

**SECTION - 5**  
**TECHNICAL SPECIFICATION**

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**SECTION - 5**  
**EXTENT OF WORK (STP)**

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## **1. Scope of Work:**

- 1.1. The scope of Sewage Pumping Station and Sewage Treatment Plant(s) includes but not limited to detailed design including hydraulic, process, equipment design, and preparation of detailed layout working drawings for process layout plan, general arrangement drawings, civil, electrical, mechanical, instrumentation and structural drawings, electrical, mechanical, instrumentation system, automation diagrams, data sheets of equipments and cable schedules and detailed structural steel fabrication drawings, preparation of design report manufacture and testing at places of manufacture, painting, packing, transport, delivery, supply, storage, erection, building-in, setting work, commissioning, testing, painting, lining and finishing after erection of all plant required for the plant, including pipelines, pumps, pumping installations, machinery apparatus, flow meters at various installations, on line monitoring equipments for process parameters, whole plant SCADA based automation system, pipe work, lifting, handling and ventilation equipment, electrical equipment, instrumentation, control, lighting systems, earthing and lighting protection system, materials, articles, fittings and accessories, ancillaries, enabling works of all kind and nature required for installations of the highest possible operative standards and for compliance with the standards prescribed in the specification and with the particulars and guarantees furnished by the Contractor in the (hereinafter referred to as “the Works”), followed by operation and maintenance of the plant and constructed facilities (hereinafter referred to as “Operation and Maintenance”) following successful completion of the commissioning and issuance of the Taking-Over Certificate for the Works. It broadly comprises the following works:
  - 1.1.1. All preparatory work, including required topographical survey, clearing out trees, shrubs, debris, leveling and dressing of the site, excavation in wet saturated soil and disposal of surplus excavated earth within the site to the extent possible and proper disposal of the extra surplus excavated earth to a suitable location as decided by the Employer.
  - 1.1.2. Carrying out of necessary site surveys and soil investigations as deemed necessary by the Contractor for the purpose of designs/ drawings check and if the soil bearing capacity is less, then Contractor has to do soil treatment work on their own cost which will be subsequently approved by the Employer.
  - 1.1.3. Process and Hydraulic Design- Preparation of General Arrangement (GA) Drawings, Site Layout, Unit Process/ Equipment/ Facility/ Building layouts, Hydraulic Profile, Process Flow Diagram, Piping and Instrumentation Diagram (P&ID).
  - 1.1.4. Detailed Sizing, Design and Engineering of all treatment units, buildings, structures, and equipment (including all civil, mechanical, electrical, architectural, instrumentation, control, automation and SCADA components)
  - 1.1.5. The General arrangement drawing (GAD) should include all the units for the design requirement of capacity as mentioned in Tender documents as well as units for ultimate requirement. The placement/ layout of units should be clearly shown in the available land area.

- 1.1.6. Design and Construction of all Civil Structures and Building Works including Supply, Installation, Testing & Commissioning of all Civil, Mechanical, Electrical, Instrumentation & SCADA Works.
- 1.1.7. Submission of Detailed Engineering Designs, Drawings, Process & hydraulic Calculations, Mass Balance Calculations, and Data Sheets as per Tender requirements
- 1.1.8. Construction of Internal Plant Roads, Curbs, Pavements, Parking Spaces, Compound Wall, plant water supply and sewage disposal and Storm Water Drains.
- 1.1.9. Construction of compound wall all around the plot boundary and fixing of compound gates as the requirement and as per the approval of Employer or Employer's Representative and construction of bypass channel for excess sewage from inlet chamber to the ultimate disposal point of treated effluent or excess sewage.
- 1.1.10. Transportation and Disposal of Sludge
- 1.1.11. Plantation and Landscaping work
- 1.1.12. Receiving Raw Inlet Sewage at site and discharge of Plant Effluent to nearby water body as specified in Employer's requirements.
- 1.1.13. Design, construction, and commissioning of pipelines, conduits for the disposal of plant effluent from chlorine contact tank as per site condition to nearest receiving water body (up to the disposal point).
- 1.1.14. Plant, Testing, Commissioning, Stabilization, Demonstration of Performance Guarantee- This item shall include proper maintenance according to manufacturers' instructions of entire plant and its components during any inactive period that may be required if influent wastewater is not available at the time of works completion.
- 1.1.15. Submission of Commissioning Procedure
- 1.1.16. Submission of Operation and Maintenance Manuals - Operation & maintenance of entire system for required years including three years defect liability period of Plant(s) in this contract from the date of completion of the Works and successful passing test on completion as per the Conditions of Contract given in Volume-I of Tender document.
- 1.1.17. Construction and equipping of analytical laboratory for routine testing of raw and treated sewage quality on a day-to-day basis and control of process parameters; Instituting Quality Assurance and Quality Control procedures during construction and O& M period
- 1.1.18. Providing Training Services to Employer's Personnel
- 1.1.19. Preparation and Submission of As-Built drawings for all Civil, Mechanical, Electrical, Instrumentation and SCADA Works
- 1.1.20. Design, construction, installation, testing, commissioning, and training for any and all other equipment, systems, components, and/or services that might be necessary for a complete, fully functional facility in compliance with all requirements of these Tender

documents.

- 1.1.21. Supply, lowering, laying, jointing, testing & commissioning of necessary D. I. K-9 / HDPE grade rising main, as per site condition with instruction of Engineer-in-charge, including refilling, bedding, specials, valves, valve chamber, thrust blocks & crossings as per tender specifications.
- 1.1.22. Design, supply, lowering, laying, jointing, testing & commissioning of RCC NP3 Test Pressure, 0.7 Kg /Sq.m pipeline for effluent disposal, as per design, up to the disposal point as per site condition including refilling, encasing, provision of manholes at every 30m, bedding & crossings as per tender specifications. Also, Construction of an outfall structure bidders' scope.
- 1.1.23. Providing & Laying Incoming Raw Sewage Pipe Line from existing Chamber near STP plot to Inlet Chamber of SPS of suitable Diameter as per the design requirement as per site condition / bidder's layout and location /positioning of SPS in plot.
- 1.1.24. The Contractor shall design, engineer, procure, construct, and commission an interconnecting RCC bridge between the two designated plots across the Khari River. The bridge shall have a minimum clear width of 12 meters, suitable for vehicular movement and operational requirements. In addition to the roadway, the Contractor shall also provide for all necessary pipe crossings, including but not limited to process pipelines, utility lines, and service ducts, as per project requirements.
- 1.1.25. Power connection should be Min. 02 separate connection for different Final Plot per site requirement.
- 1.1.26. LV PCC / PMCC / MCC / APFC / AHF & etc. LV Switch board Panel (I/c Breaker rating less than 630A shall be fixed / draw out type & 630A & above rating shall be draw out type only) manufacturer shall be a Original Equipment Manufacturer (OEM) i.e. OEM means Switch gear manufacturer who has obtained type test certification complying with all 12 test as per IS/IEC 61439:2020 OR it's authorized franchisee / system integrator (having valid certificate being a franchisee / system integrator as on date) to design & manufacture LV Panel as per IS/IEC 61439 Part-0:2020, IS/IEC 61439 Part-1:2011 & IS/IEC 61439 Part-2:2020 or latest as prevailing at present & National Electrical Code of India (NEC) 2023 or latest as prevailing at present. Panel construction shall be complying to Form 3b type as per IS/IEC 61439. Only metallic sheet shall be used for compartment separations/partitions. Hylam/PVC sheets shall not be allowed & acceptable. LV Panel each feeder should have separate door for Operation control and maintenance.

LT panel shall be tested to withstand Internal arc fault Type Test Certificate have as per IEC:61641 with latest amendments, copy to be submitted.

LT panel shall also have test certificate for Seismic withstand capacity as per IS 1893 / IEC 60068-3 or other relevant standard, copy to be submitted.

LV PCC / PMCC / MCC / APFC / AHF & etc. LT Switch board Panel (I/c Breaker rating less than 630A shall be fixed / drawout type & 630A & above rating shall be drawout

type only) shall be OEM or it's Authorized System Integrator / Franchisee only.

Following documents / drawings shall be submitted by vendor duly signed & stamped by OEM recently as a minimum and forming part of LV Panel drawings, during detailed engineering: (1) General Technical Specifications (2) General Arrangement Drawing (GAD) (3) Single Line Diagram (SLD). (4) BOM.

Vendor shall require to submit Type Test certificate as per IS/ IEC:61439, IEC 61641 for all applicable incomer rating with Aluminium busbar only for offered panel (Documents shall be duly signed and stamped by the OEM latest date). along with panel drawings for review during detailed engineering. In case if type test certificate of any incomer rating offered is not available, the type test certificate for the next higher rating as available with vendor will be submitted and considered for incomer design. The Offered Panel General Arrangement (GA), busbar sizing, and switchgear selection must strictly adhere to the Type Tested design. The OEM shall bear full responsibility for this compliance.

- 1.1.27. The Contractor shall design, engineer, construct, supply, install, test, and commission an Equalization-cum-Neutralization Tank (EQ-N Tank) complete in all respects, including civil, mechanical, electrical, instrumentation, piping, and automation systems.
- 1.1.28. **Project Vehicle:** Two vehicle of latest make with A.C. (5/7-seater MUV/SUV) or its equivalent with a ceiling of total 2500 km. running of vehicle in a month shall be provided to the employee of AMC for site supervision of the work. The cost of running, maintenance, fuel, driver salary, insurance with sole responsibility etc. complete will be borne by the contractor. The vehicle shall be required in any area within Ahmedabad City limits / area and at site of STP Project for the use of Project Implementing Unit / Project Department. The vehicle shall run throughout the period of contract including Sundays & holidays. The vehicle must be handed over to AMC as soon as the work order is issued till the completion of the work. A penalty of Rs. 1,200/day shall be levied and deducted from RA Bill / Deposit of contractor for not providing vehicle as stipulated.
- 1.1.29. The Contractor shall design, submit, obtain approval, and construct the Administrative Building for the proposed STP in accordance with the requirements of Ahmedabad Municipal Corporation (AMC). The Contractor shall prepare and submit detailed architectural drawings, structural drawings, layout plans, and a 3D view of the proposed Administrative Building along with all relevant details for approval from AMC. The design shall comply with all applicable building by-laws, development control regulations, and statutory norms. All comments/observations raised by AMC shall be incorporated by the Contractor without any additional cost. No construction shall be commenced without obtaining prior written approval from AMC. The rates quoted shall be deemed to include all costs towards design, preparation of drawings and 3D views, submission, liaisoning, approval fees, and compliance with statutory requirements.
- 1.1.30. The Contractor shall design, supply, install, test, and commission suitable Odor Control Units (OCU) for areas including Sewage Pumping Station (SPS) (**i.e. Inlet unit, Screen Unit, Wet well**) and preliminary treatment units **of STP (i.e. Inlet unit, Screen**



**unit, Grit Chamber).** All such units shall be adequately covered/enclosed for effective odor capture. The odor control system shall be based on proven technologies and shall ensure that no odor nuisance is caused in the surrounding area.

1.1.31. The compound wall section shown in the drawing represent the typical section above the Finish Ground Level (FGL). Furthermore, from the existing ground level (EGL) up to the FGL any RCC retaining wall or wall on pile foundation/footing as required based on site condition shall be included in bidder's scope. Kindly note that compound wall at khari river side shall be constructed only over on RCC retaining wall.

1.1.32. **Doors, Windows & Ventilators:** Doors, Windows and Ventilators shall be of uPVC (Aluplast / Fenesta / Lingel or such reputed make as approved by Engineer-in-charge). Glass for windows, ventilators and door glazing shall be of toughened glass, min. 6mm thk. (except for the main door of administration / office building which shall have min. 10-12mm thk toughened glass). The outer windows shall be 3 tracks with 6mm Toughened and tinted glass, with one track for mosquito mesh in SS 304/316 grade. The Main entrance door of administrative building shall be double door or such suitable with 10-12 mm thick Toughened Glass along with aesthetically good and good quality accessories as approved by engineer-in-charge.

1.1.33. SS Railing should be provided in all units wherever required in the project. SS Railing (grade SS-304, Sch 10 or better) of 32 NB (horizontal rails) / 40 NB (vertical post) diameter hollow tubes, channels, plates etc. including welding, grinding, buffing, polishing & making urvature if required & fitting the same with necessary stainless steel nuts and bolts, fasteners etc. complete including fixing the railing with necessary accessories as per requirement. Painting is not required for SS hand rails. The handrail shall be 1m high with vertical post at about 1.5m C-C, with horizontal post at top and middle and provided with 100mm x min. 3mm thk toe guard (in SS-304) at bottom.

## **2. Location of the Sites**

2.1. The details of location of the Plant are provided in Annexure.

## **3. Design Life of Plant Component**

3.1. The Plant components shall be designed and constructed to provide the minimum service life listed below for each component.

Buried Piping	:	75 Years
Reinforced Concrete Structures	:	60 Years
Other Concrete Structures	:	50 Years
Steel Structures	:	50 Years
Mechanical Equipment	:	15 Years
Electrical Equipment	:	15 Years
Buried Earth Electrode System	:	40 Years

Control Panels	:	15 Years
Instrumentation Systems	:	15 Years
Computer Systems	:	10 Years

#### **4. Survey and Geotechnical Data**

- 4.1. Contractor has to carry out the topographical survey, geotechnical investigation, Survey of existing underground services (if any), Survey of existing structure (if any) to be modified or demolished and all other details necessary for proper formulation of his price proposal before submission of bid.
- 4.2. After award of contract, Contractor shall carry out independently fresh survey, geotechnical investigation, Survey of existing underground services (if any), Survey of existing structure (if any) to be modified or demolished and all other details including disposal location necessary for proper planning and detailed design.

#### **5. Site Conditions at Plant Locations**

- 5.1. The details of plant location are mentioned in the Tender Notice. The site details are tentative and for information purpose only.
- 5.2. For any further information the Contractor shall visit the site and ascertain the required details for bidding purpose as per Volume-I, Technical Bid, Clause No. 8

#### **6. Access for Other Contractors**

- 6.1. The Contractor shall allow reasonable access to other Contractors engaged on the Site or on areas adjoining the Site to carry out their works. In the event of a dispute over access or priority between Contractors, the Engineer shall be informed in writing. The Engineer shall inform all parties concerned in writing of his decision.
- 6.2. Where any part of the Works is associated with or in physical contact with plant supplied under a separate contract, the Contractor shall satisfy himself that the work carried out by the other Contractor is consistent with the correct operation of the Plant. In the event of the Contractor considering any work being carried out or any work already completed to be detrimental to the ultimate operation of the Plant, Contractor shall report the matter at once to the Engineer.
- 6.3. If the work of the Contractor is delayed because of any acts or omissions of any other Contractor, the Contractor shall have no claim against the Employer on that account other than for an extension of time.

#### **7. Erection of Plant**

- 7.1. Erection of Plant shall be phased in such a manner as not to obstruct the work being done by other contractors. Before commencing any erection work, the Contractor shall check the dimensions of structures where the various items of Plant are to be installed and shall bring any deviations from the required positions, lines or dimensions to the notice of the Engineer.
- 7.2. Plant shall be erected in a neat and workmanlike manner on the foundations and at the

locations shown on the Approved Drawings. Unless otherwise directed by the Engineer, the Contractor shall adhere strictly to the aforesaid drawings.

- 7.3. The Contractor shall be responsible for setting up and erecting the Plant to the line and level required and shall ensure that all Plant is securely held and remains in correct alignment before, during and after grouting-in. This responsibility shall not be passed to any other Contractor.
- 7.4. The Contractor shall set out the Works and carry out the Contractor's quality control procedures verifying the accuracy and precision of the setting out for each item of the works. The Contractor shall notify the Engineer sufficiently in advance of the setting out to enable the Engineer In-charge to observe the accuracy and precision of the laying out. The observations of the Engineer shall not relieve the Contractor of the responsibility under the Contract for the accuracy and precision of the setting out.

## **8. Interface with Other Contracts**

- 8.1. The Works under this Contract will physically interface with other contracts of associated projects. The Contractor of this contract shall co-ordinate with Employer and the Contractor of other contracts as applicable and ensure that all interfaces are designed, constructed, installed, tested, commissioned, operated, and maintained properly to provide a fully functional system meeting all applicable performance requirements.
- 8.2. The Contractor of this contract shall be fully responsible for independently field-verifying any and all information he considers relevant in order to provide a fully functional system.

## **9. Access to the Sites**

- 9.1. The Employer will afford to the Contractor access to and possession of the Site for carrying out the Works. The Contractor shall be deemed to have inspected the Plant Site including access before submitting his Bid.
- 9.2. The Contractor shall ensure that all the plant components offered are of a size and weight or can be divided into sections of a size and weight suitable for access to the place of installation.
- 9.3. The Contractor shall ensure that equipment used for installation purposes shall be able to gain access and position for such purposes.

## **10. Maintenance of the Site**

- 10.1. The Contractor shall be responsible for maintaining all the site structures, buildings, equipment, contract display board and related services until expiration of the Contract period or until such time as the aforementioned facilities are removed with the Engineer's prior approval, whichever is earlier.
- 10.2. At each proposed Plant site under the contract, access main gate and access road extension shall be provided by the Contractor.

## **11. Areas outside the Site**

- 11.1. In the event of the Contractor making use of any special or temporary wayleave or accommodation acquired by him for the disposal of surplus materials, or any borrow pit or quarry, he shall obtain the written consent of the owner, occupier or authority having charge of the land in which such way leave, accommodation, is situated and shall make a written record, acknowledged and signed by the owner, of the condition of the surface of that land before entering thereon, with liberal use of photographs.
- 11.2. The Contractor shall permit the Employer and any person authorised by the Employer access for the purposes of the Contract to any such special or temporary wayleave or additional accommodation.
- 11.3. In the event of the Contractor making use of any special or temporary wayleave or additional accommodation made available to him by the Employer for the purpose of the Contract, the land in which such way leave or accommodation is situated shall be deemed to be part of the Site. Under these circumstances the Contractor shall form a Working Area extending no more than 5.0 m from the edge of the Permanent Works or accommodation on all sides. The Contractor shall restrict his activities to within this Working Area. On completion of the works in this area, the Contractor shall reinstate the area to its original condition to the satisfaction of the Engineer. For the purposes of this Clause, "accommodation" shall be deemed to include housing, offices, workshops, warehouses, and storage areas.

## **12. Road Works**

- 12.1. The Contractor shall obtain all permits required for carrying out works such as excavation on public roads and shall liaise with the appropriate authorities with regard to the timing and execution of the road works.
- 12.2. The Contractor shall be responsible for establishing and maintaining temporary road diversions for the duration of the road works. The road shall be kept open at all times during the road works period, and the work shall be carried out in such a manner as to minimise the disruption to traffic. The Contractor shall reinstate all the roads to their original condition to the satisfaction of the Employer after completion of works.

## **13. Maintenance of Existing Access Roads**

- 13.1. The Contractor shall only use existing access roads within the Site boundary which are necessary for the execution of the Works. The Contractor shall obtain the Employer's approval in writing before utilizing existing access roads within the Site. Once the Employer's approval has been given the Contractor shall be solely responsible for the maintenance of the existing site access roads. This responsibility shall continue until the completion of the Defects Liability Period and O & M Period, or until such earlier date as the Employer may advise the Contractor in writing. Such maintenance work shall include general up-keep and any necessary repairs to damaged road surfaces, pavement, drainage, associated slopes, etc. to a standard at least equal to their original condition. While carrying out such maintenance work, the Contractor shall make arrangements to maintain through passage for the Employer's and his staff's vehicles and also those of other Contractors over these access roads. Such arrangements may comprise temporary

diversions, all to the approval and satisfaction of the Employer.

- 13.2. The Contractor shall not run tracked or un-sprung vehicles on surfaced roads without the written approval of the Employer who may require that planking or some other protective material be used to protect the road surface.

#### **14. Clearance of the Site**

- 14.1. The Contractor shall clear the Site to the extent required by the Employer for checking the setting- out.
- 14.2. Clearance of the Site shall also include demolition and removal of all articles, objects and obstructions which are expressly required to be cleared.
- 14.3. The Contractor shall ensure that the parts of the Site to be occupied by the Permanent Works are clear, and shall maintain the remainder of the Site as may be required for access and temporary works areas.
- 14.4. The Contractor shall remove the material arising from such clearance and dispose of it in a manner and at a location that are both in compliance with all applicable laws and regulations.
- 14.5. The Contractor shall backfill with appropriate specified materials and procedures those cavities and losses of soil which result from clearing the parts of the Site not subsequently to be occupied by the Works.
- 14.6. The Contractor shall not clear the Site of any existing structure(s) without the prior written instruction of the Employer.

#### **15. Clearance and Reinstatement of the Site on Completion of the Works**

- 15.1. On completion of the Works, the Contractor shall clear any temporary works areas and temporary access roads and reinstate the areas to their original condition and to the satisfaction of the Employer.
- 15.2. Any damage caused by the Contractor during the course of erection to new or existing plant or building or any part thereto, the Contractor shall at his own cost, make good, repair or replace the damage, promptly and effectively as approved by the Engineer and to the Engineer's satisfaction.

#### **16. Access for the Employer and Engineer**

- 16.1. The Contractor shall permit the Employer and any person authorized by the Employer including workmen of the Employer, other Contractors or utility undertakings access for the purposes of the Contract to all areas of the Site and to any additional accommodation or temporary wayleave for the duration of the Contract period.
- 16.2. A separate office for the sole use of the Engineer, his staff and Consultant shall be provided by the Contractor at Plant site. The Contractor shall provide, erect, furnish, clean, maintain and subsequently transfer the office and associated furniture / items to the Employer after the completion of works. The carpet area of the office shall not be less than 50 Sq. Meter.

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

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

## **17. Water Supply at Site**

17.1. The Contractor shall make his own arrangements for water supply at the site for the duration of the contract.

17.2. The Contractor shall ensure the quality of the water remains suitable for the purpose for which it is intended. The Contractor shall also conduct monthly test for water quality and comply with the quality requirements.

17.3. Wastewater shall be disposed off clear of the Site to the satisfaction of the Employer so as to maintain the hygienic condition at the site and no damage or complaint.

## **18. Toilets, Latrines, Washing Facilities, and Wastewater Disposal**

18.1. Throughout the period of construction of the Works the Contractor shall provide, maintain, and cleanse suitable and sufficient toilets, latrines and washing facilities for use by his employees. He shall ensure that his employees do not foul the Site but make proper use of the latrines.

