

SECTION 1

STP TECHNICAL SPECIFICATIONS

SPECIAL CONDITIONS

1. GENERAL:

These special conditions are intended to amplify the General Conditions of Contract and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply.

2. SCOPE OF WORK:

The general character and the scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative. The contractor shall furnish all labour, materials, and equipment (except those to be supplied by the owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete Sewage Treatment Plant as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances, and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The Sewage Treatment Plant shall comprise of following:

- 2.1 Bar Screen Chamber (Civil by Client)
- 2.2 Collection cum Equalization Tank (Civil by Client)
- 2.3 Air Root Blower
- 2.4 Raw Sewage Transfer Pumps
- 2.5 Air Diffuser
- 2.6 Bio Reactor Tank (Civil by Client)
- 2.7 Bio Reactor Media
- 2.8 Tube Settling Tank (Civil by Client)
- 2.9 Tube Settler Media
- 2.10 Raw Activated Sludge Transfer Pump
- 2.11 Chlorine Contact Tank (Civil by Client)
- 2.12 Chlorine Dosing System
- 2.13 Filter Feed Pump
- 2.14 Pressure Sand Filter
- 2.15 Activated Carbon Filter
- 2.16 Treated Water Storage Tank (Civil by Client)
- 2.17 Sludge Digester Tank (Civil by Client)
- 2.18 Other Miscellaneous Items (Pipes, Valve, Support etc.)

2.19 Approval from Local Authorities

2.20 Balancing, testing & commissioning of the entire STP.

2.21 Test reports (During commissioning and for 3 months (every 15 days) after commissioning), list of recommended spares, as-installed drawings, operation & maintenance manual for the entire STP contract.

2.22 Training of Owner's staff.

3. ASSOCIATED CIVIL WORKS:

Following civil works associated with Sewage Treatment Plant are excluded from the scope of this contract. These shall be executed by other agencies in accordance with approved shop drawings of and under direct supervision of the Sewage Treatment Plant contractor.

3.1 Water proofing of floors.

3.2 Civil works for construction of various compartments of STP.

4. ASSOCIATED SERVICES WORKS:

4.1 All associated ELECTRICAL WORKS listed below are excluded from the scope of this contract. These shall be installed by other agencies in accordance with approved shop drawings of, and under direct supervision of the Sewage Treatment Plant tenderer.

i. Providing power supply with earthing at the incoming of control panel in plant room.

5. PROJECT EXECUTION AND MANAGEMENT:

The Contractor shall ensure that senior planning and erection personnel from his organisation are assigned exclusively for this project. They shall have minimum 7 years experience in this type of installation.

The Contractor shall arrange to have mechanised & modern facilities of transporting material to place of installation for speedy execution of work.

6. PERFORMANCE GUARANTEE:

The contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.

The contractor shall guarantee that the Sewage Treatment Plant as installed shall maintain the design conditions as described under "Basis of Design" and relevant clauses in the specifications. The guarantee shall be submitted in the proforma given in Appendix- II.

Complete set of architectural drawings is available in the Architect/Consultant's office and reference may be made to same for any details or information.

7. BYE-LAWS AND REGULATIONS:

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or

workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

8. FEES AND PERMITS:

The contractor shall obtain all permits/ licenses and pay for any and all fees required for the inspection, approval and commissioning of their installation.

9. DRAWINGS:

The Sewage Treatment Plant Drawings listed under Appendix-I, which may be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of drainage piping etc.

The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Architect/Consultant/Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, landscape, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

10. TECHNICAL DATA:

Each tenderer shall submit alongwith his tender, the technical data for all items listed in Appendix-IV in the indicated format. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.

11. SHOP DRAWINGS:

- 11.1 All the shop drawings shall be prepared on computer through Autocad System based on Architectural Drawings, site measurements and Interior Designer's Drawings. Within Three weeks of the award of the contract, contractor shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, Pump room, Typical drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations. These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/Owner's site representative.

These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the

details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 8 sets of drawings shall be submitted after final approval along with CD.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer from the manufacturers listed in Appendix-III and quoted by the tenderer in technical data.

When the Architect/Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated alongwith check prints, for approval. The contractor shall submit further ten sets of shop drawings to the Owner's site representative for the exclusive use by the Owner's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.

- 11.2 Shop drawings shall be submitted for approval two weeks in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.
- 11.3 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labelled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.
- 11.4 Samples of all materials like valves, pipes, control wires etc shall be submitted to the Owner's site representative prior to procurement. These will be submitted in two sets for approval and retention by Owner's site representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.
- 11.5 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supercede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.
- 11.6 Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect/Consultant/ Owner's site representative. Any delay on such account shall be at the cost of and consequence of the Contractor.
- 11.7 Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's site representative, the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

12. APPROVAL:

Within three weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.

13. QUIET OPERATION AND VIBRATION ISOLATION:

The installation shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Owner's site representative.

14. ACCESSIBILITY:

The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his piping and other ancillaries. His failure to communicate insufficiency of any of the above, shall constitute his acceptance of sufficiency of the same. The Contractor shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed, valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense. Access panel shall be 50mm enclature for each piece of equipment / device / accessory and shall be clearly 50mm enclature / marked.

