

**Design, Build and Commissioning of 7 MLD
Common Effluent Treatment Plant (CETP) and
0.5 MLD Package Sewage Treatment Plant (STP)
at DPIA on EPC basis with 4 years Operation and
Maintenance -Package B**

VOLUME 2

PART 2 PROCESS SPECIFICATION

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Acronyms and Abbreviations

Abbreviations	
DPIA	Dighi Port Industrial Area
MITL	Maharashtra Industrial Township Limited
NICDC	National Industrial Corridor Development Corporation
DMIC	Delhi Mumbai Industrial Corridor
NICDC	National Industrial Corridor Development Corporation
MIDC	Maharashtra Industrial Development Corporation
STP	Sewage Treatment Plant
CETP	Common Effluent Treatment Plant
MLD	Million Litres per day
ADF	Average Daily Flow
PDF	Peak Daily Flow
LDF	Lean Daily flow
LMH	Litre/m ² /hour
MLR	Mixed Liquor Recirculation
RAS	Return Activated Sludge
TSE	Treated Sewage Effluent
RCC	Reinforced Cement Concrete
MPN	Most probable number
NTU	Nephelometric Turbidity Units
OU	Odour Units
LPS	Litres per second
CSEP	Carbon steel Epoxy painted
DC	Distribution Chamber
MBR	Membrane Bio Reactor
ACF	Activated Carbon Filter
CCT	Chlorine Contact tank
NaOCl	Sodium hypochlorite
MOC	Material of Construction
VFD	Variable Frequency Drive
DO	Dissolved Oxygen
FRP	Fibre-Reinforced Plastic
HDPE	High-Density Polyethylene
EOT	Electric Overhead Travelling
GBT	Gravity Belt Thickener
DWG	Drawing
TDS	Ton dry solids
DFT	Dry Film Thickness
DWPE	Dewatering Polyelectrolyte

1. GENERAL DESCRIPTION AND SCOPE OF WORKS

1.1 Introduction

As part of the Dighi Port Industrial Area (DPIA) development in Raigad district, Maharashtra Industrial Township Limited (MITL) plans to construct a new Common Effluent Treatment Plant (CETP) for treating industrial wastewater and effluent generated within Phase 1 of the project area. Additionally, based on the projected population and estimated sewage flows during the initial phase, a new package Sewage Treatment Plant (STP) with a capacity of 2 x 250 m³/d has been planned. The CETP and STP will be co-located.

1.2 Treatment Scheme and Scope

1.2.1 The brief description of the CETP and STP works includes

- Design, supply, installation, construction, testing, commissioning, performance guarantee test, operation and maintenance of the new common effluent treatment plant (CETP) to treat the industrial wastewater having an average flow of 7000 m³/d and quality of treated effluent to a standard suitable for industrial reuse as specified
- Design, supply, installation, construction, testing, commissioning, performance guarantee test, operation and maintenance of a new package sewage treatment plant (STP) to treat the municipal sewage having an average flow of 2 x 250 m³/d and quality of treated sewage to a standard suitable for industrial reuse as specified

1.3 Scope of Unit Processes and Equipment for new CETP

The new works to be constructed with all necessary equipment and ancillaries shall include, but not be limited to, the following:

1. Receiving chamber, Coarse Screen Chamber and Wet well
2. Wet well pumps and Valve Chamber
3. Emergency bypass line
4. Fine Screen Chamber
5. Vortex Grit Chamber
6. Equalisation tank with submersible mixers
7. Equalisation tank pump, sump and Equalisation tank pumps
8. Flash mixing tank, Flocculation tank and Primary Clarifier
9. Ultra-Fine Screen Chamber
10. Pre-anoxic tank with submersible mixers
11. Aeration tank with fine bubble diffused aeration system
12. Mixed Liquor Recirculation Pumps
13. Post-anoxic tank with submersible mixers
14. Blower house with Aeration tank and MBR blowers