18.2. Where practicable all wastewater generating facilities on site shall be connected to the nearest public sewer or if this is not practicable the Contractor shall provide an adequately sized septic tank and soak pit.

18.3. After completion of the works, the temporary toilets, latrines, washing facilities, septic tanks, and soak pits shall be removed, all ground disinfected and the surface restored to its original condition to the satisfaction of the Employer.

## **19. Electricity for Contractor's Use on Site**

19.1. The Contractor shall be responsible for provision of an electric supply to the site, energy meter, and distribution of the supply for the purpose of constructing the Works.

19.2. The installation shall comply with all the relevant regulations, Indian Standards and Codes of Practice, and Health and Safety requirements. The Contractor shall take all precautions to ensure that the installation is safe and injury to personnel or damage to plant and buildings is avoided. The Contractor shall be fully responsible for all safety aspects.

19.3. The Contractor shall test the temporary site power distribution system including energy meter every 3 months for compliance with the relevant standards.

## **20. Camp Facilities**

20.1. The Contractor shall construct and maintain to the Employer's satisfaction a camp to provide living accommodation for all Contractors staff and operatives who have no other local accommodation. The Contractor's camp shall be located close to but not on the Site itself and at a location approved by the Employer.

20.2. Responsibility for providing all services to the living quarters and compliance with all sanitary laws and other laws and regulations shall be borne by the Contractor. Security and the fencing of these areas shall be the responsibility of the Contractor.

## **21. Compressed Air Use on Site**

21.1. The Contractor shall provide the necessary compressed air plant and equipment required for construction of the Works.

21.2. Electrically driven compressors connected to the site electricity supply shall not be used. Diesel engine driven compressors shall not be sited within buildings or in a location that may cause a health hazard to personnel owing to exhaust fumes or noise.

## **22. Refuse Disposal on Site**

22.1. Refuse and rubbish of every kind shall be removed from the Site and disposed of by the Contractor at his own expense, frequently and regularly at a minimum period of one week so as to keep the Site in a wholesome and tidy condition to the satisfaction of the Employer.

## **23. Safety and Security on Site**

23.1. The Contractor shall at all times maintain safe work methods and procedures and shall comply with all enactments, regulations and working rules relating to safety, security, health and welfare of all persons who may be affected by his work.

23.2. In particular he shall ensure that only persons who are properly trained for their duties are employed, and that appropriate, approved tools, safety equipment (PPE-Good Quality Make with ISI- Standard), and procedures are used. Nothing which has been written into or omitted from the Employer's Requirements shall be taken to relieve the Contractor from his obligations under this clause. No clause in the Employer's Requirements shall prevent the Contractor from drawing the attention of the Engineer to any feature of the Works which is not consistent with normal safety practices nor prevent him from putting forward proposals at any time which would increase the safety of the installations. The Contractor shall be responsible to carry out Third party inspection & Certifications of all Construction machineries, such as cranes, hoist, generator, Lifting tools tackles etc.

23.3. Not later than four weeks before work commences on the Site, the Contractor shall submit to the Employer his comprehensive (EOHS) plans and proposals relating to the all aspects of health and safety on the Site. The proposals shall be appropriate for all grades of labour and personnel who will work on or visit the Site on behalf of the Employer or Contractor.

23.4. The Contractor shall appoint a suitably qualified representative as Safety Officer who

shall be responsible for the implementation of site procedures as per relevant standards.  
The Safety Officer's responsibilities shall include but not be limited to:

- 23.4.1. Safety
- 23.4.2. Working in hazardous areas
- 23.4.3. Permit to work
- 23.4.4. Fire and smoking regulations
- 23.4.5. First aid
- 23.4.6. Warning signs
- 23.4.7. Trenching scaffolding and other construction structures
- 23.4.8. Safety barriers
- 23.4.9. Protective clothing and equipment
- 23.4.10. Safety training
- 23.4.11. Safety meetings and inspections
- 23.4.12. Health and welfare

23.5. The Employer shall have the power to stop any activity or work in any area where there is a breach of the published site safety rules or health and safety is otherwise endangered.

23.6. The Contractor shall ensure that all other Contractors working on the Site also follow established health and safety procedures. The Contractor shall bring any violation of Site safety rules by others to the attention of the Employer in writing.

## **24. First Aid and Life-saving Apparatus on Site**

24.1. The Contractor shall provide on the Site such life-saving apparatus as may be appropriate and an adequate and easily accessible first aid outfit or such outfits as may be required in any government ordinances, factories acts, etc, published and subsequently amended from time to time. **The Contractor deploys permanent emergency vehicles with driver exclusively for site emergency handling.** In addition, an adequate number of people permanently on the Site shall be instructed in their use, and the persons so designated shall be made known to all employees by the posting of their names and designations in a prominent position on Site.

## **25. Electrical Safety on Site**

25.1. The Contractor shall be responsible for the electrical safety of all Plant and equipment supplied and installed. Whilst any equipment is being installed or tested, the Contractor shall ensure that all necessary precautions are taken to safeguard personnel working on site. If necessary, this shall include fencing off areas which are considered to pose a risk, and erecting warning notices.

25.2. The Contractor shall be responsible for ensuring that the electrical installation is carried out by suitably trained competent personnel and that the work is carried out in a safe



manner.

- 25.3. The Contractor shall be responsible for the operation on the Site of a permit to work system during the period of electrical equipment installation and testing. The Contractor must be ensuring LOTO System is implemented for Electrical activities. This system shall regulate the installation, the energization and the use of electrical Plant and equipment installed and the method of work adopted.

## **26. Environmental Protection**

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

26.1.1. Contamination of surfaces, ground, groundwater, surface water and rivers,

26.1.2. Emissions to air, including smells, gases, smoke, and dust,

26.1.3. Unsanitary or unsafe storage or discharge to drain, sewer and surface waters,

26.1.4. Unsanitary or unsafe storage or discharge of solid wastes,

26.1.5. Noise,

26.1.6. Visual intrusion, and

26.1.7. Excessive energy and water consumption

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

- 26.3. The Contractor shall appoint an Environmental Control Manager for the Works, who shall be responsible for preparing an Environmental Management Plan and ensuring its implementation by the Contractor after obtaining approval of the Engineer.

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

- 26.5. All potentially affected areas of the Site, other areas used for or affected by the works and all adjacent or affected waterways shall be monitored and, where instructed by the Engineer, tested.

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

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

26.7.1. The methods of materials delivery, storage, usage and disposal; equipment

- usage; and site activities to ensure they have minimal impact on the environment,
- 26.7.2. Only environmentally safe products and practices shall be adopted in performing his works, and
- 26.7.3. The Contractor shall comply with all of the statutes regarding environmental effects.
- 26.8. The EMP shall provide separate descriptions of its proposals for minimizing any adverse environmental impacts/effects during the construction phase and the subsequent operations and maintenance phase.
- 26.9. The EMP shall be provided in draft form within 28 days from the Notice to Commence, and shall be updated from time to time by the Contractor as agreed or required by the Engineer to ensure the objectives of environmental protection are fully met.
- 26.10. The Contractor shall ensure that the operations entailed in the construction of the Works do not cause annoyance to others working on the Site or to persons living adjacent to the Site.

## **27. Warning and Safety Signs**

- 27.1. During construction of the Works statutory safety signs shall be adequately provided throughout the Works, both indoors and outdoors. These safety signs shall cover mandatory, prohibition, warning, emergency, fire-fighting and general notices. All signs shall be positioned around the Works at highly visible points. Provision of signs and the positions of signs shall be subject to the Employer's approval. Special attention shall be given to areas designated hazardous.
- 27.2. Warning signs shall be in Gujarati, Hindi and English Languages.

## **28. Site Working Hours**

- 28.1. The Site working hours are detailed in the Conditions of Contract. The Contractor shall not extend the working hours without the prior approval of the Employer.

## **29. Delivery to Site**

- 29.1. The Contractor shall be responsible for the transporting, handling, and delivery to site of all the Plant and equipment. The proper storage and protection of all Plant and equipment at the Site shall be the Contractor's responsibility.
- 29.2. The Contractor shall check all items against packing lists immediately on delivery to the Site and shall also inspect for damage and shortages. Damages and shortages shall be remedied with the minimum of delay.
- 29.3. The Contractor may, with the prior approval and at no extra cost to the Employer, make arrangements for any other Contractor or agent to take delivery of, unload and store the Plant on the Site on behalf of the Contractor.
- 29.4. All deliveries shall take place during the Contractor's normal working hours.

## **30. Protection from Weather and Storage**

- 30.1. An area and/or building on the Site for use by the Contractor for storage of Plant prior to

erection will be subject to the approval of the Engineer.

- 30.2. The Contractor shall provide all facilities for the safe and proper storage of Plant and equipment, as recommended by the manufacturers, with particular consideration being given to temperature, rain, sunlight, wind and ground conditions.
- 30.3. The Contractor shall remain responsible to the Employer for the care and insurance of the Plant and the provisions of this Clause shall not relieve the Contractor of any of his liabilities under the Contract.
- 30.4. Stored Plant items shall be laid out by the Contractor to facilitate their retrieval for use in the required order as recommended by the manufacturer.
- 30.5. Stacked Plant items shall be protected from damage by spacers on load distributing supports and shall be safely arranged. No metalwork shall be stored directly on the ground.
- 30.6. Small Plant items shall be held in suitable bins, boxes or racks and be clearly labelled.
- 30.7. Items of Plant shall be handled and stored so that they are not subjected to excessive stresses and so that protective coatings are not damaged.
- 30.8. The Contractor shall comply with the manufacturer's package and plant markings concerning the use and location of lifting slings, chains and hooks, and all other handling, storage, protection, and installation instructions.

### **31. Contract Signboards**

- 31.1. The Contractor shall supply and erect signboards at locations to be specified by the Employer. The layout and dimensions of the signboards and their construction shall be to the approval of the Employer and the lettering in Gujarati, Hindi and English Languages shall be black on a white background.

### **32. Advertising**

- 32.1. The Contractor shall not use any part of the Site for any form of advertising without the prior written approval of the Employer.
- 32.2. Utilities including all existing lines if passing through the site and inlet arrangement and all related work such as Construction of Retaining wall, approach roads, filling etc. as mentioned in price bid schedule Part B, shall be carried out by contractor as per instruction of PMC/Engineer in-charge.

**Section – 5a**  
**General Technical and Process Requirements**

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## 1. Sewage Pumping Station and Sewage Treatment Plants

- 1.1. The plant is to be constructed on turnkey basis such that scope includes Design, construction, supply, erection, testing, commissioning, three (3) month trial run, in Ten (10) Years of operation and maintenance (including defect liability period of three years), including all civil, electrical, mechanical, instrumentation and all other allied Works.
- 1.2. All works from influent from existing nearby machine hole through gravity line to SPS to STP through Rising main to final disposal is the responsibility of the contractor.
- 1.3. Technology Requirements for the plant are included in this contract and are described here in “Minimum Process Requirements”.

Design Intermediate Capacity at average flow (MLD)	Design Ultimate Built-out Capacity at average flow (MLD)	Treatment Process
As Mentioned in Tender Notice	As Mentioned in Tender Notice	Open Technology with Biological Nutrient Removal (Nitrification, Denitrification, and Phosphorus removal)

- 1.4. The peak factor table is furnished below:

Contributory Population	Peak factor
(Up to 2.16 MLD)	3.00
(Greater than 2.16 & Up to 5.40 MLD)	2.50
(Greater than 5.40 & Up to 81.00 MLD)	2.25
(Greater than 81.00 MLD)	2.00

## 2. Treatment Technology

**The treatment process proposed by bidder should be any process for treatment of sewage in Indian Environmental condition.** The following processes shall not be accepted by the Employer.

- a) Oxidation pond / ditch (facultative/anaerobic/aerobic)
- b) DEWATS
- c) SBT
- d) Waste stabilization pond
- e) Trickling filters
- f) Oxidation Ditch
- g) Rotating Biological Rotators (RBC)

h) Up-flow Anaerobic Sludge Blanket (UASB) Technology

i) Green Technology

Bidder must provide all information necessary for complete evaluation of his technology by the Employer, including drawings, design calculations, technical specifications, datasheets proposed construction/installation methodology and other relevant details. Any bid without above information will be considered as non-responsive and summarily rejected. Bid must satisfy the Employer's performance requirements as set out in the Bid documents. Bidder shall include with their Bid evidence acceptable to the Employer of satisfactory past performance of same technology based plant designs and the associated equipment and processes offered and full details of similar plant capacities called for to enable proper evaluation of design.

The design of the plant under this project will be based on the design criteria recommended in "Manual on Sewerage and Sewage Treatment Systems" - 2013 of Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development (MoUD), Government of India (GoI), New Delhi and internationally recognized references. In case of difference or discrepancies between CPHEEO Manual and Internationally recognized guidelines / books, the process design shall be carried out considering stringent design parameters.

**2.1. Treatment Objective** - Considering the raw sewage quality and the required treated sewage quality, the Contractor shall furnish a process train to achieve the following objectives –

2.1.1. To achieve guaranteed treated sewage quality.

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

2.1.3. To ensure that the process is cost effective from both capital and O&M costs consideration.

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

2.1.5. The process preferably should utilize minimum amount of chemicals.

2.1.6. The process preferably should utilize minimum chemical/any organic chemicals except for sludge removal process. No toxic chemical shall be used by the bidder. Bidder shall submit the toxicity test report from any govt. recognized laboratory at his own cost before using such chemical.

2.1.7. Oils/lubes/fuels/media/chemicals etc. to be used shall be defined by Bidder.

2.1.8. The final treated sewage is to be disinfected through chlorination before its disposal.

### **3. Incoming Sewage line to Inlet Chamber/ Receiving Chamber of treatment plant**

**3.1.** Incoming line (rising mains) shall have pumped screened raw sewage unless specified

otherwise. Connecting existing rising main, provided at the plant location outside the plant boundary, up to the plant inlet with all fittings equipped with flow meter and quality analysers for BOD, COD, TSS, pH, Ammonical Nitrogen (NH<sub>4</sub>-N) & Total Nitrogen (N Total) shall be in bidder's scope of work.

However, items and works mentioned in Volume-III Price Bid have to be executed by contractor.

- 3.2.** Bidders are required to visit the site and assess all the works, not limited to works given in Tender documents, to be executed for construction and successful commissioning of plant as per tender specifications. Contractor should also verify the requisite details with the AMC. Cost of all the works required for construction and successful commissioning of plant shall be included in the quoted price and no extra payment shall be made to contractor. Cost of all the works required for construction not limited to site grading, levelling, foundation & successful completion of works is deemed to be included in their quoted price.

#### **4. Plant Outfall Details**

- 4.1.** The treated effluent from the plant is to be suitably disposed off in the nearest inland surface water body. A gravity main pipe line of required size to carry design peak flow equipped with flow meter and quality analysers for BOD, COD, TSS, pH, Ammonical Nitrogen (NH<sub>4</sub>-N), Total Nitrogen (N-Total) & Residual Chlorine shall be laid up to the plot boundary limit and beyond as per site condition to nearest receiving water body (up to disposal point). Bidder shall also provide necessary number of intermediate RCC manholes (at average 30m c-c distance) including the final RCC manhole/ outfall chamber.
- 4.2.** The Location of outfall and High Flood Level (HFL) in the receiving water body for disposal of treated sewage is to be obtained by the Bidder/Contractor for the planning and designing of the treatment plant. The HFL of the receiving water body and the plant site will be approved by Engineer-In-Charge during review of vendor drawings.

#### **5. Influent Wastewater Characteristics**

- 5.1.** The influent wastewater characteristics to be used as the basis of design are provided below:

<b>Influent Wastewater Characteristics</b>		
<b>Parameter</b>	<b>Unit</b>	<b>Maximum Limit</b>
pH	--	6.5 - 7.5
BOD <sub>5</sub> at 20 <sup>0</sup> C	mg/L	300
COD	mg/L	600
TSS	mg/L	375
TKN	mg/L	50
Total Phosphorus	mg/l	7.1
Total coliform	MPN/100 mL	10 <sup>7</sup> – 10 <sup>8</sup>
Minimum sewage temperature	°C	18



Maximum sewage temperature	°C	35
Maximum ambient temperature	°C	49
Minimum ambient temperature	°C	10

- 5.2. The contractor shall conduct the sampling and tests of raw sewage by themselves to ascertain the raw sewage quality for treatment process. Contractor can also verify the operating data of existing STP, in cases where it is present in respective town. For design purposes values lower than the basic design values shall not be permitted.
- 5.3. To take care of inconsistency in the sewage characteristics, based on AMC's experience for the variation in sewage characteristics over the time at various STPs within Ahmedabad, AMC anticipates the same kind of variation in raw sewage at proposed 250 MLD STP also in future and hence, AMC wants to take care of such abnormalities. In this context, Neutralisation Tank (NT) and Equalisation Tank is proposed to construct. The bidder may propose Settling tank with Flash Mixer and Flocculator and in such case, the bidder shall have to also provide sludge pumps, Chemical Storage and dosing Tank with pumps etc., as its own design and requirements. The total HRT for Equalization Tank and Neutralization Tank shall be 04 hours at average flow. The above-mentioned units shall be as per bidder's design and philosophy. **These units can be operated as per bidders design operation philosophy. It is expected that about 10% of days in a year the sewage characteristics might cross the defined characteristics. Hence, the bidder shall have to consider minimum 30 days of operations of neutralization tank and settling tank, in any time during a year. Hence, the bidder shall have to consider the necessary manpower / power/ electricity, accordingly. The power consumption for 365 days shall be considered for price evaluation.** However, for consideration of chemicals such as Lime, for the adverse raw sewage characteristics occasionally, the bidder shall have to submit the quote rate of such chemicals, as they desired for the purpose. The contractor shall have to keep inventory of above chemicals for at least 10 days' period. The payment of chemicals shall be done as per actual usage at site as per quote rate..

## 6. Treated Sewage Requirements

- 6.1. The treated sewage quality requirements to be met shall be as per standards as given below:

<b>Treated Sewage Quality Requirements (at outlet of Chlorine Contact Tank/UV disinfection system)</b>		
<b>Parameter</b>	<b>Unit</b>	<b>For each plant</b>
pH	---	6.5 – 9.0
Bio-chemical Oxygen Demand (BOD)	mg/L	Less than 10
Chemical Oxygen Demand (COD)	mg/L	Less than 50
Total Suspended Solids (TSS)	mg/L	Less than 10
Ammonical Nitrogen (NH <sub>4</sub> -N)	mg/L	Less than 5
Total Nitrogen (N-Total)	mg/L	Less than 10
Total Phosphorus	mg/L	1
Faecal Coliforms (FC)	Most Probable Number	Less than 230

	(MPN)/100 ml	
Total Residual Chlorine	mg/L	0.5-1

## 7. Dewatered Sludge Quality Requirements & Disposal

7.1. The dewatered sludge quality requirements to be met are listed below:

Treated Sludge Quality Requirements (Dewatered Sludge)		
Parameter	Unit	For each plant
Minimum sludge TSS (dry solids)	% w/w	20%

7.2. All screenings, dewatered sludge and wet grit produced daily shall be transported and disposed off by the contractor suitably approx. max. distance from plant is approximately within 30 Km radius of treatment plant away from plant site, while adhering to all environmental laws laid by pollution control board, to the place as directed by the Engineer-In-Charge as per Section 5.

## 8. Treatment Process

8.1. The treatment process for STP under this contract is open. Bidder is free to adopt and use appropriate treatment process/technology for this project: However, the technology selected should be such that the treatment parameters should meet the treated sewage standards as stipulated in the tender document. The treatment technology should also include sludge treatment and its safe disposal. Contractor shall provide a complete, fully functional facility designed for proper, easy, operation and to meet the stated performance requirements. This shall include any and all additional, ancillary, supporting, or other processes, components, equipment, or other items necessary to achieve these objectives, regardless of whether such items and/or units are explicitly listed in these bid documents or not.

8.2. The minimum number of working & standby modules for the various unit processes and components are listed below.

Minimum Number of Units or Modules to be Provided for Unit Processes		
Unit Process	STP Design Average Capacity (MLD)	
	Number of Units (W=Working S=Standby)	
	W	S
Main Pumping Station		
Coarse Screen Channel Manual (Box Type)	5	1
Coarse Screen Channel Mechanical	5	1
Raw Sewage Transfer Pumps	8	8
Wet Well	1 No. (Two Compartments)	
Sewage Treatment Plant		
Mechanical Screens	5	0
Manual Screens	0	1
Grit Removal (Mechanical)	4	2
Parshall Flume (Inlet + Outlet)	1+1	0

Equalization Effluent Transfer Pumps	4	4
Aeration/Biological Process (Other technology)	10	0
Aeration Basins/ Biological Process (SBR Technology)	12	0
Disc filter Filters (Optional to Sand filters)	5	0
Gravity Sand Filters (Optional to Disc filters)	22	2
Chlorination with baffle	1 (Two compartments)	
Chlorinator	2	1
Poly dosing Pumps	6	1
Poly dosing Tanks	3	0
Filtrate/Supernatant Pumps	3	1
Sludge Dewatering	12	1
<b>Plant Specific units depending on the Process proposed in this Bid</b>		
Primary Clarification	4	0
Anaerobic tank	10	0
Anoxic Tank	10	0
Secondary Clarification	4	0
Primary Sludge Pumping	1	1
RAS/WAS Pumping	1	1
Gravity Thickening	4	0
Flash Mixing Tank	1	0
Flocculation Chamber	1	0
Clarifier or Clariflocculator	1	0

**8.3.** The Bidders who are proposing new technologies / process must submit following details along with his bid.

- a) Treatment methodology, detailed specifications and process design calculation along with data sheets.
- b) List of Equipment and unit sizing calculations.
- c) Process flow diagram, P&ID, Layout and Hydraulic flow diagram.
- d) Power consumption statement as per tender format.
- e) Statement of Chemical consumption.
- f) Detailed break up of cost estimates for O&M as per tender including estimation of technological items.
- g) Experience certificates from client. List of clients with contact details.
- h) Duly certified copy of monthly / quarterly log-sheet of particular plant parameters indicating Inlet and Outlet characteristics of sewage. Log-sheet shall be of minimum one-year duration.