15. MATERIALS AND EQUIPMENT:

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be in conformity with list of approved manufacturers as per Appendix - III.

16. MANUFACTURERS INSTRUCTIONS:

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

17. COMPLETION CERTIFICATE:

On completion of the Electrical installation for STP works, a certificate shall be furnished by the contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The contractor shall be responsible for getting the entire electrical installation for Sewage Treatment Plant duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

18. BALANCING, TESTING AND COMMISSIONING:

Balancing of all water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and Manual on Sewage & Sewage Treatment – Published by CPHEEO Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner's site representative. All tests shall be carried out in the presence of the representatives of the Architect/Consultant and Owner's site representative.

19. COMPLETION DRAWINGS:

Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of two sets of CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate complete plant room layouts, piping layouts, location of wiring and sequencing of automatic controls, location of all concealed piping, valves, controls, wiring and other services. Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The contractor shall frame under glass, in the plant room, one set of these consolidated control and P & I diagrams.

20. OPERATING INSTRUCTION & MAINTENANCE MANUAL:

Upon completion and commissioning of part Sewage Treatment Plant the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner's site representative and two for Owners Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, regular cleaning schedule for all grease traps, spare parts manual and recommended spares for 4-year period of maintenance of each equipment.

21. ON SITE TRAINING:

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed.

22. MAINTENANCE DURING DEFECTS LIABILITY PERIOD:

22.1 Complaints:

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

22.2 Repairs:

All equipment that require repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free- of-charge to the Owner.

23. UPTIME GUARANTEE:

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month

for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all pressures, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, the proposed general arrangement drawing of the plant, a detailed operation assistance proposal for the Owner's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

24. OPERATION AND MAINTENANCE:

Contractor may be required to carry out the operation of the STP installation for the defects liability period. Further, he may also be required to carry out operation and all inclusive maintenance of the entire system for a period of three years beyond the defects liability period.

24.1 Operation contract (STP):

- a. 24 hours a day, year round.
- b. All stand-by equipment to be operated as per mutually agreed programme.
- c. Proper entry and upkeep of relevant log books.
- d. Maintain complaints register. Submit weekly report.
- e. Proper housekeeping of all areas under the contract.
- f. Prepare daily consumption report and summary of operation.

24.2 Terms of payment:

- a. Monthly at the end of each month on pro-rata basis.

24.3 All Inclusive Maintenance Contract:

- a. Routine Preventive Maintenance Schedule to be submitted:
 - i. Schedule to cover manufacturer's recommendation and/or common engineering practice
 - iii. Monthly status report.
- b. Uptime during maintenance contract:
 - i. 98% uptime of all systems under contract.
 - ii. Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.
 - iii. There shall be no reimbursement for the extended period.

- iv. Break-downs shall be attended to within ten hours of reporting.
- v. Spare compressor/motor assembly to be made available within seven calendar days in case of total breakdown/burnout.
- c. Manpower:
 - i. Adequate number of persons to the satisfaction of the Owner's site representative shall be provided including relievers.
 - ii. Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.
 - iii. Duty allocation and Roaster control shall be contractor's responsibility.
 - iv. No overtime shall be payable by Owner for any reason whatsoever.
- d. Shut Downs:
 - i. Routine shut downs shall be permitted only during summer season.
 - ii. Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.
- e. Payment Terms:
 - i. Quarterly payment at the beginning of each quarter on pro-rata basis.

25. PARTIAL ORDERING:

Owner through the Architect/Consultant/ Owner's site representative reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderers.

APPENDIX-I

LIST OF STANDARDS AND CODES

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices given below as amended upto March, 2020. All equipment and material being supplied by the contractor shall meet the requirements of IS, Pollution Control Board, electrical inspectorate and Indian Electricity rules and other Codes / Publications as given below:

1. General

Manual on Sewage by CPHEEO; Govt. of India. Sewage Treatment

IS CODE	SUBJECT
IS: 269	Specifications for 33 grade Ordinary Portland Cement
IS: 456	Code of practice for Plain & Reinforced concrete.
IS: 458	Specifications for Concrete Pipes.
IS: 694	PVC insulated cables for working voltages upto & including 1100 V.
IS: 778	Specification for copper alloy gate, globe and check valves for water works purposes.
IS: 783	Code of practice for laying concrete pipes.
IS: 784	Pre-stressed concrete pipes.
IS: 800	Code of practice for general construction in steel
IS: 1200	Method of measurements for laying of water and sewer lines including appurtenant items.
IS: 1239	Specifications for Mild steel tubes
IS: 1239	Specifications for Mild steel Tubular & other wrought steel pipe fittings
IS: 1726	Cast iron manhole covers and Frames.
IS: 1742	Code of practice for building drainage
IS: 1978	Specification for line pipe (M S Seamless)
IS: 1979	Specification for high test line pipe
IS: 2470	Code of practice for installation of septic tanks
IS: 2470	Design criteria & construction of Secondary Treatment & Disposal of septic tank effluent
IS: 2951	Recommendation for estimate of flow of liquids in closed conduits.
IS: 3589	Specifications for steel pipes for water & sewage (168.3 to 2540 mm outside dia.)
IS: 3597	Method of test for concrete pipes.
IS: 4111 (Pt. I to V)	Code of practice for ancillary structures in sewage system.
IS: 4733	Methods of sampling & test for sewage effluents
IS: 5455	Cast iron steps for manholes
IS: 5600	Specifications for Sewage and drainage pumps
IS: 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
IS: 6279	Equipment for grit removal
IS: 6280	Sewage screens
IS: 8413 (Pt. I)	Requirements for biological treatment equipment
IS: 11149	Specifications for Rubber Gasket
IS: 13095	Butterfly valves for general purposes.