15. Enclosed Blowers for Noise Control to 80 dB (A) at 1 m from blower building
16. MBR Tank with MBR cassettes
17. RAS sump and RAS Pumps
18. MBR back pulse tank
19. Permeate pump house with Permeate pumps
20. Disinfection System (UV)
21. UV Treated Water Storage Tank
22. RO pretreatment (as per contractor's design)
23. Brine Treatment and ZLD System
24. Combined Sludge Sump with submersible mixer
25. Thickener Feed pumps
26. Sludge Thickener
27. Thickened sludge storage tank with submersible mixer
28. Thickened sludge pumps
29. Centrifuge
30. Dewatering building
31. Plant return sump with plant return pumps.
32. Two stage Odour control system for Inlet works with all related equipment and instruments.
33. All Chemical Dosing system
34. GRP Cover and interconnecting ducts from process units and odour control system.
35. Lifting equipment's in Pump house, blower house and wherever applicable for lifting of mechanical equipment.
36. All other mechanical/piping, electrical and instrumentation works related to the mentioned scope of works.
37. Electrical works including power supply and distribution, control buildings, SCADA system, standby generators, site lighting and other ancillaries
38. Firefighting system
39. Ventilation system
40. Chemical Building
41. All facilities to consider and allocate sufficient
 - Corridor for laying future pipes and interconnections.
 - Corridor for laying electrical cables.

- 42. Administration building with Laboratory facilities, office room, Toilets, Conference room and other required ancillaries
- 43. Overhead tank
- 44. Maintenance Building
- 45. Guard room
- 46. Internal Road with illumination
- 47. Underground Storm Water Drainage
- 48. Landscaping of the site
- 49. Car parking area

1.4 Scope of Unit Processes and Equipment for New STP

The scope shall include two prefabricated package sewage treatment plants, each with a capacity of 250 cu m/day. These prefabricated units shall be easily transported, relocated, reinstalled, and recommissioned at other locations as per the Employer's operational/project requirements. The new works to be constructed with all necessary equipment and ancillaries shall include, but not be limited to, the following:

Preliminary and Primary Treatment

- a) Receiving chamber (common between the two package STPs)
- b) Coarse Screen Chamber (common between the two package STPs)
- c) Raw Sewage Sump (common between the two package STPs)
- d) Raw Sewage pumps and Valve Chamber
- e) Emergency bypass line (common between the two package STPs)
- f) Fine Screen Chamber
- g) Grit and Oil & Grease Removal Chamber
- h) Ultra-Fine Screen Chamber

Secondary and Tertiary Treatment

- i) Biological Treatment unit and MBR - Membrane bioreactor
- j) MBR back pulse tank
- k) Permeate pump house with Permeate pumps

Treated Water Disinfection and Pumping

- l) Disinfection system with Sodium Hypochlorite
- m) Treated Water Pumping System to pump treated water to the RO plant and the Recycle Water Sump at CETP. (common between the two package STPs)

Sludge treatment

- n) RAS sump and RAS Pumps

- o) Sludge pumping system to pump excess sludge to the sludge thickening unit at CETP (common between the two package STPs)

1.5 Instrumentation and Control Philosophy

The instrumentation and control schemes proposed for the CETP shall comprise the following. The list given below is not exhaustive but indicative of the level of instrumentation/automation required for the successful operation and maintenance of the plant. The plant automation shall be ensured so that plant operations and effluent quality parameters are not degraded due to a lack of operator attention.

- a) Pressure indicating system.
- b) Level sensing, transmitting, indicating, alarm & annunciation of levels in tanks, sumps and flow channels as well as interlock and control functions with associated equipment.
- c) Flow measurement system.
- d) Online measurement of Conductivity, pH, BOD, COD, TSS, Ammonia, Total Phosphorus, etc. at the inlet and outlet of the plant.
- e) Dissolved oxygen analysing system as well as associated interlocking with blowers/delivery valves/ suction valves to optimise the energy consumption in the aeration tank.
- f) Torque overloads annunciation and trip interlocking with associated drives.
- g) Fully automatic operation, interlock, monitoring, logging, printing, event as well as report generation, etc., through PLC-based PC and printer along with associated hardware and software.
- h) Alarm & annunciation system to annunciate the plant equipment malfunction and tripping on fault, as well as any other abnormality sensing.
- i) Manual override facilities shall be provided at all places where the PLC controls the operations.

