost.

9. The contractor shall make his own arrangement regarding water required for the execution and testing of the work and shall also arrange for the supply of drinking water to his own employees. He shall defray all charges in this connection and should include in his rates a sufficient amount to cover such charges. All such facilities as are required now to be provided for the labour, made under labour welfare rules inforce, shall also be provided by the contractor at his own cost.

10. The contractor will be required to see that the usual hours of work are adhered too. No work shall be done after the sun set without the permission of the engineer-in-charge.

11. The security deposit of the work shall be refundable after six months from the date of completion of the work only after successful testing of the works.

12. The contractor/firm or company while executing the work will adopt all safety measures at his cost to safeguard from any loss of life and damage of public and private property. If any loss and damage is occurred, they will pay the full compensation from their own pocket to the concern. All the consequence (legal and or financial) will be born by the contractor only and JDA will not be responsible in any way.

13. Water for construction / testing purpose shall have to arranged by contractor at his own cost. If water is supplied by the department, the same shall be recovered from the contractor from each running bill at the rate of 1% of total value of pipe line laying work, In case of metered connection the charges shall be recovered on the actual consumption basis on the commercial rates.

14. The contractor shall be fully responsible for structural safety and water tightness of pipeline when tested.

15. No secured advance against material procured at site will be allowed.

16. Pipeline laying should be done in the presence an Engineer not below the rank of Junior Engineer of the JDA, and trench shall be refilled after checking of sector engineer. After taking layout, the contractor shall submit day to day schedule of work to the Engineer–in- charge in advance.

18. **The contractor/firm or company will take utmost care to safeguard the water mains, Electric and Telephone cable existing surface drains water connections etc., while executing the work. Any damages/rectification shall be born by the contractor only**

19. **The contractor shall, at his own cost, arrange to provide, erect and maintain necessary display boards/ flags/banners etc. at selection points of project site giving such information as considered necessary for public awareness/ information/ safety as directed by the Engineer-in-charge.**

20. Contractor shall provide sufficient number of boards at site of work indicating "JDA AT WORK" at his own cost as required by Engineer-in-charge.

21. The surplus earth and damaged materials will be immediately removed from the site of work and dumped as per instruction of Engineer-in-charge

22. The material collected at site and paid provisionally shall remain under the watch and ward of the contractor till it is consumed fully on the work.

23. Any material not conforming to the specifications collected at site shall have to be removed by the contractor within a period of 3 days of the instructions, issued by the Engineer-in-charge, failing which, such material shall be removed by the Engineer-in-charge at risk and the contractor after expiry of 3 days period.

24. The contractor/firm/company is bound to get the workmen insured against accident from the Insurance Company at his own cost.

25. Contractor shall be the sole custodian of the men and material at work and will be fully responsible for any loss of life or otherwise occurred during the execution of the works.

26. **The submission of the as-built drawings of the water line work is the precondition for the final payment. The final drawings shall be submitted in one reproducible set and 3 copies on linen bound in an album of an approved size. The contractor shall submit all the completion drawings and approved design calculations on CD ROM / DVD in two copies with proper directory structure. The scale of drawing and the size of drawing shall be as per the direction of the Engineer in Charge.**

27. **If there is any typographical error or otherwise in the 'G' Schedule. The nomenclature and the rates as given in the relevant BSR-2012 and JDA approved items/rates on which schedule 'G' is based, shall prevail.**

The above conditions may be read very carefully and adhered strictly.

I/we confirm above

Signature of contractor **Executive Engineer (PHE-I)**

JDA, Jaipur

(A) Specifications of SR

1. 0 Location and site Condition

As per scope of work

2.0 Scope / Volume of work for Contractor

Job Work for ESR

The work consists of construction of RCC Elevated Service reservoirs as follows:

S. No.	Particular	No.	Capacity
1	Elevated Service Reservoir of 20 m staging at Smriti Van	1	500 kL

The present contract is on Lump Sump. basis, where the responsibility of the contractor will include preparation, execution and testing of all works as per General arrangement drawings attached and specifications.

The work will include: -

To carry out survey using level instruments to find out average ground of site. The bench mark location and it's value are available with the Engineer in Charge. Ground level of ESR is 354 m & 365.50 m for Zone 3&4 respectively. Reconnaissance and investigation of site is necessary. Detailed soil investigation at the location of tank at site for confirming the safe bearing capacity of soil indicated by JDA so that the contractor is equally responsible for the value adopted in the design.