TECHNICAL SPECIFICATIONS

1.1 SEWAGE TREATMENT PLANT

1.1.1 SCOPE (Item Description)

1.1.1.1 The scope shall cover design, manufacture, supply, installation, testing & commissioning of an aerobic Sewage Treatment Plant with all civil & structural work, electro-mechanical equipments, piping & valves, gauges & meters & necessary electrification of the plant.

1.1.1.2 The contractor may propose alternatives to this type of system, but these must be to a standard acceptable to water and sanitation authority requirement, local pollution control board norms, World Health Organization guide lines, the local environmental and pollution control authorities and subject to the approval of Client/ PMC.

1.1.1.3 The work shall be carried out in a manner consistent with good practice in the local market. The Contractor shall take into account all site conditions in designing the system and selecting the equipment.

1.1.1.4 The attached specification is for FMR (Fluidized Aerobic Media Reactor) type. However, the bidder /contractor shall offer other technology also. The Contractor shall be responsible for engaging a STP specialist to perform the system design and obtain approval from relevant Authorities. A qualified and experienced Engineer shall be engaged for the system design, preparation of system proposal submission, obtaining approval and site supervision.

1.1.1.5 The Contractor shall perform the system design based on the criteria/ data and component technical requirements specified in this section/ drawings and the local Authorities' regulation/ requirement.

1.1.1.6 The Contractor shall furnish system which comprises products of manufacturers who have designed and made these associated products for a period of at least five years.

1.1.1.7 The Contractor shall submit complete catalogue information, design calculation and samples complete with full technical data and shop drawings for the entire system, test certificates, etc. for acceptance prior to commencement of installation.

1.1.1.8 The Contractor shall submit analytical test reports of effluent water samples after the commissioning or after the system is put into operation or as required by Client/ PMC.

1.1.1.9 The report shall contain analysis of all data related to those requirements laid down by the local Authorities.

1.1.2 DESIGN CRITERIA

1.1.2.1 Estimated daily flow 250 m³ / day for the podium building.

1.1.2.2 Estimated daily flow 190 m³ / day for the girl's hostel building.

1.1.2.3 Discharge period 20 hrs / day

1.1.2.4 Average flow 12.5 m³ / hr for the podium building

1.1.2.5 Average flow 9.5 m³ / hr for the girl's hostel building

1.1.2.6 Peak flow 37.5 m³ / hr for the podium building

1.1.2.7 Peak flow 28.5 m³ / hr for the girl's hostel building

1.1.2.8 Raw sewage will be disposed & collected into collection tank & then disposed to centralized Sewage Treatment Plant. The Collection chamber shall also be under the scope of contractor. The sewage will contain only residential wastewater i.e. grey water from Kitchen/ bath/ wash basins only.

1.1.2.9 It shall be the Contractor's responsibility to ensure the quality of the treated effluent to comply with the local Authorities requirement and the following characteristics, whichever is stringent.

SR	ITEM OF ANALYSIS	UNIT IN mg/liter or As per GPCB Standards
1	pH value	6 – 7.5
2	BOD (5 day at 20°C)	< 5
3	COD	< 50
4	Total Suspended Solids	< 20
5	Grease and Oil	< 10

1.1.2.10 The treated waste water/ effluent from the Sewage Treatment Plant shall be used for flushing & irrigation. The treated waste water tank will also be under contractor's scope.

1.1.2.11 The contractor shall check space availability at site (shown the location), invert level of last manhole chamber/ chambers & site soil condition to design the sewage treatment plant.

1.1.3 PROCESS FLOW

The Treatment shall comprise the following flow of process:

1.1.3.1 Screening.

1.1.3.2 Oil & Grease removal.

1.1.3.3 Equalization with air mixing.

1.1.3.4 Diffused aeration along with settling.

1.1.3.5 Chlorination.

1.1.3.6 Tertiary Treatment and UV Sterilization.

1.1.3.7 Sludge dewatering by Filter Press.

1.1.3.8 Sludge cake disposal.

1.1.4 PROCESS DESCRIPTION

1.1.4.1 The Contractor shall design & install the Sewage Treatment Plant so that it will accommodate in allocated space.

1.1.4.1.1 BAR SCREEN CHAMBER

Screens in the form of perforated stainless steel plates/ PP-FRP/ PVC-FRP with 20 mm diameter openings shall be installed at inlet end of receiving sump to retain extraneous materials such as plastic bags, waste paper etc. from entering the receiving sump.