2. GENERAL PROCESS DESIGN REQUIREMENTS FOR CETP

The process specification shall be read in conjunction with the Process Flow Diagram and Process and Instrumentation Diagram (Vol. 5).

The industrial effluent/wastewater shall be tapped from the designated manhole and conveyed to the receiving chamber by gravity. The wastewater shall then flow through the Coarse Screens, which have an automatically operated screen-cleaning mechanism. The screenings shall be collected on the conveyor belt and deposited into trolleys for disposal.

After passing through the mechanical coarse screen channels, the wastewater shall be collected into the wet well and shall be pumped to the fine screen channels.

The mechanical fine screens shall have an automatically operated screen cleaning mechanism. The screenings shall be collected on the conveyor belt and deposited into trolleys for disposal.

After passing through the fine screen channels, the wastewater shall flow to the vortex grit chamber for grit separation and then be subjected to an oil skimmer. Post O&G removal, the wastewater shall flow by gravity to the equalisation tank, where it will be mixed under aerobic conditions.

The wastewater shall then be treated for pH correction, heavy metal removal, and toxic chemical removal using conventional coagulation, flocculation, and clarification. The contractor shall ensure that the supernatant from the clarifier is suitable for the biological treatment and subsequent Reverse Osmosis treatment. The clarified wastewater shall pass through the Mechanical Ultra-Fine Screens before biological treatment.

An elaborate biological treatment involving the necessary sequence of anoxic, anaerobic, and aerobic conditions shall be employed by the contractor to ensure that the 'CETP-treated effluent characteristics' as indicated above are achieved post-membrane bioreactor (MBR). In addition to removing dissolved organic matter and BOD, the biological treatment shall be designed to remove nutrients, rendering the treated wastewater suitable for Reverse Osmosis treatment.

The biologically treated wastewater shall then pass through the MBR membranes for solid-liquid separation and be subjected to disinfection and tertiary polishing through filtration, softening, and chemical conditioning to remove hardness and scaling constituents. The conditioned effluent shall then be treated in a Reverse Osmosis (RO) system to recover permeate or produce recycled water.

The RO reject shall be directed to a brine concentrator where further volume reduction shall be achieved. The concentrated slurry from the brine concentrator shall be processed in a crystallizer to precipitate dissolved salts. The crystallised solids shall be dewatered using suitable equipment, such as centrifuges or filter presses, and disposed of in accordance with the latest MPCB/CPCB Hazardous Waste Management Rules.

The distillate water recovered from the evaporators and crystallizers shall be collected, polished if necessary, and blended with the recycle water.

The system shall be designed, installed, and operated to guarantee compliance with Zero Liquid Discharge norms, with no effluent released outside the facility boundary.

The chemical and biological sludge generated from the clarifier and the MBR system shall be treated separately. The sludges shall be subjected to sludge thickening before the chemically assisted mechanical dewatering process. The supernatant shall be recycled to the appropriate treatment plant units.

An Odour Control System shall be provided to capture, convey, and treat the fumes/gases generated from various units of the CETP, especially from each process unit upstream of the Aeration Tank.

Apart from the treatment process as broadly described above, the contractor's scope shall include the construction and operation of various other facilities, including but not limited to the following.

- a) Administration Building, 300 Sq m. minimum 2-storey.
- b) Transformer Yard and MEP Room, Electrical Works.
- c) Interconnecting piping & appurtenances
- d) Plant Utilities
- e) Necessary bypass Arrangements for operation & Maintenance of the Plant
- f) Disposal of grits and sludge arrangements
- g) Treated effluent ground-level reservoir and pumping station

In addition to the above process units, the following utility components are dedicated to CETP, as a minimum requirement:

- a) Diesel-driven electric power generator set, including a shed
- b) Office and Conference Room
- c) Laboratory
- d) Workshop
- e) General Toilet Block
- f) Internal Roads and Pathways with cross drainage works.
- g) Approach road and cross the drainage works
- h) Stormwater drains
- i) Yard Lighting
- j) Landscaping, green belt development, tree plantation and gardening
- k) Boundary wall, gate, etc.
- l) Firefighting Arrangements / Water supply & sanitary arrangements

2.1 Design flow for New CETP

The CETP should be designed as a modular system and configuration that will enable capacity augmentation with a minimum footprint. The process design flows for CETP are summarised below

Parameter	Flow	Unit
Average Daily Flow (ADF)	7000	m ³ /day
Peak flow factor	1.5	
Peak Daily Flow (PDF)	10,500	m ³ /day
Lean flow factor	0.5	
Lean Daily Flow (LDF)	3500	m ³ /day

2.2 Industrial Raw Influent Quality

The plant shall be designed to treat the industrial wastewater with the characteristics summarised in Table 2-1.