Preparation and submission of detailed drawing and design of ESR of required particulars. The ESR shall be of intze type shape, supporting on raft foundation. This shall not include the design of pipes, valves, lightening arrester, conductor, earthing system, which shall be as stipulated in the tender document. The shape of ESR piping arrangements and other functional features shall be as per the drawings enclosed with the document.

The structural design and reinforcement design shall be prepared assuming SBC of the site as 8.0 T/Sqm. at 3.0 meter depth in case of ESR. If the SBC is found to be less than 8.0T/sqmat 3.0 meter depth then the structure shall be design on the basis of actual SBC found on testing for which no extra payment will be made to the contractor.
All the surfaces of the structure below ground level shall be painted with 2 coats of ISI make bituminous paint.
Supply and fixing of all ancillary material as stipulated including inlet, outlet, washout, over flow pipe, sluice valves, non-return valves, duck foot bends, other specials, level indicator, lighting arrester, conductor and Earthing, manholes, ventilators, railing, ladders, etc.
Construction plinth protection works, overflow pipe chambers, fixing of manhole covers, stair case railings etc. as stipulated and detailed in the set of drawings attached with the document.

The testing of tanks for water tightness by filling with water shall be the contractor's responsibility and shall have to be done in accordance with procedure laid down in the tender document.
The entire structure along with all it's installation shall being finished condition when handed over. All the exposed concrete surfaces should be finished with carborandum stone rubbing.
Painting of the slogan on vertical wall of Tank as indicated by the Engineer In Charge.
Providing ancient Jaipur State Architectural effects on the outside of the container with nice finishing along with water proof paint (Snowcem) of approved shade on complete structure on all exposed surface after smoothing the surface with carborandum stone rubbing.
Before handing over the work the site has to be cleared in every respect. The earth has to be leveled at a uniform level and surplus earth, if any, shall be disposed off as per the direction of the engineer in charge.
The contractor has to submit 2 sets of as built drawings in bounded form.

No separate payments shall be made for reconnaissance, preliminary investigations, surveys, inspections, plinth protection, site clearance, earth works, leveling etc. They shall be included in the L. S. rates.

The contractor shall be fully responsible for the soundness of the construction, structural safety and water tightness of the structure based on the specifications, Sound engineering practices and latest IS provisions. The contractor shall also ensure at his level correctness of design and drawing of ESR and CWR for structural safety.

3. 0 Job Work for ESR

The shape and scope of work is given in the General Arrangement drawing. The main scope of work is given below-

a. Construction of ESR as per Detailed General Arrangement Drawing.

b. Interconnection of inlet and outlet pipes as shown in the General Arrangement Drawing.
c. Installation of CI spun cast screw flanged outlet or distribution pipe as per IS:1536 specifications as shown in the GA drawing.

d. Connecting the overflow pipe up to the chamber shown in the Campus drawing.

Inlet pipe from the Pump House building to the SR.

4. 0 Particular Details of ESR

Particular Details of ESR is given in the table below

S. No.	Details of ESR	Particulars smirtivan
1.	Capacity in cum.	500 KL
2.	Staging in mtrs	20.0m
3.	Type of reservoir	Transmission
4.	CI spun cast screw flanged Inlet, out let (out let pipe .) and over flow pipe 150 mm and length in m (IS: 1536) up to plinth protection	As per scope
5.	CI spun cast screw flanged Washout pipe Size 150mm and length in m (IS: 1536)	-
6.	Free board in cms.	30
7.	Dead storage in cms.	15
8.	Minimum depth of foundation in meters	3.0
9.	CI D/F puddle collars 300 mm	-
10	CI D/F puddle collars 150 mm	3 nos.
11.	CI D/F Duck foot bends 300 mm	-
12.	CI D/F Duck foot bends 150 mm	3 nos
13.	Sluice Valve 300 mm	-
14.	Sluice Valve 150 mm	3nos.
15.	CI dismantling piece 300 mm	-
16.	CI dismantling piece 150 mm	3 nos.
17.	D/F Bend, tees & specials 150 mm to 300 mm for inter connection over flow ,out let & inlet pipes	As per required at site
18.	MS Specials	As per required at site

5.0 PREPARATORY WORK

The contractor shall provide and maintain a benchmark with a level at a location approved by the Engineer In Charge at ESR construction sites. All levels shall be deemed to refer to that benchmark. The Contractor may establish other secondary benchmarks on the site.

5.1 Soil Investigation

The contractor necessarily has to perform S.B.C. test at site for a permissible settlement of 25mm at the depth of 3.0 mtr for ESR. And accordingly design should be carried out. For estimation purpose SBC may be assumed as 8.0 T/sqm. He shall be solely responsible for the overall
safety of structure.