**8.4. Other details / specifications including Instrumentation and Automation work mentioned in tender shall be applicable to any new technology without any deviation.**

**9. ~~Land Requirement~~**

**9.1. ~~Land requirement has to accommodate all the following:~~**

**9.1.1. ~~Plant with all the process units and associated buildings and structures of proposed capacity, to achieve specified treated sewage quality with internal roads of minimum 4.5 meters width (A1)~~**

**9.1.2. ~~Green zone of minimum 33% along the compound wall (A2= 33% X A1)~~**

**9.1.3. ~~Sludge drying bed (SDB) for 25% of sludge generated (for ultimate flow) (only area to be landmarked)~~**

**9.1.4. ~~Additional land for future expansion (for ultimate flow)~~**

**9.1.5. Compound wall all along the plot boundary as specified in tender documents.**

**9.1.6. The Bidder shall have to submit the extent of land requirement in Technical Bid duly justified in the Layout Plan. The excess usage over and above the land requirement proposed by the bidder shall be deducted from his payment towards capital cost at the prescribed land rate.**

**9.2. The Bidder shall have to submit a detailed Layout Plan showing the extent of land requirement considering intermediate as well as ultimate build out capacity.**

**Note:** The bidder shall have to submit the extent of land requirement in Technical bid duly justified in the layout plan.

**9.3. Multi-stacking of units on one another shall not be acceptable. All units/ buildings shall be independent with a horizontal distance of minimum 3 m between them. The plant layout shall strictly adhere to minimum distance requirement, minimum plant road width of 4.5m, landscaping, tree plantations, modular approach.**

**9.4. Thus, the plant should be designed so as to meet criterion of treated sewage characteristics, minimum power consumption and fit in land available. The provision and placement of future units should be clearly marked in plant layout to be submitted with technical bid. The available land details are furnished in Annexure. The bidder shall field verify details from respective Nagar Palika.**

**9.5. Topographical survey and levels grid at 1m intervals with High Flood Level (HFL) of the receiving water body and at the Plant site will be assessed by the Contractor and the same will be approved by the Employer during vendor drawings approval process.**

**10. Demolition of Interfaces and Tie-Ins with Existing Facilities**

**10.1. All existing facilities that are to be demolished shall be properly dismantled, removed, and appropriately disposed of by the Contractor in accordance with all applicable laws, regulations, and standards. Items, components, or materials, whether buried, exposed, submerged, or otherwise, shall not be abandoned or left on site unless explicitly**

indicated in the Tender Documents. For facilities that are to be eventually demolished but must remain in service until alternate or replacement facilities are constructed and commissioned, whether under this contract or a different contract, the Contractor shall ensure that the facilities are protected and remain functional until such time as the alternate or replacement facilities are constructed, tested, commissioned, and accepted by Employer.

- 10.2.** All existing facilities that must remain in service permanently shall be protected by the Contractor such that they remain fully functional, operable, and serviceable throughout the period as indicated in the Technical Bid. Contractor shall be fully responsible for installation and, if necessary, ultimate removal of any temporary facilities or connections (piping, utilities, power, controls, etc.) that may be necessary to maintain existing facilities fully operational throughout construction and commissioning. Temporary or permanent interfaces between existing and new facilities may involve making connections or “tie-ins” to existing live structures, piping, wiring, cabling, equipment or other components. Contractor shall be fully responsible for detailed design, planning, and implementation of such interfaces in a safe and secure manner.

## **11. Plant Layout and Hydraulic Profile**

- 11.1.** The Contractor shall ensure that the layouts and hydraulic profiles submitted as part of the Contractor’s bid comply with the following specific constraints and all other requirements described in the Tender Documents:

11.1.1. For plant where all or part of the influent flow is pumped from main pumping station to outside the plant boundary, the Contractor shall connect the incoming line to the inlet chamber of the plant. The incoming pipe length to be field verified by the Bidder and to be included in price bid.

11.1.2. All weirs in the plant, including variable height weirs on weir gates, shall remain un-flooded / un-submerged, with a minimum 75 mm freefall (except Grit basin which shall have free fall over the exit weir not less than 200 mm at peak flow) from the weir invert to the downstream water surface level under the following conditions occurring simultaneously:

- a) Maximum/ high flood level in receiving water body/ structure
- b) Operating flow equal to design average flow
- c) One unit of each unit process out of service

For all structures containing water or process liquid, the minimum freeboard (FB) shall be 0.5 m of peak hydraulic flow unless specified otherwise. The hydraulic design shall be checked considering the maximum water level at peak plant flow with one unit of each unit process out of service, which shall be below the top of wall / structure.

11.1.3. Parshall flumes provided at Plant inlet and outlet shall remain un-flooded/ un-submerged up to the design peak hour flow.

**11.1.4. By pass arrangement:** RCC pipes with manholes and C.I. Sluice gates (MH to be raised above TWL of adjacent unit) Contractor shall provide at plant all necessary facilities for manual bypass of the process liquid at the Grit tank Outlet Channel to Plant's main outfall pipe. This facility is included in this contract and shall be provided regardless of whether or not they are shown in any drawings included in the contract document, shall be fully functional in all respects, and shall include any and all components necessary to safely and efficiently accomplish the intended bypass. Each bypass facility shall include, but not be limited to: (i) downward opening overflow weir gates installed in the appropriate channel or structure from which the bypass is to be effected, (ii) an RCC channel or structure to receive the bypass flow over the weir gate, (iii) an appropriately sized buried (above ground piping will not be acceptable) cement mortar lined and coal tar epoxy coated ductile iron pipe to carry the bypass flow from the channel or structure in (iv) above to a manhole or junction box in the Plant's main outfall pipe.

Bypass facilities as described above shall be provided at the following locations:

- a) **Grit Tank Outlet Channel to STP's main outfall chamber / pipe including flow measuring device.**
- ✓ Aeration Basin Influent Channel to STP's main outfall pipe (only in plants containing primary sedimentation units)

**11.1.5.** Topographical survey information, benchmarks, contour maps, geotechnical/soil investigations, and treated sewage receiving water body high flood level (HFL) elevations shall be obtained by the bidder. Bidder shall be fully conversant with site conditions and all site information necessary. The information provided in these documents is for information purpose. However, Employer makes no guarantees or representations whatsoever regarding this information. Bidder's use of this information shall be at his own risk.

**11.1.6.** Contractor shall independently obtain any and all site information necessary for proper planning, design, and operation of all components in the contract.

**11.1.7.** All aspects of Contractor's technical design shall also be subjected to review and approval by the Employer.

## **12. Plant Layout and Orientation**

**12.1.1.** The plant components shall be laid out and fully contained within the respective designated site boundaries so as to logically interface with any and all existing infrastructure that may be present at the site and that must remain in service. Bidder's proposed site layout shall clearly show the space allocated for all plant components, including those components and/or unit processes that may be designated for future construction or installation. Setbacks and clearances from the site boundary shall be provided as appropriate and as required by law. All existing utilities (including water, sewer, power, or others, whether overhead or underground and whether physically located on the site or not) requiring to be relocated to accommodate the Contractor's

proposed and approved site layout shall be relocated by the Contractor at no additional cost and without interrupting provision of such utility services to users and customers. Such relocations shall be fully coordinated with Employer.

12.1.2. The plant layout shall adhere to the following general rules:

- a) Minimum clear distance provided to permit safe and convenient access for operation and maintenance shall be 3 m between adjacent treatment units or fixed structures and 1 m between pieces of equipment
- b) An area adjacent to all mechanical equipment shall be provided as a maintenance lay down area
- c) Separate land for grit conveyance to be indicated
- d) All electrical equipment (except for motors) shall be located above the high flood level elevation for the site or for the treated sewage receiving water body, whichever is higher.
- e) All internal roads of minimum 4.5 m clear width shall be provided in the plant area.
- f) All roads shall be provided with storm water covered drains on both sides.
- g) Multi-stacking of process units on one another shall not be acceptable.

**13. Modular Design, Construction, and Operation for Reliability, Redundancy, Turndown, and Easy Future Expansion**

**13.1.** The intermediate design capacity and the ultimate build-out design capacity required are both specified in Tender Notice.

**13.2.** Conveyance pipeline upto inlet channel and from plant outlet chamber to final discharge near the drain/ river shall be designed on Ultimate capacity. Space for all the treatment units & sludge handling units for ultimate capacity shall be secured for future. For STP components, the design and construction shall be for the intermediate design capacity under this contract.

**13.3.** Further, for all components under this contract, the capacity to be provided shall be designed and constructed using multiple, suitably sized unit process modules to ensure reliability, redundancy, and appropriate turndown for optimum capacity utilisation and process efficiency. The minimum number of working and standby modules or units required for each component shall be as per clause 8.

**13.4.** The Bidder shall be fully responsible to include in his bid the whole of the Works, including each individual component, designed and constructed in accordance with bid specifications and good engineering practice. The offered plant should function as a whole, a fully integrated system which is capable of achieving the required treated sewage parameters in an efficient and economical manner and eliminate the odours and pest nuisance assignable to improper design and/or poor Operation & Maintenance. The offer shall include all buildings, plant, equipment and accessories required for the efficient, safe and satisfactory operation of the facilities. Any accessories which are not specifically mentioned in the specifications/requirement, but which are usual or necessary for completion of the Works and successful performance of the plant and

facilities, shall be provided by the Bidder without extra cost to the Employer. The Bidder shall, to the maximum extent practical and feasible, endeavour to offer standardized designs and Plant and equipment keeping in view minimization of operation and maintenance requirements.

#### **14. General Design Requirements**

**14.1.** The following general design requirements shall be met for plant. These requirements shall be fully met regardless of whether or not such requirements or any related components are shown in any drawings included in the Tender documents.

14.1.1. Plant should be designed, such that the proposed design is meeting treated sewage requirement and with least power consumption and ease of O&M and shall fit in available land. The formation level of plant should be planned with respect to HFL of receiving water body to avoid flooding. The Formation level shall be at least 0.50 m above HFL. It is the responsibility of Contractor to match the outfall chamber level with proposed disposal point of treated sewage. In case gravity disposal of treated sewage is not feasible, treated sewage pumping station shall be provided for safe disposal of treated sewage without extra cost to Employer. The bidder shall assess the treated sewage disposal aspects as per site conditions carefully at bidding stage and consider in his bid.

14.1.2. All components (including but not limited to equipment such as pumps, blowers, screens, diffusers, inline devices; instruments such as flow meters; and distribution and collection channels or pipes) shall be provided with appropriate isolation devices such as valves, gates, or other devices in order to allow isolation, drainage, cleaning, calibration, servicing, and maintenance of such components. Bypasses shall be provided around all flow meters and other in-line instrumentation such that the instrument can be isolated and removed for calibration and maintenance without interrupting the flow.

14.1.3. Where necessary, equipment shall be provided with acoustic, sound-dampening enclosures to limit ambient noise during normal operation to the limits detailed in the General Requirements.

14.1.4. All equipment shall be arranged, and buildings and structures designed to permit safe and easy access to and removal of all equipment.

14.1.5. Fixed runways, lifting eyes, cranes, hoists, or other appropriate devices and means shall be provided to permit safe and easy removal of all equipment for maintenance or any other purpose.

14.1.6. All liquid or sludge flow distribution shall be accomplished using one of the following options only:

- a) Non-submerged (i.e. with a positive free fall from weir invert to the water surface on the downstream side) overflow weirs,
- b) Non-submerged downward opening overflow weir gates, any other means of flow distribution shall not be acceptable.



- 14.1.7. Process air flow distribution shall be using automatic feedback flow control using inline flow measurement and modulated flow control valves with electric actuators
- 14.1.8. All structures, whether liquid-holding or not, shall be designed such that they can be fully and completely drained and will not float or move when empty, because of groundwater buoyancy (considering water table as per soil report) or any other reason. The structures shall be designed to counteract any possible floatation without the use of any type of groundwater pressure relief valves.
- 14.1.9. The floors of all liquid-holding structures shall be appropriately sloped and trenches and drain sumps shall be provided at the bottoms of such slopes to facilitate complete drainage of liquid. Appropriate drain pipes and valves connected to the drain sump(s) shall be provided for all structures. Where the drain pipe connects to the structure, the top-of-pipe elevation shall be at least 150 mm lower than the lowest floor elevation for the structure. The drain piping shall be routed from the structure being drained to the Plant Drain Pump Station and shall be continuously sloped downward in the direction of flow with a minimum slope of 1 percent. For liquid-holding structures, the drain piping and fittings shall be sized such that the entire structure can be drained by gravity in no more than six (6) hours. The Plant Drain Pump Station, Plant Drain Pumps, and other related equipment and controls shall be designed and sized to allow draining of the structure with the largest volume from full to empty within six (6) hours. The highest design water level (High High Alarm) in the Plant Drain Pump Station wet well shall be at least 300 mm lower than the lowest pipe invert elevation amongst all drain pipes connecting to the wet well.
- 14.1.10. Non-liquid-holding areas, structures, or buildings where leakage or other wet activities can occur, whether in normal use or during maintenance, shall be provided with covered drainage channels which shall direct the spillage either to a suitable gravity drain or to a sump equipped with standard dual submersible sump pumps discharging to the Plant Drain Pump Station.
- 14.1.11. All channels carrying process liquid shall be fully covered with solid non-skid GRP/SFRC cover plates (not grating) designed for human traffic live loads at a minimum and heavy vehicle live load wherever the channel crosses traffic paths.
- 14.1.12. Inlets into tanks, reactors, or other structures via pipes, channels, valves, or gates shall be designed such that the incoming flow does not cause any damage or excessive wear whatsoever to the structure or any equipment in the vicinity under any hydraulic condition, including but not limited to the condition when the structure is empty.
- 14.1.13. All piping shall be of corrosion-resistant material appropriate for the service and shall be provided with interior lining, exterior coating, and other corrosion protection as appropriate. All piping shall be fully and adequately supported and braced to comply with all applicable codes and standards. All supporting hardware shall also be of corrosion-resistant material. The design of pipe supports, and anchors shall fully account for static and dynamic vertical, lateral, longitudinal, and seismic loads, fluid flow, and thermal expansion. Seismic bracing thrust restraints and/or thrust blocks, and appropriate

expansion joints or loops shall be provided as needed. Pipe lengths and joints shall be assembled and arranged for ease of removal in such a way that individual runs can be changed without dismantling adjacent pipes, by providing dismantling joints at regular intervals.

- 14.1.14. Specification for Anti-Corrosive Internal Coating/Lining protection of Concrete Surfaces Application limits of Anti-Corrosion Internal Coating/Lining for Concrete Surfaces: (1) All units upstream of and including Aeration/Aeration basin influent channel will have to be provided with internal coating/ lining for the full internal surface area (Walls and base slab). (2) For the units - Aeration basin/ Influent channel, Anaerobic Zone, Anoxic Zones, Aeration Zones and Aeration Basin/ Effluent Channels, internal coating/ lining shall be provided on the walls only from the top of the structure to 1.0 m below the lowest operating liquid level. (3) For the units handling the solids part such as: Gravity Sludge Thickener, all Sludge/ Scum sumps including Plant drain sump, internal lining shall be provided for the entire internal surface area.
- 14.1.15. For liquids and sludge, the maximum pipe flow velocity shall not be more than 1.5 m/s for pumped suction and not more than 2.0 m/s for pumped discharge. For gravity flow, the minimum pipe flow velocity shall not be less than 0.6 m/s and not more than 1.2 m/s. All mixed liquor and sludge lines shall be minimum 200 mm diameter and shall be provided with appropriate cleanouts and flushing arrangements for safe and easy flushing using high-pressure water. The normal pipeline flow velocity for air shall not be more than 18.0 m/s & for biogas not more than 12 m/s.
- 14.1.16. All liquid service pipes shall be provided with appropriate means for safe and easy drainage of the pipes when not in service.
- 14.1.17. All pipes shall be colour banded and suitably labelled with the stream designation and direction of flow to enable individual lines to be identified throughout their run.
- 14.1.18. Particular attention shall be paid to the layout of the chemical piping, which shall be arranged without clutter and shall be functional and neat in appearance. Generally, where piping is installed in ducts, it shall be supported not less than 150 mm clear of the floor.
- 14.1.19. Inlet, outlet, wash water inlet pipe shall be DI only and minimum size of 200 mm as per approved make / brand. All piping routed under any type of structure or equipment shall be fully and completely encased in reinforced cement concrete, with the encasement thickness beyond the outer diameter of the pipe being at least 200 mm on all sides or as per structural designs. The encasement shall extend along the pipe length for a minimum horizontal distance of 1500 mm in each direction beyond the footprint of the overlying structure or equipment.
- 14.1.20. All piping connecting to, entering, or exiting any and all structures shall be provided with appropriate restrained flexible connections and/or joints at all such interfaces with structures to allow for differential movement between pipe and structure in all directions without stressing or breaking the pipes.
- 14.1.21. Appropriate restrained flexible connections and/or joints shall be provided for all pipes where they connect to any and all of the following:

- a) Equipment such as pumps, blowers, or inline devices
- b) Valves
- c) Wall, floor, or roof penetrations

14.1.22. Where piping or other materials susceptible to damage from ultraviolet radiation are employed, they shall be protected from such radiation through the use of appropriate additives and/or coatings and shall be physically shielded from direct sunlight at all times in their normal service location using enclosures, covers, canopies, roofs, and/or other similar means.

14.1.23. Platforms, handrails/guardrails, ladders, and stairs shall be provided where necessary for proper, safe, and easy access to and/or operation of valves, gates, instruments, control panels, and other devices, equipment, or structures.

14.1.24. Appropriate sampling ports and/or sampling valves shall be provided to allow easy, safe sampling of all process streams without spillage or contamination and without the need to interrupt normal operation.

14.1.25. The influent flow meter and influent sampling location shall be selected such that the true influent flow and characteristics will be measured without inclusion of in-plant recycles or other extraneous streams. Separate flow measurement and sampling shall be provided for the recycle streams.

14.1.26. Foam, scum, fats, oil, grease, or any other floating material removed from any location in the plant shall be completely removed from the process flow path along with waste activated sludge, thickened sludge and/or dewatered solids leaving the STP and shall under no circumstances be recycled or returned to any location in the plant. Scum removal arrangement and mechanism shall be provided in grit chambers.

14.1.27. All units shall be interconnected by RCC overhead walkways, minimum 1.2 m wide with handrail and RCC staircase.

14.1.28. Contractor shall strictly comply with the specified treatment concept, treatment unit processes, flow configuration (connectivity between unit processes and facilities), performance requirements (such as effluent and sludge quality and equipment efficiencies), and design criteria (such as design operating conditions, various process loading rates and/or detention times, and dimensions where specified).

## **15. Major Process Units and Facilities Description**

**15.1.** This Process and Facilities description is intended to provide a general indication of the various unit processes and type of facilities that the Contractor shall be required to design, construct, and operate, and applies to all Plants in this contract unless specifically indicated otherwise. The Contractor shall use this description together with other specific information for each Plant provided elsewhere in these bid documents, including but not limited to Process Unit Design Criteria given under, Process Flow Diagram (PFD), Piping and Instrumentation Diagram (P&ID) and Plant Location, all of which are integral to this Process and Facilities Description and are incorporated herein for reference.

**15.2.** The Contractor shall strictly comply with the specified treatment concept, flow configuration (connectivity between unit processes and facilities), performance requirements (such as treated sewage and sludge quality and equipment efficiencies), and design criteria (such as design operating conditions, various process loading rates and/or detention times) as specified below

**15.3.** Contractor should note that the ‘Major Process Units and Facilities’ described are for bidders guidance purpose only. Any other process units or facilities required for successful completion and commissioning of this plant will be a part and parcel of the contract and no separate payment will be made for such account.

#### **15.4. Primary Treatment Units**

##### **15.4.1. Inlet Chamber**

- a) Pumped sewage shall be provided at the plant location outside the plant boundary. The Contractor for this contract shall connect the incoming line to the inlet chamber of the STP, construct the inlet chamber and coordinate the exact location of such chamber with Employer. The maximum water level (MWL) in the inlet chamber will be decided based on plant hydraulics with respect to HFL in the receiving water body. However, the Contractor shall be fully responsible for proper coordination to ensure proper alignments and interfaces and for proper implementation of all connections.
- b) Designing, providing, and constructing RCC (M: 30) inlet chamber for the peak flow and recirculated flow (if any), including necessary excavation in all types of strata including walkway all around the periphery. Inlet chamber having minimum HRT of 60 seconds, each compartment will have steel gates with extension rod, head stock operating wheels. SS pipe railing etc. The work includes providing and making necessary arrangements to connect the flow to screen chamber by approach channel.

Items	Unit	Values
<b>Inlet Chamber</b>		
Design flow	M3/day	Peak flow + Recirculated flow (If any)
Hydraulic Retention Time (HRT)	sec	60
Minimum number of unit	Number	1
MOC	-	RCC M30

##### **15.4.2. Fine Screens**

- a) The fine Screens shall receive sewage from the upstream inlet chamber. The screenings removed by the screens shall be discharged at the appropriate elevation above ground on to a conveyor. A belt conveyor positioned above ground level shall convey the screenings through a galvanized steel chute to a trolley positioned at ground level.
- b) Designing, providing, constructing, testing and commissioning of approach channels, mechanically cleaned bar rack screen (6 mm clear opening 10 mm thick flats), Escalator screens, with standby manual fine screen (10 mm clear opening) MOC: SS316, CI sluice

gates (one before screen & one after screen), designed for peak flow and recirculated flow (if any), in RCC (M-30), including inlet pipe/ channel from inlet chamber, outlet pipe / channel to detritus tank, free board of 0.5 m minimum, RCC walkway 1.2 m wide with SS pipe railing. RCC stair case of 1.2 m width from GL to screen chamber with operating platform and belt conveyor system incl. panel & push bottom switch at local level as well as MCC room for two-way control. For STP<= 10 MLD capacity, manual fine bar screen shall be of 100% capacity. For STP>10 to<=50 MLD capacity, manual fine bar screen shall be of 50% capacity.

- c) Fine screens (SS 316) are of mechanically cleaned type for working unit and manual bar screen type (SS 316) for standby unit.