Table 2-1 Influent Characteristics of new CETP

Parameters	Values*	Unit
Biochemical Oxygen Demand (BOD ₅)	600.0	mg/l
Chemical Oxygen Demand (COD)	1500.0	mg/l
Total Dissolved Solids	2100	mg/l
Total Suspended Solids (TSS)	600.0	mg/l
Total Kjeldahl Nitrogen (TKN)	100.0	mg/l
Total Phosphorus	10.0	mg/l
pH	6.5-9.0	
Oil & Grease (Free oil)	100	mg/l
Total Coliform	10 ⁶ to 10 ⁸	MPN/100 ml
Wastewater Temperature (Min)	20	Deg C
Wastewater Temperature (Max)	40	Deg C
Chloride	600	mg/l
Sulphate	1000	mg/l
Phenolic compounds	5	mg/l
Iron	5	mg/l
Arsenic	0.2	mg/l
Cadmium	1	mg/l
Lead	1	mg/l
Copper	3	mg/l
Zinc	5	mg/l
Nickel	3	mg/l
Mercury	0.01	mg/l
Selenium	0.05	mg/l
Total Chromium	1	mg/l
Hexavalent Chromium	0.1	mg/l
Cyanide	0.2	mg/l

Fluoride	2	mg/l
Boron	2	mg/l

Note:

- a) * Concentration Influent Parameters at the Equalisation Tank Outlet
- b) Contractor to make own assessment of parameters of plant returns and account for them in the design of the CETP.
- c) Alkalinity (as CaCO₃) can be considered as 300 mg/l for arriving at the Alkali dosage required for the process, and the same can be considered for OPEX calculation
- d) An auto-composite sampler shall be installed for sampling and analysis purposes of raw influent quality and treated effluent quality.
- e) An Online Continuous Effluent Monitoring System (OCEMS) shall be installed to monitor the raw influent, as per the MPCB directive/circular.

2.3 CETP Treated Effluent Limits

The effluent shall be treated to achieve a quality that will satisfy the end user requirements for surface drain disposal as described in Table 4.3.

Table 4.3 CETP Treated Effluent Characteristics

Parameters	Discharge Limit	Unit
Biochemical Oxygen Demand (BOD ₅)	≤ 5.0	mg/l
Chemical Oxygen Demand (COD)	≤ 20.0	mg/l
Total Suspended Solids (TSS)	≤ 1.0	mg/l
Turbidity	≤ 0.5	NTU
Total Nitrogen (TN)	≤ 10.0	mg/l
Ammoniacal Nitrogen	≤ 2.0	mg/l
Total Kjeldahl nitrogen	≤ 5.0	mg/l
Total Phosphorus	≤ 1.0	mg/l
pH	6.5-9.0	
Oil and Grease	≤ 10.0	mg/l
Total Dissolved Solids	≤ 500	mg/l
Chloride	< 600	mg/l
Sulphate	< 1000	mg/l
Bacteria	≥ Log 5 Reduction	
Viruses	≥ Log 5 Reduction	

Protozoa	≥ Log 5 Reduction	
Phenolic compounds	< 1	mg/l
Iron	< 0.5	mg/l
Arsenic	< 0.05	mg/l
Cadmium	< 0.5	mg/l
Lead	< 0.1	mg/l
Copper	< 0.5	mg/l
Zinc	< 0.5	mg/l
Nickel	< 0.5	mg/l
Mercury	< 0.01	mg/l
Selenium	< 0.05	mg/l
Total Chromium	< 1	mg/l
Hexavalent Chromium	< 0.1	mg/l
Cyanide	< 0.2	mg/l
Fluoride	< 2	mg/l
Boron	< 2	mg/l

Note: The above parameters shall be guaranteed as follows:

- 24-hour composite samples with 95 % plus compliance.
- Conformity is based on a 30-day Rolling month with a maximum of two failures allowed per month for composite samples, and at no time does a grab sample exceed the limits as specified above.
- An auto-composite sampler shall be installed for sampling and analysis purposes of raw influent quality.
- An Online Continuous Effluent Monitoring System (OCEMS) shall be installed for monitoring the treated water as per the MPCB directive/circular.