5.2 Location

The site for the tanks has been fixed. This may be seen to have a fair idea of the work site.

6 CIVIL WORKS

6.1 General

The construction of service reservoir shall be carried out in accordance with the drawings specification mentioned herein and relevant IS amended up to date. The general arrangement of the piping system shall be as per drawings enclosed with the tender documents. In cases where the specifications given below are silent about any aspects in respect of any item, the work shall be carried out as per the relevant IS code of practice in the latest version and as per sound engineering practice as decided by the Engineer in Charge.

Some of the important IS codes to be referred during execution of the work are as follows:

Earth work

- IS 3764 – Safety code for excavation works

- IS 3720 – Methods of tests for soils

Soil Investigation

- IS – 1888 – Load test on soil

IS – 2131 – Standard Penetration Test for soil method

Concrete Works & Reinforcement

- IS.280 – Mild steel wire for general engineering purposes

IS.1786 – High strength deformed bars and wires for concrete reinforcement

- IS.269 – Ordinary & low heat Portland cement
- IS.383 – Aggregate, coarse & fine, from natural sources for concrete
- IS.456 –plain and reinforced concrete, Code of practice
- IS.516 – Methods of testing for strength of concrete
- IS.1199 – Method of sampling and analysis of concrete
- IS.1566 – Fabric reinforcement
- IS. 3370 – Code of practice for concrete structures for the storage of liquids
- IS. 7861 – Recommended practice for hot weather concreting (Part-I)
- IS. 4082– Recommendation on stacking and storage of construction material on site.

General

- IS.875 - Code of practice for structural safety of buildings, loading standards
- IS.1911 – Dead loads
- IS.1893 – Criteria for earthquake resistant design and structures
- IS.2950 – Design & construction of raft foundation, code for practice (part-1)

IS-11089- Design & construction of ring foundation, code for practice

- IS.1200 – Method of measurements

6.2 Detailed design

- The detailed design, structural design and drawings (including reinforcement detailing and bar bending schedule) shall have to prepared taking provisions of dead load, water load, live load, seismic load, wind load, point loads due to pipes etc. and shall be checked for most critical condition resulting for various load combinations. The design shall be based on no crack basis for water retaining components.
- For the purpose if design safe bearing capacity of soil shall determine by SBC test at site or as directed by Engineer in Charge.

6.2.1 LOADS

Account shall be taken of all loads due to dead loads, live loads, wind loads, seismic loads, water pressure, soil pressure and point loads caused during installation of pipes etc.

The live load for top dome shall be taken as 1.50 KN/sqm. The platforms and stairs shall be designed for a live load of 3.00KN/sqm in addition to other loads.

Full water depth including free board and dead storage shall be considered for structural design of the tank.

The area is situated in seismic zone number II and the seismic load shall be taken accordingly.

The wind load shall be taken assuming a basic wind speed of 170 Km/h.

6.2.2 CONCRETE MIXES

Cement concrete (plain or reinforced) shall comply with the requirement of specifications of Rajasthan PWD (B&R) Specification and Explanatory Notes for Buildings and House Drainage except in so far as these are not altered or modified by specific stipulations as given in the specifications herein. The concrete grades to be used shall not be leaner than following:

- Water bearing structure i.e. container, beam platform in the M-30 reservoir and roof.

-	Other structural concrete	M25
-	Lean concrete in foundation	M15

6.2.3 CONCRETE COVER AND THICKNESS

The minimum clear cover of reinforcement bars shall be as following:

-	In case of dry surface (shaft, platforms)	25 mm
	In case of dry surface (foundation)	50 mm
-	In case of occasionally wetted surface (roof)	30 mm
-	In case of permanently wetted surfaces/walls and bottom of the water chamber, central access shaft, platform in the reservoir) reinforcement dia up to 20 m	35 mm
-	In case of permanently wetted surfaces/walls and bottom of the water chamber, central access shaft, platform in the reservoir) reinforcement dia above 20 mm	40 mm

The various dimensions shall not be less than the following

-	Thickness of top dome	125 mm
-	Thickness of bottom dome for ESR	150 mm
-	Thickness of platform, landings	150 mm
-	Thickness of Water retaining walls, slabs <2m	150 mm
-	Thickness of Water retaining walls, slabs >2m	200 mm
-	Thickness of Other structural walls (load bearing)	150 mm
-	Thickness of Non structural walls	150 mm
-	Free board depth for ESR	300 mm
-	Dead storage depth for ESR	150 mm
-	Thickness of lean concrete below foundation	150 mm
-	Depth of foundation for ESR	2.50 m
-	Age factor shall not be more than	1 (one)

6.2.4 GENERAL RCC

The aggregates and cement shall be proportioned by weight only. The mixing shall invariably be carried out in mechanical mixer and in such a way so as to avoid any loss of water or cement. No hand mixed concrete will be allowed. It should be conveyed, placed in position and compacted by suitable type of mechanical vibrator as rapidly as practicable but in no case the time of compaction after mixing shall increase 30 minutes. Standby Concrete Mixer and Vibrator shall be available at Site.