<b>Fine Screen Channels (Working)</b>		
Design flow	m <sup>3</sup> /day	Peak flow + Recirculated flow (If any)
Screen type	-	Bar screen/ Mat screen/ Step screen/ Escalator Type/ Drum Screen/ Rake Type Screen/ Circular Wedge Wire Screens with mechanical Cleaning/ Parabolic Screen with Automatic Self Cleaning
MOC – Channel	-	RCC M30
MOC – Screens (all screen components)	-	SS 316
Angle of inclination of screen	deg.	For step type mat screen: 45 degree and for Mechanical fine screen other than (Step mat screen): 75 degree.
Approach velocity in channel	m/ sec	0.6-0.8 (not less than 0.3 at lean flow)
Velocity through openings at peak flow	m/ sec	0.6-1.2
Length of upstream channel	m	Minimum 5 times width of screen channel
Length of downstream channel	m	Minimum 3 times width of screen channel
Clear spacing between bars	mm	6

<b>Fine Screen Channels (Standby)</b>		
Design flow	-	Peak flow + Recirculated flow (If any)
Screen type	-	Bar screen/ with Manual cleaning rake
MOC – Channel	-	RCC M30
MOC – Screens (all screen components)	-	SS 316
Angle of inclination of screen	deg.	45-60

Approach velocity in channel	m/sec	0.6-0.8 (not less than 0.3)
Velocity through openings at peak flow	m/sec	0.6-1.2
spacing between bars		

#### 15.4.3. Grit Basins and Grit Washers and Classifiers

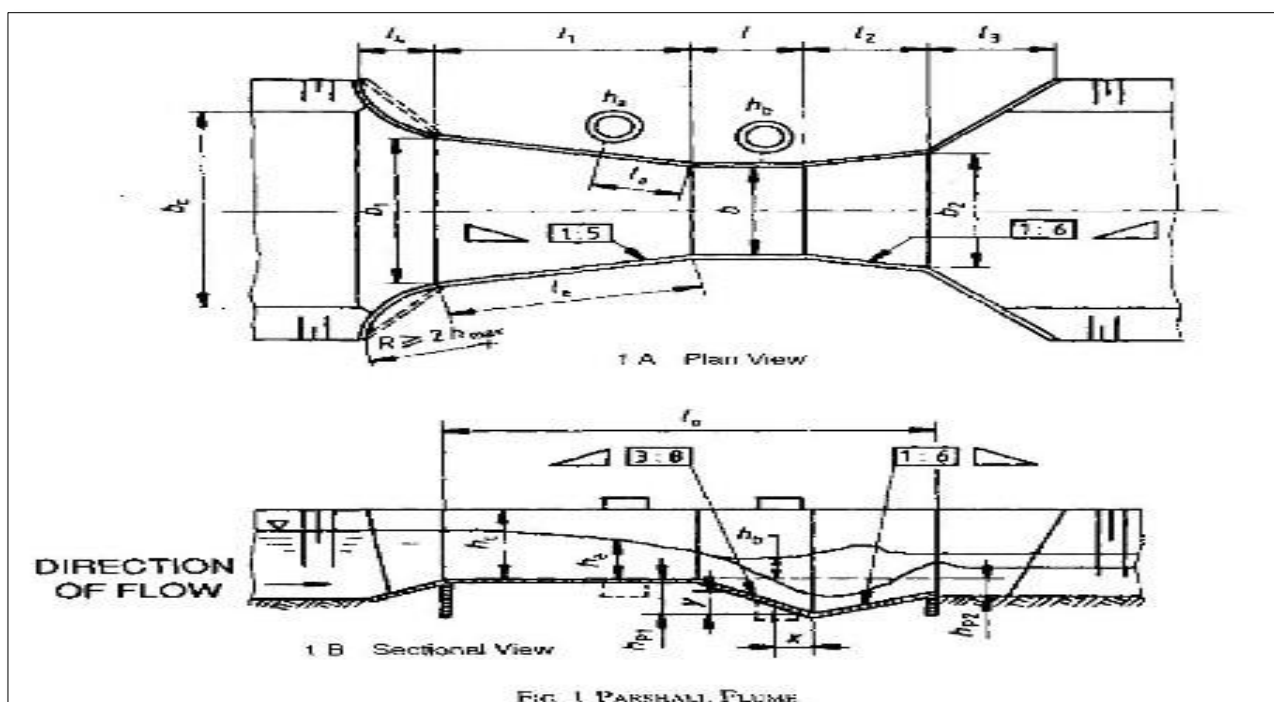
- a) A complete grit removal facility shall be provided, with integrated fats, oil, and grease (FOG) removal. All equipment and components (including but not limited to conveyors, pumps, and blowers) necessary for a fully functional system shall be provided regardless of whether or not such items are specifically listed or described in the bid document. Dewatered grit shall be collected in a trolley positioned at ground level below the Grit Classifier discharge. De-gritted sewage shall exit the Grit Basins over the outlet weir. Liquid streams from grit washers and classifiers shall be returned to the de-gritted sewage stream or to the Plant Drain Pump Station. Any FOG skimmings removed shall be routed to the thickened sludge sump. Each Mechanism shall be provided with Organic return pumps. This shall be suitably located to return organics back to Grit Chamber. The de-gritted sewage shall flow through open channels from the grit separators and confluence into a single channel of suitable width for provision of Parshall flume. Bypass facility for de-gritted sewage shall be provided. Separate land for grit conveyance shall be indicated in the layout.
- b) Designing, providing and constructing grit Chamber- Detritus or vortex type or aerated type, mechanically operated in RCC (M 30) capable of removing grit particles of 0.15 mm size and above, having specific gravity 2.65 as specified below, HRT of 1 minute at average flow (Detritus Tank), horizontal velocity not exceeding 0.30 m/sec at peak flow (Detritus Tank) with suitable arrangement of separation of grit from putrescible solids. Inlet and outlet channels of required sizes as may be required to connect the flow to connecting unit etc. Complete including hydraulic testing for water tightness of structure having minimum FB of 0.5 m, wash out arrangement to Grit chamber and platform 1.2 m wide RCC walkway with GI pipe handling shall be provided. A pit for collecting grit conveyed by conveyor shall be provided. It should be suitable to handle the grit for carting. All arrangements shall be as detailed specifications and as directed. CI sluice gates for upstream of grit chamber and for bypass arrangement to be provided.

Grit Basins		
Design flow	-	Peak flow + Recirculated flow (If any)
Type	-	Mechanical Detritor type or Vortex or Aerated Type with center drive, full diameter scraper
MOC of Basin	-	RCC M30
MOC – Equipment/Mechanism	-	SS 316
Design particle diameter (Specific Gravity – 2.65)	mm	0.15

<b>Detritor type Grit Chamber</b>		
Maximum Design SOR at peak flow	m <sup>3</sup> /m <sup>2</sup> /day	959
Minimum efficiency	%	75
Minimum HRT at average flow	sec	60
Minimum design SWD	m	0.85
Grit accumulation	m	0.15
Minimum free board	m	0.5
Organic return pump and organic wash pump	-	To be provided as per requirement (for each Detritor type grit chamber separately)
<b>Grit Washer and Classifier</b>		
Type	-	Reciprocating rake mechanism or screw conveyor
<b>Aerated Grit Chamber</b>		
Transverse velocity at surface	m/s	0.6-0.8
Depth-to-width ratio	-	1.5:1 to 2:1
Air supply	-	4.6-7.7 l/m/s of length 0.3-0.4 m <sup>3</sup> /m <sup>3</sup>
Detention time at peak flow	Minutes	3-5
Quantity of grit	ml /m <sup>3</sup>	7.5-75
<b>Vortex- Type Grit Chamber</b>		
Minimum Velocity	m/s	0.15
Detention Time @ peak flow	sec	20-30

#### 15.4.4. Parshall Flume

- a) A Parshall flume shall be provided at downstream of Grit Chamber. There will be one number Parshall flume in R.C.C channel, which shall be designed for measuring peak flow including the recirculated flow, if any. There will be an approach channel, a throat, and a downstream channel. At the throat, there will be a hydraulic jump and a corresponding head loss. An Ultrasonic flow meter shall also be provided for flow measurement shall be mounted above the channel to measure the flow, record it and integrate it. Recorder and integrator will be housed in the control room.
- b) Parshall flume shall be as per IS 14371:1996 with necessary flow measuring devices/ meter consisting of digital indicator in LPS & MLD. For dimensional details refer table given below



IS 14371 : 1996

Table 1 Dimensions for Standard Parshall Flumes

(Clauses 8.2 and 8.2.1)

All dimensions in metres.

Parshall Flume No.	Throat					Entrance Section				Exit Section			Side Wall Height
	$b$	$t$	$X$	$Y$	$h_{p1}$	$b_1$	$l_1$	$l_e$	$l_4$	$b_2$	$l_2$	$h_{p2}$	$h_c$
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0.152	0.305	0.05	0.075	0.115	0.40	0.610	0.622	0.415	0.39	0.61	0.012	0.60
2	0.250	0.600	0.05	0.075	0.230	0.78	1.325	1.352	0.900	0.55	0.92	0.072	0.80
3	0.300	0.600	0.05	0.075	0.230	0.84	1.350	1.377	0.920	0.60	0.92	0.072	0.95
4	0.450	0.600	0.05	0.075	0.230	1.02	1.425	1.454	0.967	0.75	0.92	0.072	0.95
5	0.600	0.600	0.05	0.075	0.230	1.20	1.500	1.530	1.020	0.90	0.92	0.072	0.95
6	0.750	0.600	0.05	0.075	0.230	1.38	1.575	1.607	1.074	1.05	0.92	0.072	0.95
7	0.900	0.600	0.05	0.075	0.230	1.56	1.650	1.683	1.121	1.20	0.92	0.072	0.95
8	1.000	0.600	0.05	0.075	0.230	1.68	1.700	1.734	1.161	1.30	0.92	0.072	1.00
9	1.200	0.600	0.05	0.075	0.230	1.92	1.800	1.836	1.227	1.50	0.92	0.072	1.00
10	1.500	0.600	0.05	0.075	0.230	2.28	1.950	1.989	1.329	1.80	0.92	0.072	1.00
11	1.800	0.600	0.05	0.075	0.230	2.64	2.100	2.142	1.427	2.10	0.92	0.072	1.00
12	2.100	0.600	0.05	0.075	0.230	3.00	2.250	2.295	1.534	2.40	0.92	0.072	1.00
13	2.400	0.600	0.05	0.075	0.230	3.36	2.400	2.448	1.632	2.70	0.92	0.072	1.00

#### 15.4.5. Primary Clarifiers ( as per process selection)

Parshall Flume		
Minimum number of Units (Inlet + Outlet)	Numbers	1 Each
MOC	-	RCC M30



Design Flow	-	Peak flow Flow (if any) + Re-circulated
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- a) Distribution chamber having appropriate size with CI sluice gates shall be provided for each clarifier.
- b) Primary Clarifiers shall be provided wherever ASP process is proposed by the bidder, for removal of suspended solids from fine-screened and de-gritted sewage.
- c) The primary sludge sump shall receive the sludge from primary clarifier by gravity. The primary sludge pumps (Minimum 1W+1S) shall pump the sewage to gravity sludge thickener. Sludge Sump with Pumping station shall be provided.

Primary Clarifiers		
Drive type	-	Center-column supported with center drive. Peripheral drive or bridge-supported not allowed.
MOC – Structure	-	RCC
Conical bottom minimum slope	-	1 to 12
MOC – Center column	-	MS Epoxy coated
MOC – Bridge	-	MS Enamel painted
MOC – Mechanism	-	MS Epoxy coated
Max SOR at average flow	m <sup>3</sup> /m <sup>2</sup> /day	As per CPHEEO Manual
Max SOR at peak flow	m <sup>3</sup> /m <sup>2</sup> /day	
Max Weir loading at average flow	cum/day/m	
Minimum SWD	m	
Scum removal	-	To be provided by bidder
Primary Removals and Primary Sewage Characteristics		
BOD Removal	%	As per CPHEEO Manual
TSS Removal	%	As per CPHEEO Manual

### 15.5. Secondary Treatment Units

15.5.1. Secondary treatment processes included but not limited to the following options shall be considered for organic removal along with Biological Nutrient Removal (BNR) to achieve the treated sewage quality specified in Vol-III A of this tender document.

- a) Modified Activated Sludge Process (MASP)
  - Anaerobic –Anoxic-Oxic (A2O) Process (with provision of coagulant dosing system)
  - Bardenpho 4-stage Process (with coagulant dosing)
  - Bardenpho 5-stage Process (without coagulant dosing)
  - Modified Ludzack Ettinger (MLE) Process (with coagulant dosing system)

To achieve treated sewage quality as per process design requirement, the plant based on

above processes shall have Tertiary filtration units.

- b) Sequential Batch Reactor (SBR) (optional coagulant dosing system)
- c) Moving Bed Bio-reactor (MBBR) (with pre-anoxic tank and additional coagulant dosing system) with Tertiary filtration units.
- d) Membrane Bio-reactor (MBR) (with coagulant dosing system)

15.5.2. It is to be noted that multi-stacking of units on one another shall not be acceptable.

**Equalization cum Neutralization tanks are mandatory.** Bidder/Contractor shall make necessary arrangement to safeguard the biological treatment and to accommodate the shock loads/peak flows.

### 15.5.3. Biological Process Requirements (MASP):

- a) Modified Ludzack Ettinger Process (With coagulant dosing system) --

Minimum Total HRT (Hrs)	F/M	MLSS (mg/l)	Sludge Age (Days)	Internal recirculation (%)	Return Sludge (%)
12	0.083 - 0.12	1500-4000	17.00	400 % to Anoxic Zone	100% to Anoxic Zone

**Note-** Bidder to strictly comply with minimum total HRT as mentioned above in table. For design average flow + re circulated flow. Post anoxic tank is not acceptable for MLE process

- b) Design parameters for A2O Process (With Provision of Coagulant Dosing System)

F/M as MLVSS (d <sup>-1</sup> )	SRT (day)	MLSS (mg/l)	Minimum Total HRT (Hours)	Return Activated Sludge (% of Influent)	Nitrified Recycle (% of Influent)
0.15-0.25	4-27	3000 - 4000	12	100 % to Anaerobic Zone	400 % to Anoxic Zone *

Note- 1 Bidder to strictly comply with minimum Total HRT as mentioned above in table. For design average flow + re circulated flow

Note- 2 \* Provision to be made to pass 50% of nitrified recycle / Mixed liquor internal recycle to anaerobic tank and 100% to anoxic tanks in A2O process.

- c) Design parameters of Bardenpho Process

Process	SRT(d)	MLSS (mg/l)	Retention Time (Hrs)	Return Activated Sludge (% of Influent)	Internal recycle % of Influent
Bardenpho (4 Stage)	10-20	3000-4000	12	100 % to Anaerobic Zone	400% to Pre Anoxic Zone
Bardenpho (5 Stage)	10-20	3000-4000	12	100 % to Anaerobic Zone	400% to Pre Anoxic Zone

#### 15.5.4. Aeration Basin Influent Channel

- a) Primary treated sewage shall flow by gravity to the Aeration Basin Influent Channel from where it shall be distributed to the aeration basins. Appropriate isolation gates and/or valves shall be provided to allow isolation of each basin. A bypass mechanism shall be designed and constructed such that channel contents will be bypassed around the aeration basins only if inflow to the channel exceeds the combined peak hydraulic design capacity of all aeration basins in service. The bypass flow shall be routed to the receiving water body via the plant outfall pipe.
- b) Distribution chamber with CI sluice gates for each compartment of anoxic followed by aeration tank & bypass chamber, having appropriate size, operating platform with railing shall be provided.

#### 15.5.5. Anaerobic Tank

- a) Sewage shall flow by gravity into Anaerobic Tanks through a channel and distributed by a distribution chamber. Anaerobic tank shall be designed for biological phosphorus removal as per the tender specifications.
- b) Suitable Anaerobic and/or Pre-Anoxic Tanks for Biological phosphorus removal and denitrification with submersible mixer arrangement respectively as specified below, shall be provided.

#### 15.5.6. Anoxic Tank

- a) Sewage from Anaerobic Tank shall flow by gravity into Anoxic Tank. Nitrified Mixed Liquor Recycle (MLR) from Aerobic Tank shall be internally recycled to Anoxic Tank for denitrification as per the tender specifications.
- b) Suitable Anaerobic and/or Pre-Anoxic Tanks for Biological phosphorus removal and denitrification with submersible mixer arrangement respectively as specified below, shall be provided.

<b>Anaerobic Basin (if required)</b>		
MOC – Structure	-	RCC M 30
Depth	m	5
Min Freeboard	m	0.6
Minimum mixing rate for submersible mixers	W/m <sup>3</sup>	10
<b>Anoxic Basin</b>		
MOC – Structure	-	RCC M 30
Minimum SWD	m	5
Minimum Freeboard	m	0.6
Minimum mixing rate for submersible mixers	W/m <sup>3</sup>	10
<b>Aeration Basin</b>		

MOC – Structure	-	RCC M30
Min SWD	m	5
Min Freeboard	m	0.6
<b>Recycle Configuration</b>		
Hydraulic design of wet well	-	Minimum HRT 30 Min for upto flow of 75% of return sludge capacity
RAS Ratio ® – hydraulic design	-	As per CPHEEO Manual

- c) All anaerobic and anoxic zones shall be provided with mechanical submerged mixers. Individual HRT and corresponding volumes of each zone shall be as per CPHEEO /contractor design to achieve treated sewage characteristics; however, it shall meet the overall minimum requirements as specified herein.

#### 15.5.7. Aeration Basins

- a) Sewage shall enter aeration tank for oxidation of organics and nitrogen by biological reactions in presence of oxygen.
- b) Minimum 2 no of modules. Minimum free board 0.6 m in case of diffused aeration system (disk / tube type diffusers) & in case of aspirator aerator, CS piping, air blowers.
- c) The Contractor shall provide suitable arrangements for draining the aeration tanks. The Contractor shall design the inlet and outlet channels and/or pipe work with isolation gates to permit any of the individual aeration tanks to be taken out of service.
- d) The Contractor shall minimize dead spots within the aeration lanes by providing baffle walls and fillets to corners of tanks where necessary. The size of any fillets at the base of walls shall be kept to a minimum in order to maximize the area of horizontal aeration tank floor available for installation of the aeration system.

#### 15.5.8. Biological Process Requirements (SBR):

##### a) SBR Division Box:

The RCC Division Box shall receive the screened and de-gritted sewage flow prior to feeding it to the Sequencing Batch Reactor (SBR) Basins. The box is designed for peak flow and re-circulated flow and shall divide the flow into equal parts with adjustable overflow gates to take the flow to feed channel or weir followed by motorized gates. Each feed channel feeds sewage into each SBR basin. Appropriate isolation gates and/or valves shall be provided at all inlet points to allow isolation of each basin.

##### b) Anoxic Basin/ Bio-Selector Zone (For SBR):

- Sewage shall flow by gravity into Anoxic Tank via appropriate isolation gates. Anoxic Tank shall be designed for biological nitrogen removal as per the tender specifications.
- The system shall have a sludge volume index (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 Sequencing Batch Reactor (SBR) Units shall be discharged in Chlorination Tank for its disinfection.

**c) SBR basins:**

1. Sequencing Batch Reactor (SBR) shall be either continuous flows and intermittent decant or intermittent flows and intermittent decant type. It shall perform biological Organic Removal, Nitrification, De-nitrification and Biological Phosphorous Removal and shall be capable of simultaneous sludge stabilization. SBR designs shall strictly comply with process requirement set out in this bidding document and all other requirements specified in the bid documents.
2. If the SBR cycle includes fill during settle, the contractor shall fully describe the internal configuration of each basin which ensures that mixed liquor settlement is not adversely affected, and that short circuiting of influent wastewater does not occur.
3. The decanters shall be designed to prevent solids entering the decanting device during the aeration phase. Each decanter shall be fitted with scum retention mechanism/ baffles to prevent surface scum and floatables from exiting with the treated sewage. Any shortfall in meeting the performance standards due to decanting depth observed during commissioning and operation of the plant shall be corrected by contractor at his own risk and cost.
4. Each SBR tank shall be fitted with separate scum collection & removal system. The system shall be designed to minimize the volume of liquid discharged with the scum whilst providing efficient removal of the scum and shall be capable of collecting the scum with varied water levels of tank. All the scum shall be properly screened separately in accordance with screening requirements specified in tender document and liquid stream shall be sent directly to the Thickened Sludge Sump using an automated pumped system.
5. SBR basins may or may not have internal partitions. Regardless of such internal partitioning, all SBR designs shall strictly comply with the minimum requirements specified in the bid documents.
6. Designing, providing and constructing in RCC (M 30), SBR basins for biological removal of BOD along with built-in nitrification-de-nitrification, Bio-P removal in compartments to handle design flow including recirculation flow and construction of selector compartments and providing 1.2 m wide clear approach walkways, expansion joints wherever necessary, including foundations etc as per specifications, aeration system complete with air blowers, fine diffused aeration grid and FB 0.5 m and SWD as required. DO level in basin to be minimum 2 mg/l and all related instruments, Stainless steel decanters and automation works. MLSS concentrations & F/M shall be as specified below to arrive at the specified HRT range and SRT suitable for fully digested sludge. SBR process shall have steps like Fill & aeration, Settling (Sedimentation/clarification), Decanting. The system should work on a gravity influent condition. It should have all other related works.