1.1.4.1.2 SEWAGE COLLECTION/ EQUALISATION TANK WITH AERATION

Usually, sewage generation is more during morning hours & evening hours & no sewage or very less sewage is generated during night hours. Any biological system needs constant feed for bacteria to work efficiently. Hence, collection cum equalization tank is proposed to collect excess flow during peak hours & feed sewage in lean hours.

The tank will collect sewage generated from the proposed building and pump the same at a uniform rate to the subsequent treatment units. The provision of air grid is to be made for thoroughly mixing of sewage to make it homogeneous quality & to keep the suspended matter in suspension to avoid septic condition. The air will be supplied by twin lobe air blowers.

1.1.4.1.3 MBBR TANK WITH AERATION

The wastewater enters from the top of the reactor and comes in contact to the microorganisms attached to the Bio Pac Media. This phase of the treatment process utilizes the principal of microbial degradation of pollutants in the presence of oxygen. The MBBR system is an attached growth aeration process that uses a neutrally buoyant plastic media to optimize biomass growth and protection within a bed. The MBBR process employs a

submerged Bio Pac Media onto which microorganisms attach. The Bio Pac Media has a very high surface to volume ratio, allowing for a high concentration of biological growth to thrive within the protected areas of the media. As the media supports a biomass concentration several times that achievable in activated sludge systems, treatment is significantly more productive. The biomass retained on the ring media provides effective treatment for the wastewater. The Bio Pac media are kept in motion by coarse bubble aerators. Apart from oxygenation air introduced into the reactor is sufficient to ensure thorough mixing and turnover of the media within the reactor. The air from the aerator periodically strips of most of the accumulated biomass. This makes it possible to control the Bio Film thickness and age distribution, and prevent the development of anaerobic conditions. The frequency of air shearing is optimized so that the microbes remain in a high growth phase, but they still form a fully developed food chain, in which larger organisms consume smaller ones. The result is more BOD conversion to water and CO₂ and less to biomass, so sludge production is minimized. The need to periodically waste sludge and the requirement to supply a dilute return activated sludge to maintain an appropriate food to microorganisms (F/M) ratio is eliminated. Once acclimated the Bio Film is highly resistant to shock caused by abrupt changes in BOD loading or exposure to toxins. The MBBR process has been shown to be effective in a range of operational conditions including carbonaceous, nitrification and combined carbonaceous & nitrification removal. High loading rates can be applied for carbonaceous removal.

The effluent will be aerated with fine bubble air diffusers. These diffusers will be provided to mix the contents of aeration tank as well as to diffuse air in it. The dissolved organic matter will be subjected to biological degradation by bacterial action in presence of oxygen & nutrients. This will convert dissolved organic matter into stable settleable matter.

The bacterial concentration (MLSS) of 3000mg/l and dissolved oxygen of 2.0mg/l will be maintained in the aeration tank.

1.1.4.1.4 TUBE SETTLER TANK

After oxidation, the bacteria will grow & need to be separated out from aeration tank liquor. For the same lamella plates are to be provided which will help in clarification & separation of bacteria (sludge) & clear overflow will flow into chlorine tank.

1.1.4.1.5 CHLORINE CONTACT TANK

In chlorine contact tank, sodium hypo chlorite is added for pre disinfection of the clarified sewage.

1.1.4.1.6 SECONDARY SETTLING TANK

The biological sludge developed in the aeration tank shall be settled in a treated water tank/ secondary settling tank. The sludge accumulating in the central sludge pit is transferred to the Sludge Holding Tank by means of sludge pumps. The bottom slope for the setting tank shall be 1:12.

1.1.4.1.6 DUAL MEDIA FILTER

The treated effluent from the treated sewage collection/ secondary settling tank shall be pumped to dual media filter for removal of solid particles.

1.1.4.1.7 CARBON FILTER

The outflow of Dual Media Filter will further be treated through Activated carbon filter to remove odor & taste.

1.1.4.1.8 SLUDGE HOLDING TANK

Adequate size sludge holding tank shall be proposed. Two nos. of horizontal non-clog centrifugal pumps set shall be installed adjacent to settling tank to pump the sludge to Sludge holding tank & to recirculation the sludge to aeration tank to maintain the MLSS ratio. The pump will be coupled to a motor of suitable capacity. The motor shall be with IP55 winding and class B insulation. The pumps shall be mounted horizontally. The delivery shall be provided with valves to regulate the flow in the aeration tank.

1.1.4.1.9 FILTER PRESS

The sludge from the sludge holding tank shall be dewatered in the filter press. Available sludge cake shall be disposed manually & can be used as manure.

1.1.4.1.10 FINAL TREATED SEWAGE COLLECTION TANK

The treated sewage after post chlorination will be stored into final treated sewage collection tank. The final treated water can be further pumped for recycling for domestic use like gardening, flushing, car washing, etc. Collection tank of at least 2/3 day storage is to be considered. The recycling pump for flushing application will be supplied by Client/ owner. High flow UV sterilizers are to be installed for disinfection before Treated waste water will be entered into collection (Flushing) tank.