The concrete shall be cured properly by keeping it moist constantly until end of three weeks from the date of casting.

Ordinary Portland Cement (OPC) conforming to IS: 269-1976 mark shall only be used. Cement manufactured in mini-cement plants shall not be used.

All reinforcement used shall be of Tor steel (Fe 415) ISI marked shall be clean and free from loose mill scales, rust and coating of oil or other coatings which may destroy or reduce bond. Minimum size of reinforcement bars shall be of 8mm. Only steel shuttering shall be used. Shuttering shall be new or in good condition without holes or dents. It has to be approved by the Engineer in Charge. The individual elements should be in the good shape to ensure a gap free shuttering according to the drawings. The paint used shall have good bonding and shall not stick to the concrete surface. Suitable system have to be provided for keeping the surface in place and keeping the correct distance in case of walls. The construction joints should be minimum and they have to be executed with most care. Before continuing concreting the loose material has to be removed and they have to be cleaned properly. Honey combing has to be avoided by suitable shuttering and proper use of vibrators.

The water used for concreting shall be free from all undesirable salts and other impurities and shall be fit for concreting as per IS : 456.

It is specifically being mentioned that the ground water available in this area may not be potable and not fit for concreting, therefore transportation from nearby safe water source has to be made. For the purpose of concreting and curing only potable water is to be used. For this purpose contractor shall make a temporary masonry/RCC underground water reservoir of 3 days

average water consumption storage capacity. He shall provide a diesel pump set and necessary piping arrangement to ensure proper curing.

The exposed surface of concrete shall be kept continuously in a wet condition by ponding or covering with a layer of sackings, canvas, hessain or similar materials and kept continuously wet for at least 21 days from the date of placing of concrete.

To obtain a dense concrete and to reduce chances of honeycombing adequate admixture approved by Engineer In Charge shall be used as integral water proofing compound in concrete work. The quantity of the admixture shall be as prescribed by the manufacturer and as approved by the Engineer in Charge.

6.3 Testing

Materials and workmanship shall comply with the relevant specifications as described in subsequent clauses and in the Rajasthan PWD(B&R) Specification and Explanatory Notes for Building and House Drainage. Any material or workmanship not covered by the above specifications shall comply with the relevant Indian Standard (with up to date amendments).

6.3.1 MATERIAL

The Contractor shall submit to the Engineer In Charge or his representative, samples of the materials which will form part of the permanent works, sufficiently in advance of the start of the work, so that necessary tests can be carried out for the approval of the Engineer In Charge or his representative, before using any such material on site. Samples for the basic materials shall be submitted from every supplier and from each consignment; if materials differ from one consignment to another, the consignment differing from the accepted sample shall be replaced by the Contractor free of cost. The format will be provided by Engineer In Charge.

The testing of materials to be used in the Works, or of the quality of finished items shall generally be done in a laboratory approved by the Engineer In Charge or his representative. All testing charges shall be borne by the Contractor. The following tests shall be carried on a routine basis:

Gradation and specific gravity of coarse and fine aggregate to be used for concrete work.

Moisture content in fine and course aggregates, bulking of sand of fine aggregate.

Determination of fines and deleterious materials, organic impurities and light weight places in course and fine aggregate.

Workability tests on concrete by means of slump cone.

Determination of the crushing strength, absorption and efflorescence of bricks.

Concrete cube crushing strength at 7 days and 28 days.

Determination of flakiness index and crushing value for coarse aggregates.

The above tests (a) to (g) inclusive, shall be done on a routine basis as per the provisions of the relevant Indian Standards, or as specified by PMC and explanatory notes shall be kept during the construction period. The following additional tests of materials and workmanship shall also be carried out at contractor's cost, if the Engineer In Charge or his representative require:-

Chemical tests of fine and coarse aggregates, to determine the sulphate, chlorides and other deleterious material present in the aggregate.

Testing of cement (Physical and Chemical), as per IS 269 or IS 485, as the case may be.