<b>Division Box for SBR</b>		
Design Flow	-	Peak Flow + Re-circulated Flow from sludge treatment
Minimum HRT	Sec	60
Minimum Freeboard	M	0.5
MOC	-	RCC M30
<b>Anoxic Basin/ Bio-Selector Zone</b>		
Design Flow	-	Avg. Flow & Re-circulated Flow from sludge treatment per number of basin under fill simultaneously + RAS Flow (if any)
MOC – Structure	-	RCC M30
Side Water Depth (SWD) at average level	M	5 - 6
Minimum Freeboard	M	0.5
Minimum HRT at Average flow	Hrs	For STP based on SBR process as per technology provider's design; combine HRT of Anoxic Basin/ Bio-Selector Zone and SBR Biological Processes put together shall be in the range of 14-18 hrs.
Mixing in Selector zone/ Pre-react zone	-	Submersible mixers or mixing as per bidder's design
<b>SBR Submersible Mixers (if required)</b>		
Direct pumping turnover frequency	per hr	1
Minimum number of Mixers per basin - Working	Number	1
Maximum number of Mixers per basin - Working	Number	4
Mixer type	-	Submersible mechanical or floating
Minimum number of mixers - Uninstalled Spares as percent of Working	%	25
Minimum number of mixers - Uninstalled Spares	Number	1
Required Minimum unit power input	w/cum	5
MOC	-	SS316

<b>SBR Biological Processes – Design Requirements</b>				
<b>Sr.No.</b>	<b>Parameters</b>	<b>Units</b>	<b>Continuous Flow</b>	<b>Intermittent Flow</b>

			and Intermittent Decant	and Intermittent Decant
1	Minimum number of basins	Nos.	2	
2	MOC – Structure	-	RCC M30	
3	SWD at average level	m	5-6	
4	Minimum Freeboard	m	0.5	
5	Decanting mechanism		Swing down / float type	
	Decanting depth shall be designed to handle peak hourly flows + re-circulated flow while meeting the specified performance standards for treated sewage.			
6	Food applied to Microorganism ratio (F/M)	d-1	0.05-0.08	0.05-0.3
7	Sludge Age	d	15-20	4-20
8	Sludge Yield	Kg dry solids/ Kg BOD	0.75-0.85	0.75-1.00
9	Mixed Liquor Suspended Solids (MLSS)	mg/l	3,000-4,000	3,500-5,000
10	Cycle Time	h	4-8	3-6
11	Settling Time	h	>0.5	>0.5
12	Decant Depth	m	1.5 -2.5	1.5 -2.5
13	Fill Volume Base	-	Peak Flow	Peak Flow
14	HRT	h	As per technology provider's design; combine HRT of Anoxic Basin/ Bio- Selector Zone and SBR Biological Processes put together shall be in the range of 14-18 hrs	
15	Minimum RAS (% of influent)	%	30	30
16	Number of RAS pumps, (if required)	per basin	1 W+1 S	

#### 15.5.9. Biological Process Requirements (MBBR):

The bioreactor shall be designed to treat the peak flow sewage for organic load reduction along with BNR using an integrated fixed Film Activated Sludge system using free floating/moving cylindrical biomass carriers having more than 7years of life. The media/carriers shall be kept in suspension at any time by diffused aeration. MBBR tanks shall be aerobic stage for BOD removal.

The recirculation of activated sludge (RAS) may be provided depending upon bidder's design/proposal. The MBBR bio reactor shall be suitably sized to achieve the desired treated sewage quality. The shape of the reactor can be circular or Square or rectangular

as per the bidders design, the shape should be so fixed so that it is suited for a compact and operationally flexible layout

Reactor Media shall be as per bidder's patented design but compatible with other media types for future operations considering about 20% variation in specific surface area. The media shall have a specific gravity of equal to or less than that of the waste water and be suitable of providing axial rotation in all planes as well as ensuring aeration to all surfaces. Aeration should be done through fine or coarse bubble diffusers.

Media Trap made from SS 304 (wedge wire screens) or superior material as approved by Employer shall be provided to ensure that media does not escape to the downstream unit. The size of the screens will be governed by the size of the bio-carriers. The entry and exit of waste water shall be at opposite ends both in horizontal & vertical plane. The reactor dimensions, media quantity shall be adequate for providing adequate sufficient surface area for maintaining the biomass required for degradation and air required as required to achieve the quality. The aeration system shall be provided for sufficient oxygen supply for the effective biodegradation in aerobic reactors. The level of dissolved oxygen in the Aerobic reactors shall be maintained minimum at 2.0 mg/l or above to facilitate the required biodegradation.

Blowers, piping, valves and other equipment to maintain air flow to the aerobic reactors must suit the needs of the media circulation and aeration of MBBR system. All systems and process equipment including tertiary treatment units as necessary to meet the performance requirements will be provided by the Contractor.

Biological Processes – Design Requirements	
MBBR	Designed based on 0.8 – 1.2 Kg BOD / m <sup>3</sup> .d
	Min. HRT of 4 hrs
	Volume of MBBR Media – Min. 33% and Max. 50%

MBBR Basin		
Water Depth (Minimum)	m	As per CPHEEO Manual
MBBR Media		
% of MBBR Media required	%/volume of MBBR Tank	As per CPHEEO Manual
MBBR Surface Area	m <sup>2</sup> /m <sup>3</sup>	
Shape	-	
MOC of Media	-	PE/ PU PP/UPVC (Only virgin plastic)
Corrugation	-	One side (Inside)
Min. expected life	years	7

#### Biological Process Requirements (MBR):



For STPs with MBRs shall be designed to treat peak flow sewage for organic load reduction along with BNR, the Aeration Basin shall house the membrane filtration modules. The MBR basins shall be fully covered with solid non-skid GRP cover plates. The design shall provide for easy isolation of each MBR basin and shall include all required facilities for complete, fully automated clean-in-place (CIP) functionality. An electric overhead bridge crane shall be provided for easy removal of the membrane modules. The crane shall provide adequate vertical clearance to safely lift the membrane modules above all piping, equipment, or other items that may be located in the travel path from the module location in the tank to an adequately-sized adjacent membrane “lay-down” area designated for membrane maintenance. The crane coverage shall include the entire MBR basin area plus the lay-down area.

The sludge from MBR basins shall continuously overflow into an adequately-sized common structure that shall serve as the wet well for RAS pumps.

An MBR building shall be provided. This building shall house all MBR-related equipment such as Scour Air Blowers, Permeate/Back pulse Pumps, and RAS Pumps.

In addition, the MBR Equipment building shall house all equipment necessary for all types/modes of membrane cleaning.

The Process Air Blowers for MBRs may be housed in the MBR building or a separate building.

In addition to fine screen, the drum screen upstream of MBR tank shall be provided. Drum Screens shall have clear openings 1 to 2 mm for MBR:

<b>Biological Processes – Design Requirements</b>					
<b>Treatment</b>	<b>SRT (d)</b>	<b>F/M (Kg BOD / Kg MLVSS. D)</b>	<b>MLSS (mg/L)</b>	<b>Aeration Tank HRT (hr)</b>	<b>RAS (% of influent)</b>
MBR	5 to 20	0.1 to 0.4	5000-20000	Min 6	0.5 to 2.00

<b>MBR Basins</b>		
Membrane Type	-	Flat sheet, Hollow yarn membrane
Membrane Material	-	PVDF /PS/PES
Membrane in Tank	-	Immersed in Bioreactor (side stream is not allowed)
Flux	LMH	As per CPHEEO Manual
Diffusers in Bioreactor	-	Fine Bubble diffused aeration
Diffusers in MBR Tank	-	Fine Bubble diffused aeration
Applied Vacuum	Kpa	5 to 30
Chemicals for Membrane cleaning	-	NaOCl and Citric Acid
Type of cleaning	-	CIP (cleaning in place)

#### 15.5.10. Diffused Aeration System

- a) The oxygen required shall be supplied through Fine Bubble Diffused Aeration System with auto control of oxygen level in the Basins. Diffused aeration shall be of Fixed / retrievable type. Each aerobic basin shall have a separate diffuser grid supplied by a separate air drop pipe with the air flow controlled by a separate valve and measured by a separate flow meter. All systems shall use Variable Frequency Drive (VFD) driven Blower interlocked with Dissolved Oxygen (DO) control. Stub walls shall be incorporated into the structural design of the aeration basins to allow easy addition of the extra partition wall in the future if needed.
- b) The RAS piping/channeling shall also be designed such that potential future piping and valve modifications necessary to match the potential future zone modifications described above can be accomplished with ease and minimal disruption.
- c) The aeration shall be provided primarily for biological treatment. The aeration equipment shall also to provide adequate mixing arrangement in the aeration tank to keep the solids in suspension. In case of diffused aeration, the air volume for mixing shall be in the range of 1.8 to 2.7 m<sup>3</sup>/hr/m<sup>2</sup> of floor area.
- d) The Plant should be based on Dissolved Oxygen/Oxygen Uptake Rate Control with VFD driven Aeration Device. The Aeration System shall be designed for 110 % Capacity of the design Air requirement. The aeration Blower/Aeration Device shall be having 100% installed standby unit in case of single unit and in case of multiple unit the standby capacity shall be 50%.
- e) Air diffuser shall be of disk/ tubular type. The wetted part of the aeration system shall be of non-corrosive materials such as SS316.

Material of Construction (MOC) of diffuser laterals shall be SS 316 / uPVC

- f) Air Blowers shall be housed in process air blower building. The surface Aerators are not acceptable.
- g) In case of Aspirator Aeration Equipment one total set of equipment should be provided as standby.

Diffused Aeration System		
Maximum Alpha Factor, $\alpha$	-	0.6
Maximum Beta Factor, $\beta$	-	0.95
Maximum Fouling factor, F	-	0.9
Oxygen demand peaking factor	-	1.0
Aeration system sizing basis liquid temperature		Maximum liquid temp
Aeration system sizing basis air temperature		Maximum air temp
Maximum air temperature	°C	49
Minimum liquid temperature	°C	10

Aerobic basin DO (minimum)	mg/L	2
Diffuser type	-	Fine bubble diffuser (Disc or Tube type) Coarse bubble diffusers are acceptable for MBBR process only
Diffuser Installation	-	Fixed/ Retrievable
Diffuser material	-	PU/ EPDM/ Silicon Elastomer/ Aluminium Oxide/ Silicon Oxide with anti-microbial coating
Minimum numbers of diffusers – Uninstalled shelf spares	%	10
Maximum SOTE per unit diffuser submergence at peak air flow (for design calculations)	%/m	4 to 5
<b>Aeration System</b>		
BOD oxidation oxygen requirement	KgO <sub>2</sub> /Kg BOD	1.1
Oxygen required for Nitrification	KgO <sub>2</sub> / Kg of NH <sub>3</sub> -N	4.6
Type of Aeration	-	* Type of Aeration- Diffused Aeration or Aspirator Aeration.
*Note- The proposed aeration system shall be in successful operation in plant since last three (3) years in India.		
<b>Process Air Blowers</b>		
Blower type	-	Rotary lobe PD or with turbo single stage centrifugal type air blower with Variable frequency drive (VFD) for all blowers with acoustic enclosure.  Air Blowers shall have to acoustic enclosure to ensure that the noise level due to air transmission to air diffusers from air blowers, around air blowers' delivery piping up to diffuser shall be less than 85 db at 1.00 m from pipe. It shall be less than 45 db at 1 m (Outside) from periphery of compound wall.
Blower Capacity	-	110% of calculated total air requirement (All systems shall use Dissolved Oxygen (DO)/ Oxygen Uptake Rate (OUR) control with VFD driven Blower
No of blowers – Working	Minimum	1

No of blowers – Standby	Minimum	50 % for each set of basin
MoC		
Casing	-	CI FG 260 as per IS 210
Integral Shaft with Lobe	-	Cast Steel
Fabricated Items	-	Epoxy Coated MS as per IS: 2062
<b>Aspirator Aerator</b>		
Capacity	%	125
Aerobic basin DO (minimum)	mg/L	2
Maximum Alpha Factor, $\alpha$	-	0.6
Maximum Beta Factor, $\beta$	-	0.95
Oxygen Transfer Efficiency	Kg O <sub>2</sub> /kWh	1.2 to 2.4
Mixing Power Requirement	W/m <sup>3</sup>	15-26

#### 15.5.11. Secondary Clarifiers (as per selected Process / technology)

- Distribution chamber with CI sluice gates for each clarifier (in no case bypass shall be provided after aeration without secondary clarification), having suitable size, operating platform with CI pipe up to central pier shall be provided.
- Secondary clarifiers shall be provided to separate mixed liquor solids from the treated liquid phase. Lamella / Plate clarifier for Secondary Clarification stage is not acceptable.
- Secondary Clarifier surface loading rate of 8-12 cum./sq.m/day or less as required and free board of 0.5 m, weir loading limited to 185 cum/day.m. (at average flow), double armed scrapper mechanism, launder as required, telescopic valve, sludge removal pit with CI piping for inlet & outlet, 6 mm thick FRP weir plate, up flow velocity in central pier receiving sewage from the pipeline (from distribution chamber) limited to 0.9 m/sec in central pier, sewage outlet fins of required size as per manual of practice (CPHEEO/ ASCE)(maximum diameter 48 m)

<b>Secondary Clarifiers</b>		
Type	-	Circular, center-column supported with center drive, and center or peripheral feed. Peripheral drive or bridge-supported not allowed.
Sludge and scum removal	-	2-arm spiral sludge scrapper. Full- radius scum baffle with beach-type skimmer.
MOC – Structure	-	RCC M30
Conical bottom minimum slope	-	1 to 12
MOC – Center Column	-	MS Epoxy coated
MOC – Bridge	-	MS Enamel painted

MOC – Scraper and Skimmer	-	MS Epoxy coated
Maximum SOR at average flow	m <sup>3</sup> /m <sup>2</sup> /day	8-12
Maximum SOR at peak flow	m <sup>3</sup> /m <sup>2</sup> /day	25-35
Maximum SLR at average flow	Kg/m <sup>2</sup> /day	25-120
Maximum SLR at peak flow	Kg/m <sup>2</sup> /day	170
Maximum Weir loading at average flow	cum/day/m	185
Clarifier SWD	m	3-4

#### 15.5.12. Return Activated Sludge (RAS) Pump Station

- a) RAS pumps shall be provided to return settled sludge from the Secondary Clarifiers back to the Anaerobic and / or anoxic zones of Aeration Basins. A valve- controlled and metered tapping shall be provided from the RAS pump discharge header to withdraw Waste Activated Sludge (WAS) to Sludge Treatment facility for solids processing. No separate WAS pumps shall be provided.
- b) Sump with minimum HRT of 30 minutes up to flow of 100% of return sludge capacity & depth of sludge limited to 2 m, 4.5 m minimum diameter, separate panel room outside the wet well, 100% standby pumps

<b>Return Activated Sludge (RAS) Pumps &amp; Pumping Station (as per as per elected process / technology)</b>		
RAS Ratio – hydraulic design		As per design criteria of selected process / technology
Minimum numbers of units	Nos.	1 W+1 S
		In case of SBR - RAS pump (1w+1s) shall be per basin
Pump Type		Non-clog centrifugal solids handling dry pit with VFD or non-clog submersible pump with VFD
Capacity of Each pump	M <sup>3</sup> /hr	As per design
Head of Each pump	Mtr	As per design
Minimum HRT of Sump (as per selected process / technology)	Hrs	0.5
Type of Mixing		Coarse bubble or mechanical mixers
MOC		RCC M30
Maximum Sludge depth	M	2

#### 15.5.13. Waste Activated Sludge (WAS) Pumps (process / technology specific)

WAS pump shall be provided as per the process / technology requirement. The excess sludge generated shall be pumped to Gravity sludge thickener by WAS (waste activated

sludge) pumps. WAS pumps shall be minimum 1W+1S for each basin so as to waste excess/ surplus sludge to dewatering units while maintaining appropriate amount of MLVSS in the aeration tank for efficient biological treatment.

In case WAS is not provided then a valve-controlled and metered tapping shall be provided from the RAS pump discharge header to withdraw Waste Activated Sludge (WAS) to Sludge Treatment facility for solids processing.

<b>Waste Activated Sludge Pumps (WAS)</b>		
Minimum numbers of units per basin	Numbers	1W+1S
Type of Pumps	-	Non-clog centrifugal solids handling dry pit or submersible
Capacity of Pump	-	As per design
Head	-	As per hydraulic design
MOC Casing	-	CI FG 260 as per IS 210
MOC Impeller & Shaft	-	AISI SS 316

#### 15.5.14. Internal Sludge recirculation pumps (process / technology specific)

Suitable pumps of capacity up to 400% to be provided for internal recirculation of MLSS from Aeration Tank to Anoxic Tank. There should also be the provision of 100% standby pumps in the warehouse.

<b>Mixed Liquor Recycle (MLR) Pumps</b>		
No. of MLR pumps per basin	Nos.	1 W+1 S
Type of pump		VFD operated Submersible Pump
Location		Aeration tank

#### 15.5.15. Alum Dosing System

Alum dosing is mandatory for MLE process and for A2O process. However, an alum dosing system shall be provided (if required as per selected process / technology duly supported by process calculations) to accomplish backup chemical phosphorus removal in the event of inadequate biological removal. A common set of Alum Pumps shall pump to a single common dosing point located in the Aeration Basin Effluent Channel.

<b>Alum System</b>		
<b>Alum Dose Calculation</b>		
Aeration basin effluent soluble P	mg/L	1.00
Plant effluent target SOP	mg/L	0.25
Commercial alum form		Dry cake/brick

<b>Dry Alum Storage</b>		
Dry alum design storage period	Days	30
Dry alum storage type		Cake/brick stacks in building
<b>Alum Solution</b>		
Purity of Alum	%	99
Alum Solution Strength	% w/w	10%
Alum solution Storage tank (Dosing + Preparation)		
HRT of each tank		
Alum Solution Tank Mixers (Turbine Type)		
Capacity of Pumps	LPH	As per design
Alum Dosing Pumps	Nos.	2 W + 1S

### 15.6. Tertiary filtration units

Fiber are piled to enable depth filtration. The filtration shall be Inside to Outside or Outside to Inside and it shall be a partly / fully submerged filter with vacuum suction for cleaning the filter disc as per manufacturer design.

Generally influent flows by gravity (non-pressure) into the respective disc filter. The RCC structure to accommodate disc filters, shall be as per requirement of the vendor drawing of disc filter. For small capacity filter the filter can be offered housed within SS fabricated tank housing instead of RCC tanks. The filter structure shall ensure that Suspended Solids (SS) are filtered (treated) from outside to inside or from inside to outside of the filter panels installed in both sides of the disc filter and that filtered water is discharged through the centre drum to the treated waterway.

During the filtration process, loss of head gradually gets higher as Suspended Solids are trapped on the fibre media. This raises the level of water in the tank and activates the water level sensor to rotate the disc and drive the suction cleaning pump to clean automatically. Disc filter should partly / fully submerged under water as per manufacturer's design. Disc filter shall be operated for filtration without stoppage during backwash and suction cleaning. The dirty backwash water / drain shall be discharged by providing required sludge pumps. In case of gravity drain, required drain pit of capacity as recommended by disc filter vendor with required pipe up to filtrate sump shall be provided. From filter, sewage enters the Disinfection Unit (CCT / UV Channel) / Treated sewage sump.

Filter Bypass arrangement (Overflow weir or motorized gate suitably interlocked with disc filter inlet water level) shall be provided for 100% design flow. This gate shall operate with required interlocking with disc filter water levels to ensure that at no point of time the filter is submerged beyond permissible level i.e. at high-high level required alarm shall be provided at SCADA and the bypass gate shall open fully / partially as required to prevent the filter submergence beyond permissible level.

Disc filter shall comprise high strength and separable discs in each stream, each of which consists of filter panels on both sides. Each filter disc shall be subdivided into smaller sections to constitute a prefab disc frame (module) so as to ensure easy replacement and maintenance. In case of replacement of Fiber media, the left and right of the fiber media can be replaced quickly without disassembling of segments (Disc frames)

Each disc shall be mounted on the center drum by strap band (steel band) for the exact roundness and it shall not be fixed by Stud bolts. When Fiber media is mounted in the segment (Disc frame), the sealing shall be maintained by one or more fixing device which has slope on both sides of segment. Fiber media shall envelop some parts of backside of filter frame and the several springs shall be used to fix the fiber media. The drum shall be round type/ diamond shaped filter wheels and shall have enough area in order to discharge the treated water without trouble.

The material of the fiber media shall be polyester / woven mesh made of stainless steel AISI 304/316 grade / Polyamide free fibre filter cloth / SS-304/316 screen ; the filter frame that fixes the fiber media, the disc frame and the cover.

The dirty backwash water / drain shall be led to filtrate sump for further recycling back to STP as specified.

Design Inlet Flow (Average)	:	Average flow or higher as per design
Design Inlet Flow (Peak)	:	As per process design
No. of streams / disc filter units	:	Min. as per design requirement with Bypass arrangement for 100% Design Flow
TSS inlet concentration, mg/L	:	Min. 20 mg/L or higher as per secondary treated sewage quality
TSS outlet concentration max. (24 hrs. composite sample), mg/L	:	< 10 mg/L
Max. permissible design filtration rate (m <sup>3</sup> /m <sup>2</sup> /h)	:	12 m <sup>3</sup> /m <sup>2</sup> /h Max.
Type of Filtration Media	:	Fibre Disc / Cloth Media / mesh or screen made of stainless steel AISI 304/316 grade
Filter Membrane		Fiber Disc: Polyester with ABS resin or suitable MOC Frame Cloth Media: Polyamide free fibre filter cloth (4 to 5 mm Thick) with ABS resin or suitable MOC Frame SS Screen / Mesh: SS-304 or better  Min. 10% of total or 2 nos., whichever is higher quantity to be provided as spare with supply.
Size of Filtration / Filter membrane pore size (micron)	:	20 microns Max. or smaller as per vendor recommendation
Backwash Quantity per Day	:	Shall not exceed 2% of the inlet design flow to filter i.e. min. 98% recovery
Max. permissible Hydraulic Losses across	:	500 mm WC



Filter		
Operation method	:	Fully Automatic operation by the water level and timer including backwash and with manual override facility. All inlet, outlet, bypass Gates / Valves as applicable shall be Electric Actuator Operated.
Mounting	:	Horizontal / other – Mfr. to specify
Filtration direction	:	Out to In / In to Out
Filter wheel diameter, mm	:	Mfr. to specify
Number of filter frames per wheel, Nos.	:	Mfr. to specify
Number of filter wheels, Nos.	:	Mfr. to specify
<b>MOC of Major Disc Filter Components</b>		
• Centre drum / Distributor	:	STS 304
• Chain	:	Stainless Steel (STS 304)
• Sprocket	:	Stainless Steel (STS 304) or Nylon
• Protective cover	:	Stainless Steel (STS 304)
• Spray Nozzles	:	Stainless Steel (SS - 304 / 316)
• Backwash Piping	:	uPVC / SS-304
Suction cleaning pump		
• Nos. of pumps		Min. 1 No. or higher as per manufacturer design per stream with min. 1 No. store standby
Sludge / Dirty Backwash Disposal Pump		
• Nos. of pumps		Min. 1 No. or higher as per manufacturer design per stream with min. 1 No. store standby
Level Sensor	:	1 Set / stream
Control panel		
• Type	:	Self-standing / Wall Mounting type, PLC based controls with color HMI (min. 7” touchscreen type). PLC shall be provided with communication protocol (RS-485 with Modbus Protocol) for connectivity to Plant SCADA and for remote monitoring and alarms
• MOC of control panel	:	Stainless Steel, SS-304
• Protection Class	:	IP-55 or better suitable for outdoor mounting. Shall be provided with canopy for rain and sun light protection.
Isolation Gates (Electric / Pneum. Actuator	:	At inlet of each stream At outlet of each stream (if applicable) For

Operated)		Bypass as applicable
Other valves / gates / piping	:	1 Lot / stream as applicable
Level Sensor	:	1 Set / stream
On-line TSS analyzer	:	Required for monitoring TSS value at Disk Filter Inlet & trends shall be displayed at HMI. Audio-visual alarm for High TSS Level alarms shall be provided.