1.1.5 EQUIPMENT

Following are the major equipments for Sewage Treatment Plant:

All equipment and components of the system shall be of top quality construction and shall be corrosion resistant.

1.1.5.1 COARSE SCREENING EQUIPMENT

Bar screen shall be of 304 stainless steel/ FRP construction. Drip trays shall be provided for holding and drainage of the screenings. An isolation valve shall be provided to divert the flow to the bypass screen when the screen requires service.

1.1.5.2 AIR BLOWERS

Suitable rating Rotary twin lobe, air cooled air blowers (1working + 1stand by) shall be provided for equalization & diffused aeration process. The blower shall be complete with all accessories such as safety valves, suction filters, v- belts, v- belt guard, driving and driven pulley, base frame, discharge silencer, anti vibration pad, foundation bolts and set of tools coupled to TEFC, 1500 RPM motor of suitable capacity. The motor shall have IP55 enclosure and class B insulation. The blower shall be provided with acoustic enclosure to keep noise level within 70 db.

The size and performance of the air blower shall be so selected that it can generate sufficient air flow rate to maintain a minimum of 2.0mg/liter dissolved oxygen in the aeration tanks in operation.

1.1.5.3 AIR DIFFUSERS

Air diffusers shall be made to provide a uniform distribution of fine bubble air release performance in the system. The air diffuser shall be either made of elastomeric rubber membrane or composed of crystalline fused aluminium oxide with a suitable ceramic bonding material or as per manufacturer's standard.

Diffuser shall be of self-cleaning, non-clog disc or dome-shaped type.

The Contractor shall submit calculation to justify the diffuser selection and air requirement during the detailed design.

1.1.5.4 EQUALIZATION TANK

The equalization tank shall be designed to provide a minimum storage of 2 hours at peak flow while pumping. Two submersible pumps shall be provided with level switch control and automatic cut-in of the standby unit.

An aeration system similar to the extended aeration tank shall be provided for mixing and aerating the sewage.

1.1.5.5 SEWAGE PUMP

Working and standby sewage pumps shall be provided.

Each shall be of submersible type with lift chain and auto coupling connection. Pump casing and impeller shall be of cast iron material. Shaft shall be of stainless steel material. All pumps shall have non clog impeller & shall be capable of handling solid particles 10 mm minimum.

1.1.5.6 FINAL SETTLING TANK

Settling tanks shall include tube settler or equivalent arrangement.

Sludge withdrawal shall be by means of submersible sludge pump.

1.1.5.7 TERTIARY TREATMENT

This tertiary treatment shall be provided for the effluent used for irrigation, and flushing system.

The tertiary treatment plant shall comprise of the pressure sand filters and activated carbon filters. This shall be sized to accommodate 100% of the effluent discharge flow rate and shall achieve the performance as outlined and described in Design Criteria.

1.1.5.8 DISINFECTION

High Flow U.V. Sterilizers shall be installed in the outlet of pumps for water being discharged to building OHT for flushing use.

1.1.5.9 ELECTRICAL CONTROL

The operation of the treatment process shall be provided with all electrical accessories like starters, cabling, earthing, protections, etc.

A completely assembled and prewired control panel with mimic diagram consisting of weatherproof cabinet shall be furnished. The control panel shall contain all metering and status indicators, motor starters, on-off-auto change-over switches and duty selectors for equipment.

Proper control sequence shall be designed according to system requirement and manufacturer standards.

1.1.5.10 MISCELLANEOUS EQUIPMENT

Miscellaneous accessories, such as buffer, riser, scum removal devices, partition, control panel, collection devices, etc. for all the tanks and pumps (where necessary) shall be provided in order to provide a fully working systems.

1.1.5.11 PIPING

Piping for air submerged in the tank: SS
Piping for air over the tank: MS Class B epoxy painted
All other Influent/ Effluent Pipe: PVC

All piping shall be provided with necessary supports/ anchors/ thrust blocks in case of over ground piping & required bedding, pedestal, etc. for below ground piping as per local soil condition.

1.1.5.12 VALVES

The scope shall include all isolating valves and control valves as required for the proper and efficient operation and maintenance of the entire treatment plant.

All valves supplied shall be suitable for PN 1.0 rating.
All valves shall be full line size.

Each valve shall have a purpose made reference number plate for label engraved or stamped indicating the manufacturer's catalogue number, pressure and temperature ratings. Valves shall be arranged so that clockwise rotation of the spindle will close the valve.

Where possible locate all valves at convenient positions of operation from the floor with valve stems upright.

All valves above 40 mm shall be flanged.

1.1.5.13 INSTRUMENTS

The plant shall be provided with required pressure gauges, flow measurement & level controller devices, etc. complete. It shall also include all the metering devices, etc. as required. Wetted parts shall be of SS & hardware in contact with fluid shall also be of SS.

1.1.6 MATERIAL

1.1.6.1 All materials incorporated in the Works shall be the most suitable for the duty concerned and shall be new and of reputed make/ approved quality, free from imperfections and selected for long life and minimum maintenance. Nondestructive tests, if called for in the specification, shall be carried out.