Tests on steel (High Tensile (Tor) as per IS 1786 to establish the Ultimate tensile strength, yield stress, percentage elongation and chemical composition.

Tests for suitability of water for concrete work.

In addition to the above tests, the Engineer In Charge or his representative, may request any other test to be carried out from time to time as per the Indian Standards or the Rajasthan PWD specification, at contractor's cost.

6.3.2 **CONCRETE**

During the progress of construction sampling, preparation of test specimens, curing and testing of concrete shall be conducted in accordance with IS :1199 and IS : 516, to determine whether the concrete being produced complies with the strength requirements as specified.

At least one slump test shall be carried out for every compressive strength test carried out, or as directed by the Engineer in Charge. Six No.15 cm cubes shall be made for each cubic meter or portion thereof or for each pour per grade of concrete. This number may be increased at the discretion of the Engineer In Charge. Six specimens shall preferably be prepared from different batches, three being tested after 7 days and the remaining three being tested at 28 days. The Contractor shall provide, at his own expense, all apparatus, labour and arrange for testing at a

laboratory, approved by the Engineer in Charge.

The concrete tested in accordance with "Testing of Concrete" clause above, shall me the criteria for acceptance of concrete as per IS 456. The strength of concrete shall be the average strength of three specimens tested at 28 days and conform to strength requirements for different grades of concrete. If the advance 7 days tests show crushing strengths that are too low, corrective measures shall be taken at once, at the Engineer's direction, without waiting for the results of the 28 days tests.

6.3.2.1 **Failure to meet Strength Requirements**

In cases where concrete tested fails to meet the test requirements, the Engineer In Charge shall have the right to require any one or all the following additional tests. These shall be carried out by contractor at his own expense. The Engineer In Charge shall be the finally authority for interpreting the results and shall decide upon the acceptance or otherwise.

Curing and load testing of the concrete member concerned represented by the test which failed.

Replacement of any such portions of the structure. No payment shall be made for the dismantling of the concrete, relevant form work, or reinforcement. Embedded fixtures and reinforcement of adjoining structures damaged during dismantling shall be made good by the contractor at his own expense.

Extended curing of the structure of the concrete represented by the specimen.

Collecting and testing of a core specimen from the hardened concrete. The location number and size of such specimen shall be taken as directed by the Engineer In Charge.

Any Other tests i.e. ultrasonic/ or rebound hammer tests to be decided by the Engineer In Charge, at the contractors own cost.

6.3.2.2 **Check of Reinforcement and Concreting**

All reinforcement shall be got checked recorded prior to pouring of concrete, by a representative of the Engineer In Charge. Similarly, the entire concrete pouring work shall be done in the presence of an officer not below the rank of Site Engineer. The contractor shall therefore, give a notice of a minimum three days to the Engineer In Charge or his representatives, such that the work can be checked by him or his representative . No work shall be covered before inspection and approval of Engineer In Charge.

6.3.2.3 **Final Finishing**

The contractor shall ensure that the entire structure along with all its installations are in a finished and in new and fully operative condition when handed over. He shall have repaired and remove all signs of damage that might have been done during the course of installation and fixing of equipment. He shall also see that all the exterior finished properly and the entire site is cleared all extra construction material, debris and excavated soil. This shall have to be done to the satisfaction of Engineer In Charge.

6.4 **All flanged Specials**

The cast iron flanged specials (all flanged tee, flanged tapers, bends, blank flanges. Puddle collar) shall conform to IS 1538.

The specials shall be internally and externally coated with hot applied (dip) bituminous paint.

All flanged specials shall be used for nominal pressure of 25 kg/cm2 (2.5 Mps).

Flanged specials shall be supplied with the galvanized bolts, nuts and rubber gaskets. The galvanized nut & bolts shall be supplied in jute bag; rubber gasket shall be supplied in polyethylene bags. The rubber gaskets shall conform to IS 5382.

The length and size of the puddle collars to be fixed at different places of the structures shall be decided by the Engineer in Charge.

6.5 **Puddle Collar**

All puddle collars shall be of C.I. The length and size of the puddle collars shall be as shown in drawings.

6.6 **Ladder**

M. S. ladder 450 mm wide, made up of 50mm x 50mm x 6 mm M. S. angle iron and 25mm M. S. bars welded at 300mm c/c shall be provided outside from the balcony to top dome. MS cage shall also be provided on this ladder as shown in drawing. The ladder from top dome to inside platform and from platform to button dome in the container shall be of aluminum. Its drawing shall be got approved from EIC before dispatch.