2.4 Sludge Generation and Dewatered Sludge Requirement

A sludge treatment system shall be designed to treat the entire quantity of the sludge generated from the CETP and STP with influent parameters and flows as indicated above. The dewatered sludge from the dewatering unit should have a minimum DS content of 20%. The treatment facility shall be designed to treat sludge for disposal at a landfill/waste management facility in accordance with MPCB norms, at a suitable location approved by the Engineer-in-Charge. For any hazardous sludge generated in the treatment plant in accordance with MPCB norms, the contractor shall be solely responsible for its treatment, secure transportation, and safe disposal, in accordance with the latest MPCB/CPCB Hazardous Waste Management Rules.

2.5 Odour Quality

The contractor shall design the Odour Control System for capturing, conveying, and treating the fumes/gases generated from the CETP, especially from each process unit upstream of the Aeration Tank. The OCU shall be designed to ensure that no odour nuisance whatsoever emanates from the CETP.

The Odour treatment shall be capable of achieving the standard of 5 Odour Units (OU)/m³ on a 99.8% basis, i.e., on an hourly averaging basis, measured at the nearest receptor.

2.6 Noise Limits

There should be no noise nuisance generated from the CETP. Therefore, the noise limit at 1m away from the blower house/enclosure or any other equipment should not exceed 80 dB (A).

2.7 Battery Limit for CETP

The battery limit of the CETP will start from the designated manhole outside the CETP and STP plot boundary and ends at the Recycle Water Pump discharge line extended up to 2m outside the CETP and STP plot boundary.

The Recycle Clear Water Reservoir (Re-CWR), along with the Recycle Water Pump House, shall be in the scope of the contractor.

The emergency bypass disposal point shall be as approved by the Employer's Engineer.

3. GENERAL PROCESS DESIGN REQUIREMENTS FOR STP

The process specification shall be read in conjunction with the Process flow diagram and Process and Instrumentation diagram provided in Volume 5 of the Tender Document.

3.1 Design flow for New STP

Each of the two STP package units should be designed for the average flow of 250 m³/d and an adequate wetwell cum equalisation tank to handle peak flow for 1250 cum/day.

The process design flows for the new package STPs are summarised in **Error! Reference source not found.**

Table 3-1 Process Design Flows to new STP

Description	Flow	Units
Average Daily Flow (ADF)	2x250	m ³ /d
Peak flow factor	2.5	
Lean flow factor	0.5	

3.2 Influent Sewage Quality

The plant shall be designed to treat the sewage with the characteristics summarised in **Error! Reference source not found.**

Table 3-2 Influent Sewage Characteristics

Parameters	Average Values	Unit
Biochemical Oxygen Demand (BOD ₅)	250.0	mg/l
Chemical Oxygen Demand (COD)	425.0	mg/l
Total Dissolved Solids	500	mg/l
Total Suspended Solids (TSS)	375.0	mg/l
Total Kjeldahl Nitrogen (TKN)	45.0	mg/l
Ammonia (NH ₃ -N)	32.5	mg/l
Total Phosphorus	7.0	mg/l
pH	7.0-7.5	
Oil & Grease (Free oil)	20	mg/l
Total Coliform	10 ⁶ to 10 ⁸	MPN/100 ml
Sewage Temperature (Min)	20	Deg C
Sewage Temperature (Max)	35	Deg C

Note:

- Contractor to make their own assessment of the parameters of plant returns and account for them in the design of the STP.
- Alkalinity (as CaCO₃) can be considered as 200 mg/l for arriving the Alkali dosage required for the process, and the same can be considered for OPEX calculation.