1.1.6.2 All submerged moving parts of the Plant, or shafts, spindles, etc. of the submerged moving parts 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.

1.1.7 WORKMANSHIP

1.1.7.1 Workmanship and general finish shall be of first class quality and in accordance with best workshop practice.

1.1.7.2 All similar items of the Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall fit all

similar items. Machining fits on renewable parts shall be accurate and to specified tolerances so that replacements made to may be readily installed.

- 1.1.7.3 All equipment shall operate without excessive vibration and with minimum noise. All revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds at any load up to the maximum there shall be no vibration due to lack of balance.
- 1.1.7.4 All parts which can be worn or damaged by dust shall be totally enclosed in dust proof housings.
- 1.1.7.5 All materials incorporated in the work shall be most suitable for duty concerned, free from imperfections, selected for long life and minimum maintenance.
- 1.1.7.6 All necessary accessories required for satisfactory and safe operation of the Plant shall be supplied by the Contractor unless it is specifically excluded from his scope.
- 1.1.7.7 All valves shall be closing on clockwise rotation of the hand wheel. The effort required to close/ open under all operating conditions shall be limited to 7 kg. The direction of opening/ closing shall be cast on the hand wheel.
- 1.1.7.8 All flanges shall be drilled in accordance with requirements of IS: 1538.
- 1.1.7.9 All flanges shall be full or spot faces on the back side. The flange thickness shall be uniform throughout.
- 1.1.7.10 Flange outside periphery shall be concentric with the bore. Flanges shall be finished smooth on periphery also.
- 1.1.7.11 Castings and fabricated materials shall be finished smooth all over.

1.1.8 DESIGN LIFE

- 1.1.8.1 The works as a whole shall be new, of sound workmanship, robustly designed for a long reliable operating life and shall be capable of 24 hours per day continuous operation for prolonged period in the climatic and working conditions are prevailing the site, and with the minimum of maintenance. Particular attention shall be given to temperature changes, the stability of paint finish for high temperatures, the rating of engines, electrical machinery, thermal overload services, cooling systems and the choice of lubricants for possible high and prolonged operating temperatures. The Contractor shall be called upon to demonstrate this for a component part either by service records, or evidence of similar equipment already installed elsewhere or relevant type tests. Routine maintenance and repair shall as far as possible not require the services of highly skilled personnel.
- 1.1.8.2 The Plant 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. No parts in the contact with water shall have a life from new to replacement or repair of less than five years. Where major dismantling is unavoidable to replace a part, the life of such part shall not be less than ten years.
- 1.1.8.3 Design features shall include the protection of Plant against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Plant shall operate without undue vibration, and parts shall be designed to withstand the maximum stresses under the most severe condition 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 Works.

1.1.8.4 Plant located outside lockable areas/buildings shall have additional features to prevent unauthorized operation.

1.1.9 LUBRICATION

1.1.9.1 A complete schedule of recommended oils and other lubricants shall be furnished by the Contractor. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the Engineer's Representative for approval before incorporation in the Instruction Manuals. In the case of grease lubricated roller type bearings, a lithium base grease is preferred.

1.1.9.2 Contractors shall indicate indigenously available equivalent lubricants, with complete duty specification, to enable the Corporation to arrange for regular supply.

1.1.9.3 Where lubrication is affected by means of grease, preference shall be given to a pressure system which does not require frequent adjustment or recharging. Frequent, for this purpose, means more than once in a month and grease systems having shorter periods between greasing should be avoided. Where necessary for accessibility grease nipples shall be placed at the end of the extension piping, and when a number of such points can be grouped conveniently, the nipples shall be brought to a battery plate mounted in a convenient position. All grease nipples shall be of the same size and type for every part of the Plant. Arrangements shall be provided to prevent bearings being overfilled with either grease or oil.

1.1.9.4 When more than one special grease is required, a grease gun for each special type shall be supplied and permanently labeled.

1.1.9.5 Oil containers shall be supplied complete with oil level indicators of the sight glass type, or where this is not practicable, with dipsticks. The indicators shall show the level at all temperatures likely to be experienced in service. The levels shall be clearly visible in the sight glass type from the normal access floor to the particular item of Plant and they shall be easily dismantled for cleaning. All sight glasses shall be firmly held and enclosed in metal protection in such manner that they cannot be accidentally dislodged.

1.1.9.6 All lubrication systems shall be designed so as not to cause a fire or pollution hazard and particular care shall be taken to prevent leakage of lubricants and to avoid leaking lubricants coming in to contact with any electrical equipment, heated surfaces or any other potential source of fire.

1.1.9.7 The Contractor shall supply flushing oil for each lubrication system when an item of Plant is ready for preliminary running and a sufficient quantity of the approved lubricants for the commercial operation of the Plant for two years after the Taking-over Certificate has been issued.

1.1.10 NAME PLATES

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

1.1.10.2 Details of proposed inscriptions shall be submitted to the Engineer's Representative for approval before any labels are manufactured. Such nameplates, rating plates and

designations shall be of stainless steel with engraved or stamped lettering. Items such as valves shall have direction of rotation for closing and opening indicated.