6.7 **Railing**

Hand railing around the platforms, Balcony, stairs and landings shall be consisting of 25mm diameter medium B class GI pipes in two rows (one at the top and other at middle level) and 1000mm high vertical post 65x65x6 mm angle iron @ 1500mm center to center (At least two vertical angles are to be provided wherever distance is less) with all accessories like elbows, tees etc. including welding, threading and embedding in cement concrete floor. Railing shall be protected against corrosion after welding. The pipe shall pass through hole in the vertical angle.

6.8 **Water level indicator**

The level will be transferred at suitable and visible place.

6.9 **Ventilator**

This shall be 300mm dia MS cowl, 300 mm high with mosquito proof jali of stainless steel as per drawing shall be fixed at the top Alternatively a CI ventilator may be provided.

6.10 **Lightening arrester**

Lighting arrester shall be of copper bar of 25mm dia and 2m. long to be provided at the top of ESR. This is to be connected by a GI strip of 25 mm wide & 3mm thick. This conductor strip shall be connected to a 450mm x 450mm x 450mm x 3mm thick copper plate to be embedded below the average ground level y digging a pit as shown in drawing. The Earthing system shall comply with Indian Electricity Rules and shall confirm to IS 3043. The pit shall be refilled by alternate layers of salt and coke as shown in the drawing and balance shall be filled with loose soil. The 40 mm dia GI watering pipe shall be provided in the pit. Care shall be taken that earth pit does not sink.

6.11 **Painting**

If not otherwise stated metallic surfaces shall receive one initial coat at the manufacturer's workshop. Alter arrival of the equipment on site, the same shall be inspected and damaged portions shall be cleaned and given the primer and under coat of similar paint. After erection all metal work shall be painted as follows:

Painting of metallic surfaces

All mild steel railing, gate, frame, MS ladders, ventilator, manholes, cover, float valve.	Primer of red oxide, two under coats and one finishing coat of an approved enamel paint and of approved shades.

6.12 **Plinth Protection**

Plinth protection works are to be constructed below the Elevated Service Reservoir, it shall be extended up to 1m from fall of balcony or edge of raft slab, whichever is more all around service reservoir. It shall consist of laying lean concrete 150 mm thick in M10 with CC 1:2:4 60 mm thick flooring over compacted soil. Sectional details shall be as indicated in the drawing including included with the document.

The minimum free space between plinth protection and the first bracing of the ESR shall be 1.60 mtr.

6.13 **Dismantling joints**

All valves shall be installed between flanges with a flexible cast iron dismantling joint at one side of the valve. The joint must allow the dismantling without stress to the joints of the attached pipes, the minimum clearance of the dismantling joint shall be 5 Cms. Drawing of the dismantling joint shall be submitted to the Engineer In Charge for approval.

6.14 **Water bars (for SR)**

PVC water stop of 320 mm. Wide will be fixed between foundation of wall and base slab. pvc water stop of 230 mm wide will be fixed between foundation of columns and base slab & all radial joints and in construction joints of vertical wall as per IS 3370 Part-I1965 Clause 8.5.2.

6.16 **Slogan and logo**

The contractor shall paint a area of 6m x 3m on the vertical wall of the tank portion by using 3 coats of plastic emulsion paint of shade as approved by Engineer In Charge to form a base for writing the slogan and logo of "JAL BHI SEEMIT PARIWAR BHI SEEMIT" in Hindi. For writing the slogan the letters shall be of 30 cm size. The size of logo shall be 75 cm. The shade for painting the slogan will be approved and directed by Engineer in Charge.

6.17 **Pipe Clamp**

The clamp shall be 10 mm thick 55mm wide MS flat fixed on pipe & column as shown in drawing.

6.18 **Man Hole Cover**

Square man hole cover 800x800 mm shall be provided. The cover shall be made of 3 mm thick MS flat. The frame shall be made of MS angle 80*80*4. The cover shall be connected to this frame by using two nos. strung hinges. Arrangement shall be provided as shown in drawings.

7. **Testing for water tightness**

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. All cost of testing shall be born by the contractor. This test shall be carried out in accordance with the procedure given below:

For water tightness test, before the filling operations are started, the reservoirs shall be jointly inspected by the Engineer In Charge and the representative of the Contractor and condition of surfaces of wall, construction joints etc. shall be inspected and noted and it shall be ensured that jointing material filled in the joints is in position and all openings are closed. The contractor shall make necessary arrangement for ventilation and lighting of reservoir by way of floodlights, circulators etc. for carrying out proper inspection of surface and internal conditions if so desired by the Engineer in Charge.