3.3 Treated Sewage Effluent Limits

The effluent shall be treated to achieve a quality that will satisfy the end user requirements for Industrial reuse as described in the **Error! Reference source not found..**

Table 3-3 Treated Sewage Effluent Characteristics

Parameters	Recycle Water Standard	Unit
Biochemical Oxygen Demand (BOD ₅)	≤ 5.0	mg/l
Chemical Oxygen Demand (COD)	≤ 20.0	mg/l
Total Suspended Solids (TSS)	≤ 1.0	mg/l
Turbidity	≤ 0.5	NTU
Total Nitrogen (TN)	≤ 10.0	mg/l
Ammonical Nitrogen	≤ 2.0	mg/l
Total Kjeldal nitrogen	≤ 5.0	mg/l
Dissolved Oxygen	> 2.0	mg/l
Total Phosphorus	≤ 1.0	mg/l
pH	7.0-8.5	
Free Residual Chlorine	1-2	mg/l
Bacteria	≥ Log 5 Reduction	
Viruses	≥ Log 5 Reduction	
Protozoa	≥ Log 5 Reduction	

Note: The above parameters shall be guaranteed as follows:

- 24-hour composite samples with 95 % plus compliance.
- The Conformity is based on a 30-day Rolling month with a maximum of two failures allowed per month for composite samples, and at no time does a grab sample exceed the limits as specified above.

3.4 Sludge Generation and Dewatered Sludge Requirement

The sludge generated in the STPs shall be pumped to the appropriate sludge sump in the CETP for thickening and dewatering. The dewatered sludge from the dewatering unit should have a minimum DS content of 20%.

3.5 Noise Limits

There should be no noise nuisance generated by the STP. Therefore, the noise limit at 1m away from the blower house/enclosure or any other equipment should not exceed 80 dB (A).

3.6 Battery Limit for STP

The battery limit of the STP will start from the designated manhole outside the CETP and STP plot boundary and end at the Recycle Water Pump discharge line extended up to 2m outside the CETP and STP plot boundary.

The STP emergency bypass shall be connected to the CETP emergency bypass.

4. NEW CETP PARTICULAR DESIGN REQUIREMENTS

4.1 CETP Receiving Chamber

- 4.1.1 The industrial wastewater will be received in the CETP receiving chamber from the last/designated manhole outside the CETP & STP plot boundary.
- 4.1.2 The CETP Receiving Chamber should be designed for the peak flow.
- 4.1.3 A motorised penstock should be provided in the incoming industrial raw influent line at the CETP receiving chamber.
- 4.1.4 One H₂S Analyser and pH Analyser should be provided in the CETP receiving chamber.
- 4.1.5 The design requirements for the CETP receiving chamber are provided in Table 4-1.

Table 4-1 CETP Receiving Chamber Description

Description	Values	Unit
Average daily flow	7000	m ³ /d
Peak factor	1.5	
Retention time at ultimate peak flow	60	sec
Material of construction	RCC	
Liquid depth	As per the Bidder's design	
Freeboard	As per the Bidder's design	

- 4.1.6 Odour extraction provision should be provided in the Receiving Chamber, and the interconnecting duct should be provided between the Receiving Chamber and the Centralised CETP Odour Control unit.
- 4.1.7 A handrail of 50 mm diameter stainless steel pipe 1.0 m high shall be provided as per safety requirements around the receiving chamber. Contractor shall ensure visibility in the receiving chamber through adequate illumination, especially during periods of natural light absence.
- 4.1.8 Rungs shall be provided on the wall of the receiving chamber to access the floor slab. Arrangements for the collection of samples shall be provided at the receiving chamber.
- 4.1.9 A continuous online monitoring system shall be provided as per the MPCB requirement or as directed by the Engineer-in-charge for the analysis of incoming wastewater.

4.2 Trash Rack and Coarse Screen Chamber

- 4.2.1 A Trash Rack shall be provided before the Coarse Screen to intercept and remove large debris from incoming wastewater before it enters the treatment process.
- 4.2.2 The Trash Rack and coarse screen chamber should be designed for the peak flow.
- 4.2.3 A penstock should be provided upstream and downstream of each Trash Rack and screen chamber to isolate the screen chamber.