**NOTE:** The above is general description and operation philosophy and construction methodology may vary for each manufacturer and for the type of filter offered and can be accepted keeping the design philosophy (rate of filtration, membrane opening / pore size, backwash losses, hydraulic losses, etc.) and operation method (manual as well as fully automatic operation) as specified above.

### **15.7. Disinfection System**

For all STP works disinfection of treated sewage from the secondary and/ or tertiary treatment as per design should be done by Chlorination disinfection system or Ultra Violet Disinfection System as per clause 15.7.1,15.7.2,15.7.3 such that outlet parameters shall be maintained (Residual Chlorine shall be laid up to the plot boundary limit and beyond as per site condition to nearest receiving water body (up to disposal point)).

#### **15.7.1. Chlorination Disinfection System**

##### **Chlorine Contact Tanks**

- a) For all STP works gas chlorinator shall be provided.
- b) Chlorine Contact Tanks shall be provided for disinfection of treated sewage from the secondary and/ or tertiary treatment as per design. Chlorine shall be injected via an inline vacuum educator placed in the pipe carrying biologically treated sewage just upstream of the Chlorine Contact Tanks or through diffusers in Chlorine Contact Tank. Gas chlorinator shall be provided for all STPs.
- c) A Chlorination Building shall be provided to house all chlorination equipment including chlorine cylinders, chlorinators, and all associated equipment
- d) Designing providing and constructing chlorine contact chamber with baffle walls for adequate capacity to deal with 1 DWF average flow. The chlorine contact tank should be of 30 min capacity, during average flow to achieve 99.99 % Coliform reduction. Chlorine dose shall be maintained as per standard provisions, including designing, providing and constructing water supply provision for chlorination, including providing dewatering and by pass arrangement jointing to final effluent mains and outlet weir etc complete. The effluent quality should match with the standards laid down by Gujarat Pollution Control Board and as per obligatory provision and as detailed specification and as directed by engineer in - charge.

- e) CCT shall have provision of operating single compartment when other compartment is under maintenance. Necessary Gates / valves as per requirement shall be provided.
- f) Chlorinator room not provided for STP up to & including 3 MLD.

<b>Chlorine Contact Tanks</b>		
Design Flow	-	Average flow + Re-circulated flow (For Plant based on SBR, design shall be based on (Decant flow + Re-circulated flow) or (Average flow + Re- circulated flow) whichever is higher)
Minimum number of units	Nos.	<b><u>For <math>\leq 5</math> MLD:</u></b> 1 (1 compartments) baffled with pump pit to fill the overhead service tank
		<b><u>For <math>&gt; 5</math> MLD:</u></b> 1 (2 compartments) baffled with pump pit to fill the overhead service tank
MOC	-	RCC M30
Minimum HRT at Average flow	Minutes	30
Minimum effective L/W ratio	-	40
SWD/Pass Width ratio	-	1 to 1.5
Minimum freeboard	m	0.5

### **Chlorination Building & Chlorination System**

- a) A Chlorination Building shall be provided to house all chlorination equipment including chlorine cylinders, chlorinators, and all associated equipment.
- b) A complete Chlorination system with necessary safety accessory and controls shall be provided as per IS code. A neutralization pit and absorption system shall be provided to contain and neutralise chlorine in the event of a leak.
- c) Designing, providing and constructing chlorinators, vacuum type, with auto switchover facility and dosage as specified below. Detailed specifications with necessary provision of having chlorinator room of adequate size. The chlorinator equipment shall include cost of chlorine cylinders/ tonner, piping, valves, measuring and controlling equipment, safety devices, lifting equipment, etc. complete as per IS -10553 (part II) 1982. The tonner room should have minimum 3 MT capacity Hoist for loading and unloading facility. Tonner storage should be distinctly isolated and should be for minimum storage space as directed in the design specification and as per gas laws 1981 and factory act shall be provided. All other matching amenities shall be provided, Minimum 5 MT gantry rail shall be provided for full length of tonner room at minimum 6.0 m height from level of tonner room, with outlet chamber and treated effluent outlet channel etc complete as per detailed specification.

<b>Particulars</b>	<b>(For STP of <math>\leq 5</math> MLD</b>	<b>(For STP of <math>&gt; 5.0</math></b>
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	Capacity)	MLD pCapacity)
Chlorine Building and Tonner Room	4 x 3 x 4.5 + 6.4 x 4.5 x 5	5 x 3 x 4.5 + 7.5 x 4.5 x 5

<b>Chlorination System</b>		
Type	-	Chlorine Gas Feed System
Minimum chlorine dose	mg/L	5
<b><u>Chlorine Tonners</u></b>		
Minimum storage period	days	7
Withdrawal rate per 900 kg tonner	kg/hr	6.5-7.5
Minimum number of cylinders – total	-	As per requirement
Minimum number of cylinders – manifold with automatic switching-		er requirement
Offline storage of Chlorine cylinders is not acceptable		
<b>Chlorinators</b>		
Type of Chlorinator	-	Vacuum
Minimum number of units – Working	Number	1
Minimum number of units – Standby	Number	50 % Standby
<b>Chlorine Ejector</b>		
Type	-	Inline vacuum induction or diffuser
No of units – Working	Number	1
No of units – uninstalled spares	Number	50 % Standby
<b>Chlorine Building</b>		
Minimum number of units	Number	1
MOC – Roof, columns, beams	-	RCC M30

### 15.7.2. Ultraviolet Disinfection System

#### **General Design**

Where Installations employ an open-channel design, the channel design shall ensure exposure of all elements of the effluent flow to the UV radiation. Flow through the system shall ideally be plug flow. and the presence of dead areas and short-circuiting. of flows shall be avoided. However, upstream baffle plates or flow straighteners shall not be used as they are subject to blinding and their absence has been demonstrated to make no difference to the removal of bacteria.

At the design stage of larger systems, the designer shall calculate the operating cost for different arrangements e.g. single channel or dual channel and take this into account

when making design decisions. Different arrangements have different numbers of lamps on permanently and so will have different operating costs.

The design of the Channel and the associated channels or pipework shall not allow the Channel to empty due to process malfunction, either back into the process or forward via the moving penstock (if fitted). The design of the channel and any level control system shall ensure that the lamps are adequately submerged through all flow conditions.

Upstream processes and plants shall be designed such that sufficient flow is maintained on the UV plant to prevent lamps overheating and baking deposits on the lamp envelope. The level control system shall avoid rapid changes of level in the Channel. The installation shall ensure adequate surrounding space to permit safe and unhindered maintenance access. Lamp modules shall be easily and safely removed and replaced by one person, with appropriate lifting equipment provided if necessary (mandatory if more than 25kg). Lifting equipment may use an electric hoist, a davit arrangement or any other suitable system.

Manual chain hoists are not acceptable as the chains frequently break the lamps. The contractor shall confirm their proposed dose rate to achieve the disinfection requirements under the contract and provide supporting calculations and references to justify their selection. The selected UV equipment shall be validated to achieve the proposed UV dose rate and certified by Deutscher Verein des Gas- und Wasserfaches (DVGW) or United States Environmental Protection Agency (USEPA).

### **Channel Draining and Cleaning**

For maintenance purposes it shall be possible to manually isolate and drain channels if necessary. Above-ground channels shall have a drain valve at each end (50 or 75mm bore depending on the channel size) piped to the works drain. Below-ground concrete channels shall have a sump at the lowest point in the channel for use with a submersible pump in order to drain the channel. Provision shall be made for a suitable discharge point for the pump.

Systems shall be provided, or methods adopted to ensure that it is possible to clean any UV channel, without breaching discharge consents. This may involve utilization of upstream storage, provision of cleaning mechanisms, provision of parallel channels or other methods agreed with the Employer.

### **Sampling**

Provision shall be made for taking effluent samples upstream and downstream of the disinfection system. The sampling points shall be fully shielded to prevent exposing operators to UV radiation. Any sampling apertures shall have an opening not less than 450 mm in any dimension to permit the use of a 10 litre sampling vessel. The downstream sampling point must be immediately downstream of the UV channel discharge weir to ensure adequate mixing of the sample.

### **Foam and Bubbles**

This design of the UV plant and upstream processes shall prevent the generation and incorporation of foam or entrained air bubbles, which might impair the UV transmittance. If required this shall include the construction of surface baffles to prevent foam ingress, and stilling chambers to calm flows and allow air to escape before entering the UV channel.

### **Multi-Channel Systems**

On UV plants where the flow is split between more than one channel, each channel shall be hydraulically separate from all the others, such that changes in level in one channel do not cause changes in level or flow in any other. Level control systems if required shall be independent for each channel. Two channel systems shall normally operate with both channels active. Provision shall be made for individual channels to be isolated and drained for maintenance and cleaning.

### **Lamp Cleaning**

An automatic lamp cleaning (in-place) system shall be incorporated within the disinfection system design, using the most effective wiper materials available. This system shall ensure that all lamps (in-use or standby) are regularly cleaned to prevent build-up of scale, fouling or other deposits which would otherwise impair the efficiency of the installation.

The system shall be capable of meeting effluent standards under conditions of full-flow operation while a cleaning cycle is in progress.

Off-line acid bath cleaning is acceptable. A safe means of diluting or neutralizing any acid or caustic cleaning chemicals shall be provided prior to disposal into the wastewater process stream.

Any cleaning chemicals provided or specified for use with the system shall be free from toxic effects on the wastewater treatment system and shall be readily degraded or diluted within the wastewater treatment system to prevent harm to the environment or compromise the discharge consent through contamination of the final effluent with any dangerous substances present as trace components of the spent cleaning solution.

It shall be possible to dispose of such chemicals into the wastewater treatment process without disruption to that process. Information on such chemicals must be available on site with usage and handling instructions available to employees.

### **Flow Measurement**

Each channel or reactor shall be provided with an independent flow measuring system. Addition or removal of flow between the point of measurement and the UV plant is not permitted.

### **Transmittance Measurement**

Transmittance shall be measured with a continuously reading on-line monitor. Continuous cleaning shall be provided for the monitor using the most effective wiper materials available.

### **Level Control**

Channel or Reactor design and level controls shall ensure optimum lamp submergence under all flow conditions.

### **Lamp Control**

The system energy output shall be automatically controlled to match the UV dose rate to the final effluent flow rate; e.g. by switching lamp banks in or out of service or by varying the power output on variable power systems. (Flow balancing might be required to avoid excessively short cycle times.

The selection of duty and boost lamp banks shall be rotated to ensure equal use of all lamps and prevent bio film growth on lamps remaining unused for prolonged periods. Lamps to be wiped even when they are not running.

The control system shall include measures to recognize and record lamps out of service through maintenance or failure and make suitable allowance for UV output energy reduction as the lamps age, thus ensuring maintenance of the correct dose.

If the dose rate is controlled by measurement of effluent transmittance, lamp intensity, flow or any other measurement, then upon any failure of any such system the plant shall revert to full power mode. In full power mode, the number of lamp banks required to achieve the applied dose at consented transmittance and full flow shall be activated in the affected channel.

### **Health and Safety**

UV lamps shall be fully enclosed, shielded or provided with covers such that no personnel can be exposed to UV radiation from the installation. Covers or removable protection shall have fail-safe interlocking for the lamp power supplies to isolate lamps before removing the protective covers such that no exposed lamps can be illuminated, and no UV radiation can escape from the installation.

Blanking covers shall be provided to prevent the escape of stray radiation if any lamps or modules are removed from the system for maintenance. These covers shall be interlocked with the electrical power supply to isolate relevant sections when removed.

Any chemical cleaning system or chemical storage for such a system shall be provided with all necessary safety and containment systems as defined by legislation.

Lifting equipment shall be provided for all removable items exceeding 25 kg in weight and for lighter loads if there is poor posture, limited space or other significant risk.

The system shall be designed to minimize the possibility of mercury spillage through lamp breakage. Spent or failed lamps shall be disposed of safely at a regulated disposal facility.

#### **15.7.3. Treated Sewage Disposal**

- a) Design, providing and construction appropriate outfall sewer of RCC NP-3 pipe, to discharge treated effluent from outlet chamber after chlorination tank to the disposal

point at outlet battery limit of STP including necessary chambers for inspection and cleaning including necessary excavation, dewatering, refilling, concrete encasing/ bedding concrete steps to reach the disposal/ nallah bed level, pitching and energy dissipation chamber in nallah portion etc. complete upto disposal point as per site condition of RCC NP3 pipeline and including all above items.

- b) The treated sewage, post chlorination shall be conveyed to the disposal point as per site condition to nearest receiving water body as per site condition including manholes (at ~30m distance) and outfall structure.
- c) Designing, providing, constructing Intermediate peak flow sized outfall sewer of RCC (NP3 class) pipe to discharge treated effluent to the local water body/ nallah at the point shown on the drawing including necessary chambers for inspection & cleaning including excavation, dewatering, refilling including appropriate bedding.

### 15.8. Service Overhead Tank and Fill Pumps

15.8.1. Treated sewage from chlorine contact tank shall be pumped to overhead tank of Dewatering Building for service water used in toilets, chemical solution preparation, tank/ equipment cleaning and flushing of sludge pipelines at minimum pressure of 4 kg/cm<sup>2</sup>

Overhead Service Water Tank & Fill Pumps		
Number of pumps	Numbers	1w + 1s
Storage capacity	Ltr	As per requirement
Free Board	mm	300
MOC of Tank	-	RCC / HDPE
MOC Casing	-	CI FG 260 as per IS 210
MOC Impellor & Shaft	-	AISI SS 316
Column height of bottom slab of tank above top slab of the building	M	1.5
Source of Water	-	Treated Sewage from CCT
Location	-	Above Dewatering Building/ Chlorination Building

### 15.9. Drinking Overhead Tank and Fill Pumps

15.9.1. Surface water from public water main shall be stored in a sump for adequate storage and pumped to overhead tank of Administrative Building for potable use. All water and plumbing connections shall be provided as per requirement.

UG & Overhead Drinking Water Tank & Fill Pumps		
Qty of Tanks	No	1 each
Storage capacity of Each Tank	Ltr	Min. 1,000
Free Board	mm	300
MOC of Tank	-	RCC / HDPE



Minimum number of Pumps	Numbers	2
Capacity & Head		As per design
MOC Casing	-	CI FG 260 as per IS 210
MOC Impeller	-	Bronze LTB 2
Shaft	-	AISI SS 410
Column height of bottom slab of tank above top slab of the building	m	1.5
Source of Water	-	Municipal water supply
Location	-	Above Administrative Building

## 15.10. Sludge Handling, Treatment and Disposal

### 15.10.1. Gravity Sludge Thickeners (As per Bidder's Design)

- Gravity sludge thickeners shall be provided for thickening of the sludge generated from the plant. Provision of dosing dewatering polyelectrolyte (DWPE) shall be made in thickener as well as dewatering facility. The thickened sludge shall be conveyed by gravity to sump of thickened sludge pump house. The overflow (supernatant) from the thickeners shall be conveyed back to inlet of STP (gravity/collection and pumping) via Drain Sump & Pumps. Flow and suspended and biological load associated with thickener supernatant shall be taken in calculation for design of biological system.
- Designing, providing & constructing watertight of sludge thickener-gravity type (picket fence) in RCC (M-30) with inlet & outlet pipes, central feed well & sludge removal arrangement, grouting wherever necessary with walkway all around of 1.20 m with G pipe railing interconnecting CI pipes all complete as per specifications, having bottom slope 1:6 with necessary fixed bridge scraper arrangement as per detailed specifications & necessary inlet & outlet arrangement. All other arrangement as per detailed specifications. (above 3 MLD, if required). Min sludge concentration of thickened sludge shall be 3%.
- Gravity sludge thickener is not provided up to 3 MLD capacities plant. Sludge will be collected into sludge sump & pumped directly to sludge dewatering system.

Gravity Sludge Thickener		
Minimum Number of Units	Number	1 (above 3 MLD Plant, optional)
Type	-	Circular, center column supported with central drive
MOC – Structure	-	RCC M30
Conical bottom minimum slope	-	1:6
MOC – Center Column	-	MS Epoxy coated
MOC – Bridge	-	MS Enamel painted
MOC – Scraper	-	MS Epoxy coated
Maximum Solid loading rate	kg/m <sup>2</sup> /day	30

Minimum SWD	M	4.0
Minimum Freeboard	M	0.5
<b><u>Check for Hydraulic Loading</u></b>		
Minimum hydraulic loading rate	cum/d/sqm	08
Dilution Pumps	m3/h	To achieve specified hydraulic loading

#### 15.10.2. Thickened Sludge sump and Pump Station

- a) Thickened sludge sump shall be provided for the collection of thickened sludge from thickeners. The sump shall be equipped with Agitator assembly or shall be equipped with coarse bubble type air grid with air blowers to facilitate mixing of sludge content. The tanks shall be designed to provide all of the following functions:
  - Thickened sludge settling and decanting of supernatant
  - Store sludge for periodic feeding to the dewatering facility
- b) Thickened sludge pump station and pumps shall be provided for pumping of thickened sludge from the sump to feed sludge dewatering unit
- c) Designing, providing and constructing of sludge sump and pump house of appropriate size with pumps, ceiling height minimum 6 m over sump for discharging sludge to centrifuge using CI pipe complete as per detailed specification. Agitators/Mixers shall be provided in sump for keeping sludge in suspension. The pump shall be of Helical Screw pumps, 100% standby.

<b>Thickened Sludge Pumping Station</b>		
Minimum number of units	Number	1
MOC – Roof, columns, beams	-	RCC M30
Minimum HRT	hrs	10
Type of Mixing	-	Coarse bubble/Mechanical mixers
MOC of mixer	-	AISI SS 316
Operation schedule	hrs/day	12
	days/week	6
Minimum number of pumps – Working	Number	1
Minimum number of Pumps– Standby	Number	1
Type of Pump	-	Progressing Cavity
MOC Casing	-	CI FG 260 as per IS 210
MOC Impeller or Shaft		AISI SS 316

#### 15.10.3. Anaerobic Sludge Digesters and Gas Holding Tank (As per selected process/ technology)

Where proposed, Anaerobic Sludge Digesters along with gas holding tank and facilities, including mixing equipment, all housed in an appropriate building, shall be provided for stabilization of the combined, thickened sludge. Necessary arrangement related to Digester feeding and digested sludge storage shall be provided as per process requirement.

<b>Anaerobic Digesters</b>		
Mixing Requirement	-	Sludge mixing by mechanical or gas mixing system
Bottom shape	-	Conical
Minimum bottom slope	-	1 : 3 to 1 : 6
MOC	-	RCC with full internal epoxy coating
HRT	Days	As per CPHEEO
SWD (max.)	m	10
Allowance for grit, scum, & foam accumulation	m	1
Min freeboard	m	1
<b>Biogas Storage Tank</b>		
Shape	-	Conical, Gas holder mechanism with steel bell dome

#### **15.10.4. Biogas Flare (As per selected process / technology)**

For all STPs with anaerobic digesters, a biogas flare shall be provided for safe flaring of biogas.

<b>Biogas Flare</b>		
Min no of units	No.	1
Type	-	Furnace combustion type
MOC	-	Epoxy coated MS with SS 304 flare tip
Diameter	mm	100
Height	M	5
Ignition	-	Electronic/ Auto ignition

#### **15.10.5. Sludge Storage Tanks**

Sludge storage tanks shall be provided to store the digested sludge in case of STPs with digesters. The tanks shall be designed to provide all of the following functions:

- Thickened digested sludge by settling and decanting of supernatant
- Store sludge for periodic feeding to the dewatering facility
- Supernatant shall be recycled back to inlet of STP (by gravity/ collection and pumping)

#### **15.10.6. Dewatering Building & Mechanical Dewatering System**

- (1) The sludge from the thickened sludge sump shall be further thickened/ dewatered with the help of mechanical dewatering (centrifuge) system. Sizing of the dewatering unit all related equipment shall be based on the operating schedule. Dewatered sludge cake shall be transported and disposed off by the contractor suitably away from plant site, while adhering to all environmental laws laid by pollution control board, to the place /site as directed by the competent authority / Engineer-In-Charge as per scope of work defined earlier. Whereas, Centrate/ Filtrate shall be led to drain sump from where it will be recycled to the Inlet Chamber of STP by pumping. Flow and suspended and biological load associated with Centrate / Filtrate shall be taken in calculation for design of biological system.
- (2) A Dewatering building shall be provided along with mechanical dewatering units (centrifuge/filter press/ bag filter/ screw press/ combi-machine) and all associated/ancillary equipment, including feed pumps, a complete polymer dosing system, dewatered sludge conveyors, sludge storage/loading hoppers, and truck/ trolley access and loading facilities.
- (3) Designing, providing constructing and installing including foundation etc. Sludge Centrifuge or Belt Press or Screw Press or Bag Type or Filter Press or Combi-machine to handle the sludge flow as per specifications, with appropriate inlet and outlet provision, sludge dewatering unit drain etc. Complete as per specifications.
- (4) Filter press or Bag Type for dewatering can be provided for plants up to 5 MLD capacities.