- 1.1.10.3 Nameplates, rating plates and labels shall be of a non-flame propagating materials, non-hygroscopic or transparent plastic with engraved lettering of a contrasting color. Fixing shall be by means of non-corrosive screws; drive rivets or adhesives shall not be used.
- 1.1.10.4 Warning labels shall be provided where necessary to warn of dangerous circumstances or substances. Inscriptions or graphic symbols shall be black on a yellow background and to internationally recognized standards.
- 1.1.10.5 Instruction labels shall be provided where safety procedures such as wearing of protective clothing are essential to protect personnel from hazardous or potentially hazardous conditions. These labels shall have inscriptions or graphic symbols in white on a blue background.
- 1.1.11 NUTS, BOLTS, STUDS AND WASHERS
 - 1.1.11.1 Nuts, Bolts, Studs and Washers for incorporation in the Plant shall conform to the requirements of the appropriate standard. Nuts and bolts shall be of the best quality of specified grade, machined on the shank and under the head and nut. Bolts shall be of one piece construction and shall be of sufficient length so that only one thread shall show through the nut in the fully tightened condition.
 - 1.1.11.2 Fitted bolts shall be a light driving fit in the reamed holes they occupy, shall have the screwed portion of such a diameter that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at site.
 - 1.1.11.3 Washers, locking devices and anti-vibration arrangements shall be provided where necessary and shall be subject to the approval of the Engineer's Representative. Jointing hardware for the entire Plant shall be provided with sufficient spares to cater for site losses.
 - 1.1.11.4 Where bolts pass through structural members taper washers shall be fitted, where necessary, to ensure that no bending stress is caused in the bolt. Where there is a risk of corrosion, bolts, nuts and studs shall be designed so that the maximum stress does not exceed half the yield stress of the material under any conditions. All bolts, nuts and washers which are subject to frequent adjustment or removal in the course of maintenance and repair shall be made of nickel bearing stainless steel.
 - 1.1.11.5 The Contractor shall supply all holding down, alignment and leveling bolts complete with anchorages, nuts, washers and packing required to attach the Plant to its foundations, and all bed plates, frames and other structural parts necessary to spread the loads transmitted by the Plant to concrete foundations without exceeding the design stresses.
- 1.1.12 ALLOWANCE FOR WASTAGE
 - 1.1.12.1 The Contractor shall supply to the satisfaction of the Engineer's Representative reasonable excess quantities to cover wastage of those consumables which will be normally subject to waste during erection, commissioning and setting to work.
- 1.1.13 PAINTING – GENERAL
 - 1.1.13.1 The Contractor shall be responsible for the cleaning, preparation for painting, and priming or otherwise protecting, as specified, all parts of the Plant at the place of manufacture prior to packing.

1.1.13.2 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 test, all surfaces shall be thoroughly cleaned and dried out if necessary by washing with an approved dewatering fluid prior to surface treatment. Except where the specification provides to the contrary all painting materials shall be applied in strict accordance with the paint manufacturer's instructions. All protective coatings shall be suitable for use in warm humid climates.

1.1.14 PAINTING AT PLACE OF MANUFACTURE

1.1.14.1 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.

1.1.14.2 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 are to be provided with adequate number coats of coal tar epoxy polyamine coating to a dry film thickness of 175 microns including primer coating.

1.1.15 GALVANISING

1.1.15.1 Wherever galvanizing has been specified the hot dip process shall be used. 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		
	Thickness less than 2 mm but not less than 1.2 mm	:	340 Gms/sqm
	Thickness 2 mm and above	:	460 Gms/sq.m
b)	Fasteners		
	Up to nominal size M10	:	270 Gms/sq.m
	Over M10	:	300 Gms/sq.m

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

1.1.16 PAINTING AT SITE

1.1.16.1 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, and any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.

1.1.16.2 Steel and cast iron parts received at site shall be provided with adequate number of further coats of coal tar epoxy polyamine coating to a total dry film thickness of 275 microns including the primer coats. All sharp edges, nuts, bolts and other items difficult to be painted shall receive a brush coat of specified paint before application of each coat of epoxy-based coal tar paint giving a total dry film thickness of at least 275 microns. In the case of fabricated steel work this work shall be done after assembly.