The water retaining structures shall be filled with water gradually at the rate not exceeding 30 cm. Rise in water level per hour and shall extend for a period of 72 hours. Records of leakages starting at different level of water in the reservoirs, if any, shall be kept.

The reservoirs once filled shall be allowed to remain filled for a period of 7 days before any readings or drop in water level is recorded again at 7 days. The total drop in surface level over a period of 7 days shall be taken as indication of the water tightness of the reservoir, which for all practical purposes shall not exceed 40mm. There shall be no indication of leakages around the puddle collars or on the wall and bottom of the reservoir.

If the structure does not satisfy the test requirements, and the daily drop in water level is decreasing, the period of test may be extended for a further seven days and if the specified limit is not exceeded, the structure may be considered as satisfactory.

In case the drop in water level exceed the permissible limit 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 In Charge to reduce the leakage in the permissible limit. The entire rectification work that shall be carried out in this connection shall be at Contractor’s cost.

If the test results are unsatisfactory, the Contractor shall ascertain the cause and make all necessary repairs and repeat the water retaining structure 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.

Executive Engineer (PHE-1)
JDA,Jaipur

APPENDIX-I

TERMS OF PAYMENTS FOR CIVIL WORKS

"Tender for Design, Construction, Erection, Commissioning, Trial Run of 1 MLD STP at Smriti Van (Jhalana), on Turnkey basis based on SBR technology with PLC, SCADA Systems, Allied works, and O & M for 3 years at Jaipur City".

Payment of civil structure work shall be paid in the following manner according to the LS price quoted in price schedule I

A. For Civil Structures

SR NO	DESCRIPTION	PERCENTAGE %
(1)	**SEWAGE COLLECTION SUMP , PH & SCREENS (Item No. 1)**	
1	On completion of Excavation, P.C.C., bottom raft	30
2	On completion of 50 % walls	25
3	On completion of 100 % walls	25
4	On completion of finishing items	15
5	After satisfactory hydraulic testing with all remaining works	5
(2)	**INLET CHAMBER,SCREEN CHANNEL,GRIT CHANNEL (Item No. 2)**	
1	On completion of Excavation, P.C.C, Footing/column	25
2	On completion of Slab	15
3	On completion of 50 % walls	25
4	On completion of 100 % walls	25
5	On completion of finishing items, hydraulic testing, with all remaining works	10
(3)	**SBR-REACTOR (Item No. 3)**	
1	On completion of Excavation, P.C.C., bottom raft	30
2	On completion of 50 % walls	25
3	On completion of 100 % walls	25
4	On completion of misc. item/finishing	10
5	After satisfactory hydraulic testing with all remaining works	10
(4)	**BUILDING WORKS (Item No. 5, 6, 9, 10)**	

SR NO	DESCRIPTION	PERCENTAGE %
1	On completion of Excavation, P.C.C., bottom raft	30
2	On completion of walls	20
3	On completion of slab	20
4	On completion of finishing items	20
5	After final completion with all remaining works	10

(5)	**CHLORINATION TANK, TREATED WATER STORAGE TANK, SLUDGE SUMP (Item No. 4, 11, 8)**	
1	On completion of Excavation, P.C.C., bottom raft	25
2	On completion of walls	30
3	On completion of slab, column & beam	35
4	On completion of finishing items, hydraulic testing with all remaining works	10

(6)	**OHSR (Item No. 12)**	
1	After excavation, laying PCC and casting of foundation tank staging upto GL	20
2	After completion of first half staging	10
3	After completion of second half staging including bracing below the ring beam.	10
4	After completion of bottom dome with ring beam, cone wall and balcony	25
5	After completion of vertical wall and inside column if any.	10
6	After completion of top dome, ventilator, stair case and fixing of pipes complete.	10
7	After fixing of CI fittings, lightening conductor railing painting and miscellaneous works, and satisfactory testing as per standards	15

B. Mile Stone Payment Breakup for Piping, Mechanical, & Electrical & Instrumentation works along with spares as specified

No.	Items	Percentage %
1.	On supply of equipment, pipes, specials, valves, accessories, instruments etc. including spares at site, after inspection, along	75%

	with literature, drawings, operating pamphlets, manual etc. as required.	
2.	On erection of all equipment, pipes, specials, valves, instruments and necessary accessories including installation of mechanical / electrical / system / equipment, cabling, etc. complete.	15%
3.	On testing, commissioning and satisfactory trial runs	5%
4.	After satisfactory running of entire plants for 1 months after item no.3 above.	5%
	Total	100%