<b>Mechanical Dewatering Unit</b>		
Minimum number of units – Working	Number	1
Minimum number of units – Standby	Number	1
Type of Sludge dewatering Equipment	-	As per bidder proposal Centrifuge/ belt Filter press Auto operated with minimum sludge man contact
Minimum dewatered sludge (DWSL) TSS required	% w/w	20%
Minimum solids capture required	%	90%
Operation schedule	hrs/day	16
	days/week	6
<b>Polymer System</b>		
Type	-	Dry polymer / Liquid polymer
Minimum polymer dose	kg/ton dry solids	2
Note: Provision for dosing Dewatering Polyelectrolyte (DWPE) shall be made in thickener as well as dewatering facility.		
Note: Capacity of Dewatering Machine, Polymer Dosing pump and tank shall be derived considering Operation schedule of Dewatering Machine.		
<b>Polymer Batch Tanks</b>		

MOC	-	GRP/ HDPE/ RCC tank with inside FRP/Epoxy Coating
Poly solution strength	% w/w	0.1%
Minimum number of tanks – Working	Tank	1
Minimum number of tanks – Standby	Tank	1
<b>Polymer Tank Mixers</b>		
Minimum number of mixers per tank	Number	1
MOC - Impeller and shaft	-	SS316
Type	-	Turbine
<b>Polymer Metering Pumps</b>		
Type of Pump	-	Hydraulic double diaphragm
Minimum number of pumps – Working	Number	1
Minimum number of pumps – Standby	Number	1
MOC Contact Parts	-	Polypropylene Material
Non- Contact Parts	-	Cast Iron
<b>Dewatering Facility Building</b>		
Minimum number of units	Number	1
Number of levels	Number	2
MOC - Roof, columns, beams	-	RCC M25
<b>Minimum Sizes for Buildings (LXBXH) in Meters (For STP of ≤ 5 MLD Capacity)</b>		
Sludge Dewatering Building – Ground Floor	Mtr	6 x 6 x 5.5
Sludge Dewatering Building – First Floor	Mtr	6 x 6 x 5.5
<b>Minimum Sizes for Buildings (LXBXH) in Meters (For STP of &gt; 5.0 MLD Capacity)</b>		
Sludge Dewatering Building – Ground Floor	Mtr	7.5 x 7 x 5.5
Sludge Dewatering Building – First Floor	Mtr	7.5 x 7 x 5.5

#### **15.10.7. Dewatering Polyelectrolyte Dosing System**

- a) Dewatering Polyelectrolyte Dosing System shall comprise of one Solution Preparation and One Solution Dosing Tank equipped with slow speed Mixers and diaphragm type Metering Pumps shall be provided to dose Dewatering Polyelectrolyte Solution.

#### **15.10.8. Sludge Drying Beds**

- ~~a) Space for provision of sludge drying beds for 25 % Sludge generation as per detailed specifications. (Construction of sludge drying bed shall be taken up at a later stage).~~

#### **15.10.9. Plant Drain Pump Station**

- a) Filtrate Pumps with 100% standby, designed to empty Recycle sump in 1 hour

- b) A Plant Drain Pump Station shall be provided to collect supernatant / centrate/ filtrate from sludge treatment and other miscellaneous waste flows for cleaning and wash-down flows generated in the plant and pump them back up to the head works for treatment through the plant.

<b>Plant Drain Pump Station</b>		
<b>Drain Sump</b>	Type	Wet well
MOC		RCC M30
Design flow	-	Thickener Supernatant + wastewater from dewatering facility + 10% safety factor or 5% of average flow of STP whichever is higher
Minimum HRT at peak flow	min	10
Minimum operating depth	M	1.5
<b>Drain Pumps</b>		
Minimum number of pumps – Working	Number	1
Minimum number of pumps – Standby	Number	1
Type of Pump	-	Submersible
Design capacity	-	Thickener Supernatant + wastewater from dewatering facility + 10% safety factor or 5% of average flow of STP whichever is higher
MOC: Casing	-	CI FG 260 as per IS 210
MOC: Impeller or shaft	-	AISI SS 316
<b>Electrical Sub-Station for plant</b>		
Minimum number of units	Number	1
MOC - Roof, columns, beams	-	RCC M 25
Switch Gear Room	-	As per requirement
Minimum height	m	5
Transformer yard	-	As per requirement

**15.10.10. Dewatering Machine Feed Sludge Sump And Pump House (In Case Of Direct Dewatering Of Secondary Sludge)**

No. of sump & pump house	:	1 No. (Sump with two compartment)
Solid concentration (Secondary Sludge)	:	0.8 to 1.2% (normal)
Specific gravity of sludge	:	1.03
Actual pumping hours for sludge Pumping	:	Dewatering Machine Feed: 16 hrs/day for design flow
Design capacity	:	As required for design average flow
Hydraulic Retention Time	:	4 hr. storage(min.) for feed

<b>Material of Construction</b>		
Sump	:	R.C.C. (M-30) with Epoxy Paint
Pump house	:	RCC frame structure with masonry walls
Air Blower Room	:	RCC frame structure with masonry walls Flooring : Polished Kota Stone
Free board	:	500 mm (min.)
Top of sump	:	Min. 600 mm above FGL with handrail
Level Transmitter	:	Required, Ultrasonic type for monitoring sludge sump level at HMI / SCADA and monitoring / operation of mechanical dewatering system. Low & High level alarms shall be provided at HMI.
Level Switches	:	Required - Displacer / Float type for low-low level for dry run protection of pumps associated to this sump & for alarm at HMI/SCADA.
Dewatering pump for pump house	:	Required along with level switches for auto operation & alarm
<b>Sludge Transfer Pumps (Centrifuge / BFP Feed as per design)</b>		
No. of Pumps	:	13 Nos. (12 W + 1S) (min.)
Type of Pump	:	Positive Displacement type Screw Pump
Capacity of Pump	:	As per sludge flow
Head of pump	:	As per hydraulic design
Pump Efficiency	:	Preferably more than 30%
Fluid Handled	:	Biological Sludge of 0.8 – 1.2 % Solids Consistency for / direct centrifuge / BFP feed
Specific Gravity	:	1.03
Solid Handling Capacity	:	40 mm Max.
<b>Material of Construction of Pumps (Screw Pump)</b>		
Pump Housing	:	CI IS 210 GR FG 260
Rotor/Shaft	:	SS AISI 410 or 431
Stator	:	Nitrile Black
<b>Sludge Mixing System</b>		
Type of Mixing	:	Coarse Bubble
For, Air mixing rate provided (m <sup>3</sup> /hr/m <sup>3</sup> of liquid volume)	:	1.2
Air Grid	:	uPVC
Drilled hole Size	:	8 mm diameter
<b>Sludge Mixing Blowers (shall be common for BNR sludge (Excess Sludge) Sump)</b>		
No. of Blowers	:	2 Nos. (1W + 1 S)

Type of Blower	:	Twin lobe/Tri lobe Positive Displacement (Roots) Type, Air Cooled
Acoustic Hood for each Air blower	:	To be provided as per Manufacturers design
Lifting arrangement	:	HOT (1.25 times the weight of the heaviest component)
Capacity of Each Blower	:	As per process design requirement.
Blower pressure	:	As per design
Air Mixing Rate	:	1.2 m <sup>3</sup> /hr/m <sup>3</sup> of volume of sludge sump

### 15.11. Air Blower Room

15.11.1. Air Blower Room shall house aeration blowers for biological treatment of sewage in aeration basin designed as per the tender specifications mentioned above.

15.11.2. Capable of delivering adequate free air for aeration device as well as filter air scouring with suitable pressure.

Process Air Blower Building		
Structure	Number	1
MOC – Roof, columns, beams	-	RCC M25
Minimum Building size (L X B X H) in Meter		
Process Air Blower Building	(For STP of ≤ 5 MLD Capacity)	(For STP of > 5.0 MLD Capacity)
	9 x 5 x 5	10 x 6 x 5

### 15.12. Administrative & Control Building (G+1)

15.12.1. An administrative building shall include Laboratory, Reception area, Office Rooms, Conference Room, Work Shop & Tool Room, storage facility, Toilet blocks on both floors, LT Room (to house LT panels) & Control Room (to house PLC/SCADA system) and along with necessary office furniture

- a) Administrative building shall be a two-storey building (GF + FF)
- b) Designing, providing and constructing administrative building, office cum Laboratory including stores. This shall be a building having appropriate carpet area and ground floor and at first floor complete as per specifications including necessary excavation, foundation in RCC M 25 framed structure B. B masonry (11- class in C.M. 1:6) 20 mm cement plaster in C.M 1:3 inside and outside with painting. Aluminium door and window with glass panels, mosaic tile flooring and skirting and all other allied items, fixtures fastening electrification arrangement water supply arrangement etc complete.
- c) Ground floor to accommodate administrative office Plant Model, PLC, MCC & UPS room.
- d) First floor to accommodate Office of the SCADA cum Office room, Laboratory and air monitoring equipments to measure wind direction & speed, hydrogen sulphide



concentration etc.

<b>Minimum Building / Room Sizes (L X B X Height) in Meter (Staircase area is not include in the room sizes)</b>	
Particulars	Size
Administration Building + Toilet Block: Ground Floor	25 x 10 x 3.5
Laboratory + SCADA cum Office Room: First Floor	25 x 10 x 3.5
MCC Room	10 x 6 x 4.5
UPS Battery room	4 x 3 x 3.5
PLC room	4 x 4 x 3.5
Pantry to be part of Admin Building	2 x 4 x 3.5

<b>Movable Assets</b>			
<b>Furniture and Fixtures and Office Equipments, Office furniture of Godrej / or similar approved quality</b>			
Item	Description	Unit	Number
1	Desk with 3 drawers with locks with a revolving chair for each plan dimension of desk 1500 mm x 900 mm approx.	No.	5
2	Chairs with Tapestry Cushion on seat, back & handle	No.	25
3	Filing Cabinets, steel with locks and drawers with suspended filling system	No.	5
4	Ceiling Fan 48" size Crompton Greaves or ORPAT	No.	10
5	Digital camera with more than 10 megapixels, zoom 8x of approved make	No	5

### **15.13. Electric Sub-station Electrical, Instrumentation and Automation System**

Comprising of HT Switchyard+ Transformer yard and Electrical Switchgear Room.

<b>Minimum Sizes for Electric Sub-station (LXBXH) in Meters</b>	
HT Switchyard + Transformer Yard (Outdoor)	Size shall be as per actual requirement.
HT Switchgear Room	4 X6 X 4.5

### **15.14. Electrical, Instrumentation and Automation System**

15.14.1. **Electrical**, Instrumentation and SCADA based Automation System shall be installed for the proposed plant for various treatment units as per specification given in Section 5.

### **15.15. Diesel Generator**

- a) DG capacity for minimum 50% electrical load of Sewage Pumping Station including lighting loads shall be provided in case of power failure. For technical details of DG set, refer Section 5.
- b) The Contractor shall have to make his own arrangement for procuring the fuel

(petrol/ diesel) including lubricant required by him as per Volume-I, Technical Bid, Clause 10 “General facilities”.

**15.16. Other Buildings include Maintenance Workshop and a guard Room near main entry of STP** and related equipment and furnishings shall be provided as needed for a fully functional facility.

<b>Minimum Sizes for Buildings (LXBXH) in Meters</b>		
<b>Buildings</b>		
	(For STP of $\leq 5$ MLD Capacity)	(For STP of $> 5.0$ MLD Capacity)
Maintenance Workshop cum Store	4 x 4 x 3.5	6 x 4 x 3.5
Guard Room	4 x 3 x 3.5	4 x 3 x 3.5

All units in the STP should be interconnected by overhead walkways. In addition, appropriate number of staircases should be provided for ease in O&M and there should be access to influent and treated sewage and sludge sampling.

#### **15.17. Sewage Pumping Station**

Sewage pumping station (SPS) for 250 MLD average design flow capacity (500 MLD peak flow) requirement comprising of:

- Raw Sewage Pipe Line from existing Chamber to Inlet Chamber of SPS of approximate length as actual as per contractor final layout.
- Receiving / Inlet Chamber
- Coarse screen channels ( Manual Box type screen followed by Mechanical Multi-rake Type Screens)
- Raw sewage Sump (in two compartments) & Raw Sewage Pumps (Submersible Non-Clog Type, equally distributed in each compartment). Raw Sewage Pumps shall be for 500 MLD peak flow requirement.
- SPS Building / Substation comprising of HT Room, Main LT Room and 11KV Transformer Yard / Substation.
- MS rising main pipe line from SPS to Inlet Unit / Chamber of STP.
- Construction of Sewage Pumping Station shall be carried out.

- **Gravity main from existing Machinehole to Proposed TSPS**

The work includes providing and laying RCC NP4 pipe line conforming to IS:458 with supplying & jointing, existing man hole / trunk mains to the inlet chamber of proposed SPS. Necessary machinehole/chamber shall be provided for proposed gravity main which includes 3 mm thick inside T-rib liner, construction of RCC chamber in M30 grade concrete upto GL with providing and fixing PVC footsteps, providing and fixing 560 mm dia meter FRC manhole cover & providing Zinc epoxy paint, backfilling & carting of excess material as directed by engineer in charge .

- **Receiving (Inlet) Chamber**

The raw sewage gravity mains will discharge the raw sewage into a Receiving chamber. The function of the Receiving chamber is to supply / distribute the flow for process units.

The Receiving Chamber shall be designed for peak flow. The Receiving chamber shall provided with thimble mounted sluice gate on inlet pipe of matching size for isolation of entire plant and shall also be provided with sluice gates at upstream and downstream of screens for flow regulation & isolation of screens. RCC platform of min. 1.2m wide shall be provided for operating the gates and other operational requirements. The inlet chamber shall be of adequate size to meet the requirements of workability inside it. The receiving chamber shall be open to sky and shall be water tight to prevent seepage of the sewage out of the inlet chamber. The entire construction is in RCC (M-30) grade concrete and as per IS 3370. RCC access platform minimum 1200 wide with railing as per specifications shall be provided on one side of the chamber.

Design Flow	:	250 MLD
Peak factor 'f'	:	2
Peak Sewage Flow	:	500 MLD
No. of Unit	:	One (minimum)
Detention Period	:	30 Seconds at Peak Flow
Material of Construction	:	R.C.C. (M-30) with water proof plaster
Free Board	:	As per level
No of Sluice gates (Thimble Mounted)	:	1 No. for inlet pipe isolation one each for coarse screen chamber inlet  All gates shall be electric actuator operated

- **Coarse Screen Channel**

Numbers of (5 Working + 1 Standby) manual box type mesh screen with 50mm x 50mm square opening followed by numbers of (5 Working + 1 Standby) multi rake type mechanical screens of 20 mm clear spacing shall be provided.

Manual Box Type mesh Screen shall be provided in each screen chamber. The box screen shall be in SS-304 construction, having round bars of min. 9 mm dia. with clear bar opening of 50 mm x 50mm, suitably welded in outer frame of equal Leg SS angle 50 mm x 50 mm x 5 mm thick, with intermediate support at required locations and having width to suit channel width / guide channel width embedded within the RCC Wall and clear height of screen shall be min. 300mm above design liquid depth. The box screen shall be located in front of suitable size of cut-out in RCC Wall (up to top of unit) which will lead to mechanical bar screen. Adequate clearance (min. 1.5m) shall be provided in front of box screen and after the box screen (i.e. in front of mechanical bar screen).

The box screen shall be with SS perforated Screening Material Collection Box at bottom end of Screen having size as required and width as per screen width, fabricated from 3 mm thick SS sheet, suitable to slide complete screen between guide passage made of SS equal leg angle of 110 x 110 mm x 10 mm thick welded with equally long insert plates of 10 mm thk (for working as well as for standby channel row) on both sides of RCC wall up to top of chamber through rollers and with all necessary hardware, SS nuts, bolts & washers, Min. two lifting lugs/hooks & lifting SS chain for each screen, etc. complete in all respects and provided with 1 set of cleaning rake with each screen, complete in all

respects.

Monorail with electric hoist and trolley of required capacity for lowering and lifting of screen and to guide the screen outside the screen chamber / away from screen chamber with at least 2.5m projection from the edge of screen chamber on one side shall be provided for cleaning purpose. Required support structure for the same shall be in RCC. A service water connection for flushing shall be provided near the screen chamber for this purpose.

The mechanical screens shall be of Inclined Multi Rake Type as per below and rest as per the specifications detailed elsewhere in the tender. Screw Conveyor and chute arrangement (with 50mmx 50mm removable type screen in chute opening over screw or higher as recommended by screw conveyor vendor to restrict particle size in screw to prevent screw damage or with such suitable arrangement) shall be provided to convey the screening material & dropped from chute to be collected in a covered wheel barrow. CI gates shall be provided at the upstream and downstream ends of each screen to regulate the flow & for isolation.

As the wet well shall be provided in two compartments, a common chamber (intermediate chamber) shall be provided after the coarse screen channels to receive the raw sewage after coarse screening which shall further be connected to each compartment of wet well by providing CI gates at inlet of each wet well compartment to regulate the flow & for isolation.

No. of Units	:	5+1 (5 W + 1S)
Capacity of each screen channel	:	As per design requirement
Material of Construction	:	R.C.C. (M-30) with water proof plaster outside
Free board above FGL	:	Min. 500 mm or higher as specified
Type of Manual Screen	:	Box Type Mesh Screen, vertically mounted
Qty. of Box Screen	:	5+1 Nos. (5W + 1S), one per channel
Clear opening / spacing for manual screen	:	50 mm x 50 mm square
Screen handling		Monorail EOT with Electric Chain Hoist of suitable capacity
Type of mechanical screen	:	Inclined multi-rake type mechanical screen
Qty. of Mechanical Screen	:	5+1 Nos. (5W + 1S), one per channel
Clear spacing for mechanical screen	:	20 mm
Vertical Bar Height for mechanical screen	:	Twice the design LD or min. 3m, whichever is higher
Angle of inclination	:	70°/75° to Horizontal
Approach velocity at av. flow	:	0.3 m/sec minimum
Velocity through screen at av. flow	:	0.6 m/sec maximum
Velocity through screen at peak flow	:	1.2 m/sec (max.)

Head loss through screen in 50% clogged condition	:	250 mm (max.)
Bar thickness for mech. screen	:	Min. 10 mm thick Flats
Panel for Mechanical Screen	:	Required, Outdoor type, SS enclosure, double door type, IP-55/65, shall be placed under weather shed / canopy
Drop in bed of screen	:	Minimum 150 mm
Belt / Screw Conveyor	:	Screw Conveyor, to be provided (interlocked with screen). Screw conveyor shall be in SS-304, min. 270mm dia and min. 4mm thk flight / shaft thickness
No of isolation gates	:	Nos., one each for coarse screen chamber inlet Nos., one each for coarse screen chamber outlet Min. 2 Nos. at wet well compartment-1 inlet Min. 2 Nos. at wet well compartment-2 inlet  All gates shall be electric actuator operated.
Wheel barrow	:	Min. 2 Nos., min. 0.5 m <sup>3</sup> capacity
Drums for screening collection	:	Min. 2 nos., of HDPE or suitable non-corrosive MOC, min. 200 Ltr capacity with lids
Alarm for Manual Screen Clogging / Level Sensor	:	Upstream level sensor shall be provided to detect clogging of manual screen with alarm annunciation at HMI/SCADA.
Operation of Mechanical Screen Differential Level Transmitter	:	Diff. Level Transmitters required for all screens to provide differential level alarm and for auto operation of mechanical screens. Operation of Mech. Screens: Manual mode, Timer mode (with timer bypass facility) as well as in auto mode through ultrasonic / hydrostatic type differential level transmitters with sensors to be provided at upstream and downstream of screen to start screen at high diff level and stop at low diff level. Diff. level shall be displayed at HMI and hi-hi diff. level shall be annunciated at HMI/SCADA. Auto operation of screen shall be through PLC only and not direct from diff level transmitter.

Adequate RCC Platforms shall be provided at the upper level to enable operation. Railings shall be provided around the entire periphery of the platform. The entire structure is to be (M-30) concrete and as per IS 3370 including the platform. RCC staircase 1000 mm wide

shall be provided for access from the ground level to the top of the unit & to each of the operating platform of entire MPS structure. All walls of screen chambers (upstream, downstream, partition, etc.) shall be of full height, up to the top of unit / above FGL as specified in tender (partial height partition or upstream/downstream wall shall not be accepted).

- **Raw sewage pumping station - Sump and Pumps**

Sewage enters into wet well of the pumping station after screening. The wet well shall be circular/rectangular in shape and shall be designed for the peak flow. The capacity of the wet well should be kept such that the detention time in the wet well shall be min. 5 minutes of peak flow and the maximum detention time shall not exceed 30 minutes at average flow. Following criteria's shall be considered to size the sump:

1. That the pump of the minimum duty / capacity would run for at least 5 minutes considering no inflow or
2. The capacity of the sump is to be so kept that with any combination of inflow and pumping the operating cycle for any pump will not be less than 5 minutes and considering maximum 4 no. of start & stop per hour for pumps.
3. The arrangement of the submersible pumps shall be as per pump manufacturer's data i.e. spacing between pumps, minimum space between pump and wall, minimum submergence, etc.
4. The side water depth (live liquid depth) shall be provided suitably as per bidder's design and in addition to this liquid depth an additional depression/liquid depth shall be provided to ensure adequate submergence of the pump as per the manufacturer's recommendations.
5. IS: 3370 and IS: 4111 (part 4) shall be followed for the design and construction of wet well.
6. Pumping machinery shall be designed for 250 MLD average flow and a peak factor of 2. The pumps shall be Submersible Non-Clog type design. The speed of pump shall not be more than 1000 rpm. The impeller should be of a non-clog design with smooth passage and solid handling capability of 100 mm size.

The Wet well shall be constructed in two compartments. Required isolation gates shall be provided at inlet of each compartment and at the common wall of interconnection of compartments suitable for 100% peak flow at each compartment inlet and for interconnection.

The raw sewage pumps shall be provided to cater to peak flow requirement. The pumps shall be distributed equally in each compartment unless for any reason requiring unequal division. The rising main shall be suitable for peak flow requirement leading to inlet chamber of STP. Air Valve shall be provided on header line.

The wet well shall be provided with adequate slope (min. 1:10 or higher slope) towards suction pit from all sides of wet well to prevent / minimize settling on wet well floor and draw all particles / grit towards the suction pit of raw sewage pumps.

The submersible pumps shall be installed within suction pit of adequate depth below the bottom of wet well / effective liquid depth for minimum submergence requirement of pump.

The pit shall be of suitable width and length to install proposed pumps and generally shall cover entire length of wet well. Suitable arrangement should be provided for lowering and lifting of pumps.

The pumps will have automatic coupling arrangement at discharge end for removal and a guide pipe and chain in SS 304 will be provided for removal and lowering of pumps. Pump shall run smooth without undue noise and vibration.