- 1.1.16.3 Before painting is commenced the Contractor shall submit for the approval of the Engineer's Representative, full details of the paints he proposes to use together with color charts for the gloss finishes.
- 1.1.16.4 All paint and coating thickness shall be measured by approved Elcometer or coating thickness gauge.
- 1.1.17 ERECTION
- 1.1.17.1 The contractor's staff shall include at least one competent erection engineer with proven suitable, previous experience on similar contract to supervise the erection of the works and sufficient skilled, semiskilled and unskilled labour to ensure completion of the works in time. The contractor shall not remove any representative, erector or skilled labour from the site without the prior approval of the engineer's representative.
- 1.1.17.2 One erection engineer who shall be deemed to be the contractor's representative shall be conversant with the erection and commissioning of the complete works. Should there be more than one erector, one shall be in charge and the contractor shall inform the engineer's representative in writing which erector is designated as his representative and is in charge. Erection engineer is to report to Project Manager.
- 1.1.17.3 The contractor's erection staff shall arrive on the site on date to be agreed by the engineer's representative before they proceed to the site, however, the contractor shall first satisfy himself, as necessary, that sufficient plant of his (or his sub contractor's) supply has arrived on site so that there will be no delay on this account.
- 1.1.17.4 The contractor shall be responsible for setting up and erecting the plant to the line and levels of reference given by the engineer in writing, and for the correctness (subject as above mentioned) of the positions, levels dimensions and alignment of all parts of the works and for provision of all necessary instruments, appliances and labour in connection therewith. The checking of setting out of any line or level by the engineer or engineer's representative shall not in any way relieve the contractor of his responsibility for the correctness thereof.
- 1.1.17.5 Erection of plant shall be phased in such a manner so as to obstruct the work being done by other contractors or operating staff who may be present at the time. Before commencing any erection work, the contractor shall check the dimensions of structures where the various items of plant are to be installed and shall bring any deviations from the required positions, lines or dimensions to the notice of the engineer. Plant shall be erected in a neat and workman like manner on the foundations and at the locations shown on the approved drawings. Unless otherwise directed by the engineer, the contractor shall adhere strictly to the aforesaid approved drawings. If any damage is caused by the contractor during the course of erection to new or existing plant or buildings or any part thereof, the contractor shall, at no additional cost to the employer, make good, repair or replace the damage, promptly and effectively as directed by the engineer and to the engineer's satisfaction.
- 1.1.17.6 During erection of the plant the engineer will inspect the installation from time to time in the presence of the contractor's site representative to establish conformity with the requirements of the specification. Any deviations and deficiencies found or evidence of unsatisfactory workmanship shall be corrected as instructed by the engineer.
- 1.1.17.7 The machinery shall be accurately installed to correct dimensions, alignments, levels, etc., all as indicated as per manufacturer's instructions & shop drawings available. The machinery shall be mounted on flat steel packing pieces of thickness suitable to

take up variations in level of the concrete foundations. Suitable packing pieces shall be located adjacent to each holding down bolt and shall be properly bedded by grinding the concrete surface to a smooth, level finish. The machinery shall be aligned and leveled and the nuts of the holding down bolts tightened with a spanner of normal length. The base plates shall be packed with grout after the machinery has been run and checked by the Project Manager for stability and vibration.

- 1.1.17.8 Installation shall include the provision and fixing of all necessary holding down bolts, washers, nuts etc.
 - 1.1.17.9 The length of all bolts shall be such that when fitted with a nut and tightened the threaded portion of the bolts shall protrude from the top face of the nut by a distance not exceeding half the bolt diameter. Exposed bolt heads and nuts shall be hexagonal.
 - 1.1.17.10 All equipment and materials of the same type shall be products of the same manufacturer. Locally made equipment will not be accepted unless otherwise specified.
 - 1.1.17.11 All similar items of plant and their component part shall be completely interchangeable. Spare parts shall be manufactured from materials similar to the originals and shall fit all similar items of plant. Where machining may be needed before fitting renewable parts, the machining fits with their tolerance shall be shown on the drawings accompanying the instruction manuals.
 - 1.1.17.12 All motors and/ or revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds and any load up to the maximum there shall be no significant vibration due to lack of balance. All parts which can be worn or damaged by dust shall be totally enclosed in dust-proof housings.
 - 1.1.17.13 Proper inspection platforms shall be provided with hand railing.
 - 1.1.18 TESTING
 - 1.1.18.1 The performance of the system shall be demonstrated by taking hourly samples of the raw sewage and final effluent over a twelve hour period. The sample shall be taken at periods approximately the flow rates specified by the plant. The sample shall be combined and a 5-day BOD shall be run, the results of which must verify the capacity of the treatment plant prior to acceptance.
 - 1.1.19 TRAINING
 - 1.1.19.1 The contractor shall provide proper training to employee's staff to have knowledge of the design, day-to-day operation, breakdown and routine maintenance, and fault diagnosis of all plant, equipment and systems.
 - 1.1.19.2 The Contractor shall be deemed to have included in his tender price the cost of providing training facilities as specified.
 - 1.1.19.3 In addition to the above, the Contractor shall submit to the Client a list describing such other spares and special tools, their number, price for two years of period from the date of successful commissioning.
 - 1.1.20 DOCUMENTS TO BE PROVIDED BY VENDOR
- The vendor shall furnish following documents with the offer.

- 1.1.20.1 Hydraulic Design.
- 1.1.20.2 Dimensional General Arrangement diagram.
- 1.1.20.3 Flow Diagram with Hydraulics.
- 1.1.20.4 Power – Installed & Operating.
- 1.1.20.5 Data sheet of mechanical equipments with Material of construction & make/model no.
- 1.1.20.6 The vendor may provide another technology with the reasons.
- 1.1.20.7 Vendor may quote for civil work i.e. construction of RCC tanks separately.
- 1.1.20.8 Catalogues & overall dimensional drawings of equipments, performance curves of pumps.
- 1.1.20.9 List of spare parts.
- 1.1.20.10 O & M Manual.