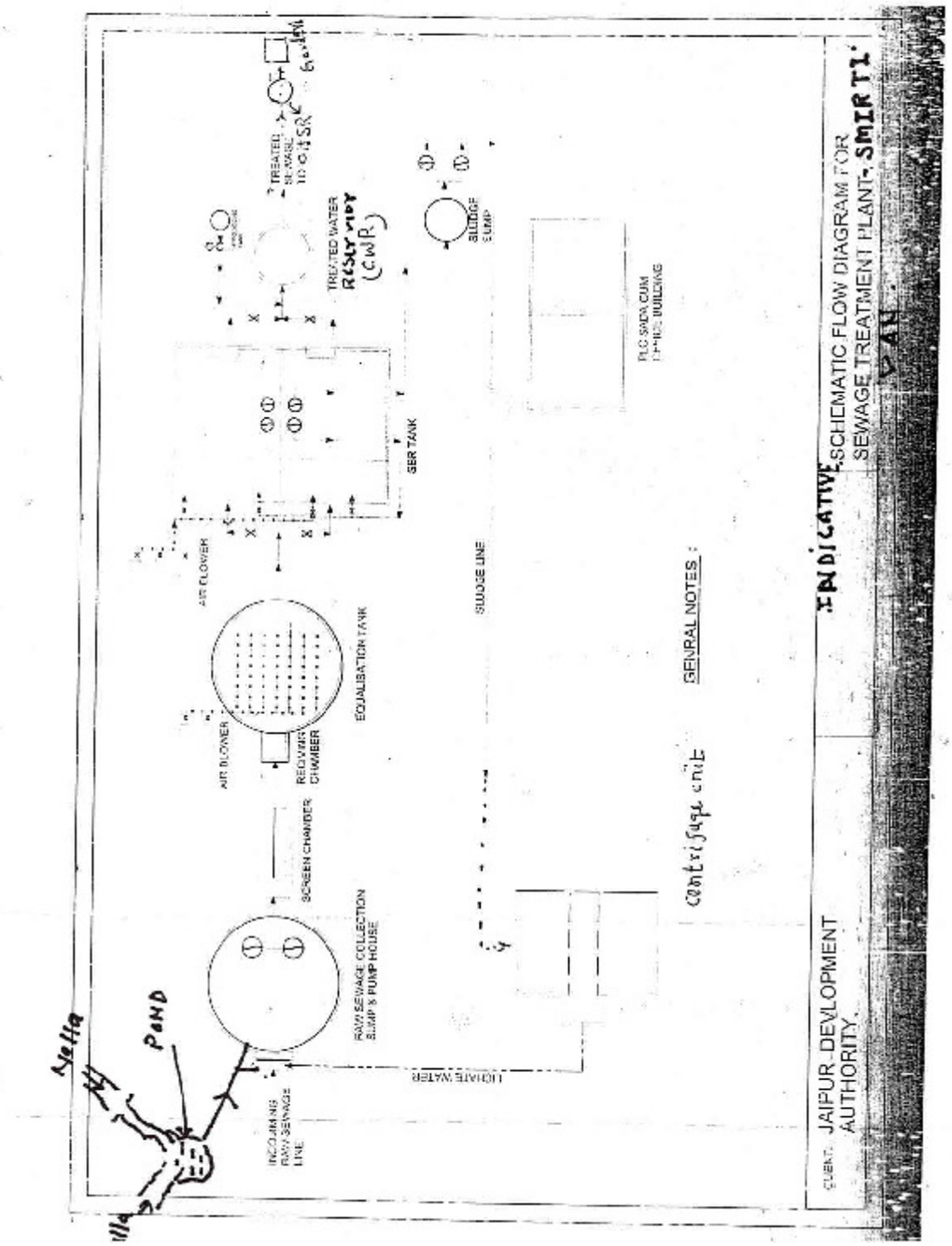
Signature of Bidder :

Name :

Company's Seal :

Date :

DRAWINGS


SCHEMATIC FLOW DIAGRAM FOR
SEWAGE TREATMENT PLANT- SMRITI VAN
CLIENT: JAIPUR DEVLOPMENT AUTHORITY.
GENRAL NOTES :
TREATED WATER RESERVOIR (GWR)
TREATED SEWAGE TO GHSK
SLUDGE PUMP
SLUDGE LINE
SBR TANK
AIR BLOWER
EQUALISATION TANK
RECYCLE CHAMBER
SCREEN CHAMBER
RAW SEWAGE COLLECTION SUMP & PUMP HOUSE
INCOMING RAW SEWAGE LINE
Centrifuge unit
Nalla
POND