Delivery line of each pump shall be provided with non-return valve / dual plate check valve, metallic expansion bellows and electric actuator operated isolation sluice / knife gate valve. An electric actuator operated isolation sluice / knife gate valve along with metallic expansion bellows shall also be provided on each pump manifold / header line. An electromagnetic flow meter with metallic expansion bellows shall be provided on common header line (rising main line) to measure the flow supply to proposed STP. A header drain line with an isolation sluice valve shall also be provided of min. 200mm dia. on each of the header line. Delivery line for each pump shall be in CI / DI K-9.

Pumping station shall have an adjacent room adequate for installing electrical & instrument panels or shall be installed in a room in nearby building. The panels shall not be installed above the wet well.

No. of wet well	:	One
Average Sewage Flow	:	250 MLD
Peak factor 'f'	:	2
Peak Sewage Flow	:	500 MLD
Detention Period (Minimum)	:	5 minutes at Peak Flow
Minimum SWD	:	As per bidder's design with additional submergence for submersible pumps below wet well floor as recommended by pump manufacturer
Panel Room	:	Required, adjacent to pump house or in nearby building for mounting electrical and instrument panels and other as specified elsewhere in tender. Panels shall be not be mounted above wet well of MPS and other rooms / facilities as specified in tender.
No of isolation gates	:	Min. 2 Nos. at wet well compartment-1 inlet Min. 2 Nos. at wet well compartment-2 inlet Min. 2 Nos. at for compartment interconnection All gates shall be electric actuator operated.
<b>Raw Sewage Pumps</b>		Pump sets shall be for 250MLD average flow @2.0 peak factor i.e. 500MLD peak flow
Type of pumps	:	Submersible Non-clog type

Number of pumps	:	8 Working + 100% standby
Capacity of each pump	:	As per design requirement
Head	:	As per Design
Overall Pump Set Efficiency	:	75% Min.
Operation Philosophy of Pumps	:	Manual as well as level based auto operation of pumps
Pump Handling	:	EOT crane, common for both or separate for each compartment, of suitable capacity& lift and of suitable span and bay length to cover the pumps and delivery line valves and header line over SPS.
Flow Measurement	:	Required, electro-magnetic flow meter on rising main leading to inlet chamber of proposed STP along with metallic expansion bellows

The size of the sump shall be suitable to accommodate the number of pumps required for operation with easy maneuverability. Bidder shall consider design of raw sewage pumping for efficient operation.

SPS Building (shall receive separate power connection) shall be provided adjacent to SPS comprising of HT Room (min. 25 sqm), Main LT Room (min. 100 sqm or higher as required), 11KV Transformer Yard, Guard room etc.

EOT crane of required capacity (min. 1.25 times the maximum single unit/ weight that may be required to be removed for maintenance) shall be provided for lowering and lifting of pumps and associated delivery line valves and header pipe over SPS, separate for each sump compartment.

Two Nos. portable de-silting pump of capacity min. 50 cum/hr & 25m head along with required length of cable (min. 25m length), starter panel, PVC/HDPE flexible hose pipe of at least 50m length, required couplings, etc. suitable to handle silt / grit settled in wet well and discharge up to drain point shall be provided.

- **Pumped Raw Sewage Conveyance**

The pumped flow from the proposed pumping station to the elevated head works inlet chamber of the proposed STP shall be taken through a pipe line suitable to convey 500MLD peak flow. The pump head shall be adequately sized to give a residual discharge head as per CPHEEO manual.

An electromagnetic flow meter with metallic expansion bellows shall be provided on common header line (rising main line) to measure the flow supply to proposed STP.

### **15.18. Equalization cum Neutralization Tank**

Equalization cum neutralization tank in RCC M-30 construction shall be provided for diverting excess flow or neutralizing the pH or required flow in case of temporary deterioration in sewage quality to equalization tanks for storage, mixing for averaging the sewage quality and



onwards pumping during lean flow. For this purpose Equalization cum neutralization Tank in two compartments with pump house and chemical house with dosing systems shall be provided with min. 4 Hrs. HRT of difference of Peak and Average Flow to STP plus recycle flow. An adjustable weir in SS-304 (min. 3mm thick & 450mm ht.) or a downward opening gate with flow calibration shall be provided at common outlet channel of grit/detritor mechanism chambers of STP such that excess flow above average flow shall be led to equalization cum neutralization tank through RCC channel.

Necessary step/ drop shall be provided in hydraulic design after off take point of excess flow in channel as per design requirement to recycle the flow from equalization tank on downstream side of tapping / point / inlet of distribution chamber or BNR unit without any backflow.

Isolation gates shall be provided at inlet of each equalization tank compartment sized for maximum design inflow considering one compartment under shutdown. An outlet chamber / pump suction pit shall be provided to draw effluent from either compartment and shall be provided with isolation gate at bottom in each compartment with each gate sized for sized for total flow of transfer pumps considering max. no. of working pumps as specified below. Submersible non-clog pumps with 100% standby as a minimum to empty the sump in 8 hours. pumps in N W + 100% S configuration to feed the flow through DI K-9/MS piping to STP (inlet of BNR unit on downstream of tapping point) during lean and average flow pumping from SPS so as to provide sewage flow at max. 1.5 times peak factor to BNR Unit (Unit downstream of grit / detritor chamber of STP). Each pump delivery shall be provided with NRV, metallic expansion bellows and sluice valve. The pumps shall be suitably interlocked with TSPS pumps for auto operation.

All further downstream units / pipe / channels shall be designed for hydraulic loading of 1.5 times average flow (for BNR Units, etc. downstream units. Further for SBR system, the downstream units/pipes/channels shall be hydraulically designed for peak decanting flow of SBR). The equalization pump flow shall be recycled back to inlet of BNR Unit / Dist. Chamber. Floating aerator shall be provided to ensure proper mixing of the effluent / for proper equalization purpose in each compartment of equalization tank .

Equalization tank of suitable size shall be constructed in RCC M30. Tank shall have required number of puddle collars and necessary cast iron penstock gates in each compartment of suitable size for flow control at inlet and outlet (considering one compartment under shutdown). Tank shall have to be designed having adequate depth and free board above top water level to avoid splashing.

Necessary hydraulic test to check water tightness of the tank shall be performed. Drain arrangement shall be provided with necessary Valve or portable de-silting pump of min. 100 m<sup>3</sup>/hr. capacity & 15m or higher head with starter and flexible hose pipe to empty the compartment shall be provided. The drain pipe shall be connected to the plant bypass pipeline / disposal chamber / filtrate sump to be recycled back. Drain Pit of min. 1m x 1m x 0.75m depth shall be provided in each compartment with gentle slope leading towards the drain pit.

The Mixing aerators shall be provided for mixing the tank contents and to avoid sludge settling and entrainment of air into the sludge as detailed in mechanical specifications. Alternatively

contractor may provide suitable capacity air blower with coarse bubble diffused aeration system for proper mixing of equalization tank content.

No. of tanks	:	1 No. with two compartments
HRT (for both compartments together)	:	4 hours at average flow / diff. of peak & average flow + Other Flows
Size of tank	:	As per design
LD of tank	:	As per design, max. 6m
MOC	:	RCC (M30)
Aerator for Equalization Tank	:	
Nos. of aerators	:	Min. 2 Nos. per compartment or higher as per design of aerator
Type of Aerator	:	Floating Vertical / Slant
Mixing requirement (For Mixer Option)	:	10 w/cu.m.
Air requirement (For Air Blower Option)	:	10 m <sup>3</sup> per 1000m <sup>3</sup> tank vol. per minute
Motor KW/RPM	:	As per design.
<b>Equalized Effluent Transfer Pump</b>	:	
Design Flow	:	As per design Requirement
Nos. of pumps	:	4W + 4S Nos. ( 4 W + 100 % S , all piping & inlet suction gate to be designed for W pumps flow)
Capacity	:	As per design
Head	:	As per design
Type of pump	:	Submersible Non clog
MOC	:	
Casing	:	CF8M delivery casing, casing cover
Impeller	:	SS CF8M
Shaft	:	SS AISI 410 or better
Accessories	:	SS Guide rail, SS lifting chain, auto coupling, duck foot bend etc.

The super structure shall consist of RCC columns and beams with steel truss on which uPVC/FRP sheet shall be bolted to act as roof. Necessary lifting arrangement in the form of monorail with electrical CPB shall be provided for Lowering & lifting arrangement for pumps including maintenance bay at top of tank with adequate extension for facility to load/unload pumps at ground level outside tank shall be provided. Clearance of min. 4.2 m shall be kept between floor and ceiling of the pump house.

RCC slab/walkway platform with hand railing, min. 1m wide, shall be provided on all sides including over partition wall at the top of Tank for access and min. 1.5m wide for operation of the penstock gates. Access to the top of tank shall be by means of 1.2m wide RCC staircase with hand rails. CI foot rests of size 35 mm x 35 mm shall be fixed inside each compartment and in pump chamber. Inside and outside plaster, bottom floor screeding and paint shall be provided as per specifications.

The Contractor shall provide a continuous mixing system (submersible mixers and/or aeration system) to ensure complete homogenization. A neutralization system including chemical

storage tanks, dosing pumps (N working + 100% standby), piping, and accessories shall be provided for dosing of acid/alkali as required.

The system shall include online pH measurement and control with automatic chemical dosing, level measurement system, and integration with the PLC/SCADA system for automatic and manual operation.

## **16. Drawings and Information to be provided**

### **16.1. General**

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

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

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

16.1.4. The softcopy format for various items shall be as follows:

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

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

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

### **16.2. Drawing Format and Numbering**

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

16.2.2. A formalised drawing numbering system shall be adopted with digits of each number, referencing location, revision, drawing type and size. The numbering format and

allocation of drawing number blocks shall be approved by the Engineer.

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

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

### **16.3. Tender Drawings**

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

16.3.2. Tender drawings shall be deemed to have been issued for the guidance of Bidders and shall, for the purpose of executing the Works, be superseded by the Construction Documents.

### **16.4. Contractor's Design Documents & Drawings (At Bidding Stage)**

16.4.1. The Bidder's drawings are those furnished by a Bidder with his Bid for the purpose of illustrating and clarifying his proposals.

16.4.2. Design/ Drawing/ Document Submission along with Bid for Evaluation Purpose: The following General and Process drawings, details and specific information pertaining to the entire system shall be furnished by the Bidder for each Plant in the technical envelope in addition to other information mentioned elsewhere in the bid. The lists provided below shall not be considered comprehensive and the bidder shall be responsible for including any and all drawings and information for any and all works that may be necessary for full and complete definition or clarification of the design, regardless of whether or not such drawings, information, or works are explicitly included in the lists below or elsewhere in these bid documents.

1.	Narrative Description of the Works
2.	Process Flow Diagram
3.	Flow & Mass Balance Calculations & Diagram
4.	Detailed Process Design Calculations covering all Units & Equipment including detailed chemical consumption calculations (daily/ monthly basis)
5.	Layout Plan indicating intermediate built out capacity and ultimate built out capacity STPs
6.	Hydraulic Calculations
7.	Hydraulic Flow Diagram
8.	Comprehensive P&ID s including details of: <ul style="list-style-type: none"><li>• Pipeline sizes and materials</li><li>• Valve size and type</li><li>• Equipment detail</li><li>• Instrumentation Identification of controlling PLC</li></ul>
9.	Plant Operation and Control Philosophy

10.	Complete Equipment List
11.	Electrical Load list
12.	Plant water utility Plan & calculations

## **16.5. Contractor's Design Documents & Drawings (Post Award of Contract)**

16.5.1. Design/ Detailed Engineering/Construction Drawings shall be submitted by the Contractor after award of the contract in two Phases.

- The first phase shall be the Preliminary Drawings / Designs. Drawings / Designs submitted during this phase shall be of sufficient detail for the Employer and Engineer to understand in outline the Contractor's proposals for the design and construction of the Works. The lists provided below shall not be considered comprehensive. The bidder shall be responsible for including any and all drawings and information for any and all works that may be necessary for full and complete definition or clarification of the design, regardless of whether or not such drawings, information, or works are explicitly included in the lists below or elsewhere in these bid documents.
- The second phase shall be the Detailed Engineering Design phase and shall comprise the submission of the Detailed Civil/ Structural/ Mechanical/ Electrical/ Instrumentation Drawings and Calculations for the construction of works. These shall be submitted after the approval of the Preliminary Drawings. The lists provided below shall not be considered comprehensive. The bidder shall be responsible for including any and all drawings and information for any and all works that may be necessary for full and complete definition or clarification of the design, regardless of whether or not such drawings, information, or works are explicitly included in the lists below or elsewhere in these bid documents.
- Mechanical General Arrangement drawings and Mechanical equipment data sheet shall be submitted only after approval of Basic Engineering Package (BEP's) - Design drawing documents. Civil drawings shall be submitted only after obtaining approval to Mechanical General Arrangement drawings in B- code.
- Document submissions shall be in a progressive manner and in the detailed /required sequence /priority including the Basic Engineering Documents and also all submissions shall be in relation to the/ correlated with the prioritized construction activities i.e., to say, all Engineering (Design Drawing Document) to correlate with the construction activities/ priorities including the related orderly/sequential equipments/ procurement requirements.
- All subsequent documents shall be submitted/ accepted only upon clearance of the preceding related documents (for Instance- Investigation-Process Design- Plant Layout- Hydraulics- P&IDs- Mechanical Gas- Civil Gas- Structural Designs etc).
- It shall be the responsibility of the contractor to obtain timely clearances/approvals for all the design drawings and related documents.
- Construction Documents shall be submitted in accordance with the timetable set down in the Work Programme.

### **16.5.2. Basic Engineering Package (BEP)**

The Preliminary Drawings/ Designs for STP shall comprise, inter alia, the following priority A, B & C:

#### **Priority A:**

- a) Detailed Description of the proposed Sewage Treatment Plant and Treatment Process offered (including Raw and Treated Sewage Quality).
- b) Detailed Process Flow Diagram (inclusive of Flow and Mass Balance)  
  
(Mass balance of the entire STP (including biological design) must take into account Supernatant from Thickener and Centrate from Sludge dewatering machine along with associated suspended and biological load.) Based on Flow and Mass balance calculations unit and equipment sizing shall be derived.
- c) Detailed Process Design Calculations and Mass Balance Calculations covering all Units/ Equipment Including detailed Chemical Consumption Calculations (Daily/ Monthly Basis).
- d) Plant water utility plan

#### **Priority B:**

- a) Detailed Plant Layout (including Pipe Sizes/ Pipe Routing/ Channel Size/ Channel Routing/ Site Roads/ Site Drainage) with List of all structures (basins, tanks, channels, buildings, etc.) including dimensions and freeboards
- b) Detailed Hydraulic Profile including Hydraulic Calculations;
- c) Preliminary Process and Instrumentation Diagram (P&ID)
- d) Preliminary Plant Operation and Control Philosophy

#### **Priority C**

- a) Major Piping Schedule to include size, material, coating, lining, gauges/thickness, and pressure rating
- b) Major Valve Schedule to include size, type, material, pressure rating, operator/actuator type, and whether Open/Close or Modulating
- c) Gate Schedule to include size, type, differential head, seating or unseating, operator/actuator type, and whether Open/Close or Modulating
- d) Major Equipment /Instrument Specifications (with supporting Brochures).

### **16.5.3. Detailed Engineering Drawings/ Documents**

<b>1.</b>	<b>General arrangements and main sections of all the units of STP</b>
<b>2.</b>	<b>Civil/ Structural Drawings/ Documents</b>
2.1.	Detailed Structural Design calculation of all the units/ Structures; along with STAAD files (Input and Output)
2.2.	Structural Drawings of all the units, Roads, Drainage and Buildings

2.3.	Cable and pipe-work chambers
2.4.	Buried pipe-work
2.5.	Pipe-work connections
2.6.	Contract interface
2.7.	Reinforcement drawings
2.8.	Bar bending schedules
2.9.	Cable routes for direct in ground and ducted systems
3.	Mechanical Drawings/ Documents
3.1.	Major Piping Schedule to include size, material, coating, lining, gauges/thickness, and pressure rating
3.2.	Major Valve Schedule to include size, type, material, pressure rating, operator/actuator type, and whether Open/Close or Modulating
3.3.	Gate Schedule to include size, type, differential head, seating or unseating, operator/actuator type, and whether Open/Close or Modulating
3.4.	Outline dimensional drawing & Cross section Drawing (with Bill of Quantity and Material of construction) for items including but not limited to the following items for each Plant
(i)	Fine screens
(ii)	Belt Conveyor for screenings
(iii)	Sluice valve – motorised
(iv)	Sluice valve – manually operated
(v)	Non-Return valves
(vi)	Knife Gate Valves
(vii)	Dismantling joints
(viii)	Cranes/ Hoist
(ix)	Sluice gate – Manual & Motorised
(x)	Dewatering Pumpset
(xi)	Grit removal equipment
(xii)	Fine Bubble Diffused Aerators along with Grid
(xiii)	Process Air Blowers
(xiv)	Return activated sludge Pumpset
(xv)	Chlorination system
(xvi)	Plant Drain Pumps
(xvii)	Plant Water Pumps
(xviii)	Sludge Dewatering Centrifuges
(xix)	Gravity Sludge Thickeners
(xx)	Thickened sludge pump sets
(xxi)	Sludge conveyor system & Hopper

(xxii)	Sludge Dewatering Centrifuge Feed Pumps
3.5.	<p>Graphs for all major pumps and blowers (including but not limited to Return Activated Sludge Pumps, Thickened Sludge Pumps, Centrifuge Feed Pumps, Process Air Blowers):</p> <ul style="list-style-type: none"> <li>• Pump Performance Curves : Q vs. H, speed, P, Efficiency, and NPSH</li> <li>• ISO-efficiency curves of the pump model proposed</li> </ul>
3.6.	Motor Performance Curves
(i)	Starting Current vs time
(ii)	Characteristics
4.	<b>Electrical Drawings/ Documents-</b> Sizing Calculations, GA, Wiring Schematics, BOM, QAP, Datasheet/ Schedules for:
4.1.	Switchyard Equipment – 11KV Two/ Four Pole Structure arrangement inside plant premises including 11 KV point of supply breaker required as per DISCOM/ statutory norms.
4.2.	HT Metal Enclosed Switchgears (As Applicable)
4.3.	Power/ Distribution Transformers
4.4.	415V Metal Enclosed Switchgears
4.5.	Local Push Button Stations
4.6.	APFC Panel with Capacitor Bank
4.7.	Cables & Cabling System
4.8.	Earthing & Lightning protection system
4.9.	Lighting & Ventilation System
4.10.	DC System
4.12.	Diesel Standby Generator with AMF and Synchronizing Panel
5.	<b>Control and Instrumentation Drawings/ Documents-</b> GA, Wiring Schematics, BOM, QAP, Instrument Datasheet/ Schedules, Instrument Location Plan, Loop Diagram & Instrument Hook Up Diagram for:
5.1.	Level Indicating/ Measuring Instruments
5.2.	Flow Indicating/ Measuring Instruments
5.3.	Pressure Indicating/ Measuring Instruments
5.4.	Temperature Indicating/ Measuring Instruments
5.5.	Sewage Quality Monitoring Analyzer
5.6.	PLC Panel with HMI and SCADA System
5.7.	Junction Boxes and Instrumentation Cable Tray Layout
6.	List of Safety Items/ Accessories, List of Special Tools & Tackles, List of Mandatory/ Recommended Spare List

- The Engineer In-charge reserves the right to ask for additional Equipment/system information apart from the above to ascertain good system design and proper selection of Equipment.



- The Contractor shall supply to the Engineer 5 (five) copies each of the drawings and design calculations for the process and sizing of all components of the System including architectural, structural, mechanical, electrical and instrumentation equipment, supported by flow diagrams and general arrangement drawings for approval.
- The Engineer may require the Contractor to submit for approval additional drawings if they are necessary to enable him to satisfy himself that the items are well designed, that they comply with the Employer's Requirements and that they are suitable for their intended purpose. These drawings shall form the agreed basis for the execution of the Works. If an approved drawing is revised, revised copies shall be submitted for approval as above and no such revised drawing shall be used for the purposes of the Contract until it has been approved in place of the earlier issue of the drawing.

#### **16.5.4. As-Built Drawings/ Documents**

1. Contractor shall submit five sets (two sets for Employer, two sets for Consultants and one set for Contractor for records) and two sets in soft copy (one set each for Employer and Consultants) of each of as-built design and detailed engineering drawings & documents in hard copy duly incorporating the changes, if any, during the construction phase and duly approved by client with respect to the approved drawings for records of Employer/ Consultants. The Contractor shall get the as-built drawings/ documents reviewed and certified by Employer's engineer and project management consultants or Third-Party Inspection Agency (if applicable) representative at site prior to submitting these documents for records.
2. Contractor shall also submit as-built drawings of all General Arrangement Drawings, piping layout and piping drawings/ isometrics, electrical Single Line Diagram, electrical and instrument cable layouts, earthing lightning layout in two sets in auto-cad format (suitable revision to be conveyed later during detailed engineering) for records and future use of Employer.
3. Draft As-Built Drawings shall be submitted 15 (fifteen) calendar days prior to the commencement of Tests on Completion.
4. The Engineer will signify his approval or disapproval of the As-Built Drawings within 15 (fifteen) calendar days of submission.
5. The submission dates referred to above shall be the dates on which the drawings and documents are received by the Engineer.

#### **16.5.5. Operation & Maintenance Manual**

- a) Draft copies of the O & M Manuals shall be submitted to the Engineer for his approval at least 15 (Fifteen) calendar days prior to the commencement of Tests on Completion.
- b) The Engineer will signify his approval or disapproval of the O & M Manuals within 15 (Fifteen) calendar days of submission.

#### **16.5.6. Drawing Submission and Approval Schedule**

Sr.No.	Items	Site Mobilization and Drawing
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		<b>Schedule</b>
1.	<b>Site Taking over from AMC and Mobilization of Machinery/ Manpower</b>	Within 15 days of LOA
2.	<b>Basic Engineering Package (BEP) as per Section 5</b>	<b>Submission</b> within 15 days of LOA <b>Review/ Approval</b> within 60 days of LOA
3.	<b>Plant equipment/ material ordering on vendors/ sub vendors</b>	Within 90 days of LOA (Contractor to submit copy of PO/ WO issued to vendors for employer's information)
4.	<b>Detailed Engineering Drawings/ Documents as per Section 5</b>	<b>Submission</b> within 60 days of LOA <b>Review/ Approval</b> within 150 days of LOA
	In case of not adhering to schedule as stated above within stipulated time frame both PMC and Contractor shall be held responsible.	