- 4.2.4 Manual Trash Rack (2 working + 1 standby) and Mechanical coarse screens (2 Working + 1 Standby) shall be installed under this contract.
- 4.2.5 A level-indicating transmitter should be provided upstream and downstream of each mechanical fine screen.
- 4.2.6 Two numbers of skips/containers should be provided for collecting and storing the screenings generated in the Fine screen chamber.
- 4.2.7 The coarse screen chamber of CETP should be fully covered with a GRP cover. Odour extraction provision should be provided in the chamber, and an interconnecting duct should be provided between the coarse screen chamber and the Centralised CETP Odour control unit.
- 4.2.8 The design requirements for the coarse screen chamber are provided in the Table below:

CETP Coarse Screen Chamber Description

Description	Values	Unit
Coarse Screen Chambers	3 (2W+1S)	Nos
Design Flow	7000	Cum/day
Peak factor	1.5	
Quantity of Medium Coarse Screen	3 (2W+1S)	Nos
Type of Trash Rack	Mechanical - Rake type	
Screen opening size	80	mm
Angle of Inclination	As per the bidder's design	
MOC of the screen and related accessories	SS 316	
Quantity of Coarse screen	3 (2W+1S)	Nos
Type of screen	Mechanical - Rake type	
Screen opening size	15 - 20	mm
Angle of Inclination	60 - 80	Degree
Maximum velocity at peak flow	1.2	m/s
Head loss in the screen during peak flow at 50% clogging is not to exceed	300	mm
MOC of the screen and related accessories	SS 316	
Quantity of conveyor	1	No.
Type of conveyor	Screw conveyor	
MOC of Screw conveyor	SS 316 / SS 316 L	

Quantity of Compactor	Minimum 1	No.
MOC of Screening Compactor	SS 316 / SS 316 L	
Compactor minimum screening solid content	40% DS	
Wash water arrangement	To be provided	
Odour extraction provision	To be provided	

4.3 Wet Well

- 4.3.1 Wet well should be designed for the peak flow.
- 4.3.2 The Wet well shall have two compartments. Each compartment of the Wetwell shall be provided with a motorised penstock for isolation. Additionally, a motorised penstock shall be provided between the compartments.
- 4.3.3 Each wet well compartment should be provided with a motorised penstock for isolation. Additionally, a motorised penstock should be provided between the compartments.
- 4.3.4 The effective liquid volume of the sump should not include the dead volume provided for the minimum submergence of pumps.
- 4.3.5 Submersible-type pumps should be provided for wet well pumps. Each pump should be provided with a Variable Frequency Drive (VFD).
- 4.3.6 The wet well and pumping station should be provided with an EOT crane with suitable capacity. The lifting capacity of lifting equipment should be at least 2.0 times the heaviest piece to be lifted.
- 4.3.7 A wet well pumping station should have a room adequate for installing electrical panels.
- 4.3.8 Both a level-indicating transmitter and a Level switch shall be provided in the wet well. In the event of a temporary failure of the level-indicating transmitter, the level switch will serve as the backup for pump protection. The contractor shall provide a Level switch with three alarms (Low, Low low and High).
- 4.3.9 A pressure-indicating transmitter should be provided at the discharge of each wet well pump.
- 4.3.10 An electromagnetic flowmeter should be provided at the common discharge header of wet well pumps.
- 4.3.11 A sturdy, permanent safety barrier, in the form of a railing, shall be provided around the wet well.
- 4.3.12 Area in the vicinity of the Wetwell shall always be illuminated, especially in the absence of natural light.
- 4.3.13 Rungs shall be provided along the wetwell wall to access the floor slab.

- 4.3.14 An emergency bypass line should be provided with a motorised valve in the common discharge header of wet well pumps. The emergency bypass should be discharged into the nearest surface drain through the treated effluent outfall chamber.
- 4.3.15 The wet well should be fully covered with a GRP cover. Odour extraction provision should be provided, and an interconnecting duct should be provided between the wet well and the Centralised CETP Odour control unit.
- 4.3.16 The design requirements for the wet well are provided in the Table below

Description	Values	Unit
No. of Wet Wells	1	Nos.
No. of compartments	2	Nos.
Design Average flow	7000	m ³ /d
Peak factor	1.5	
Retention time at the daily average flow	Minimum 10	min
Liquid depth	As per the Bidder's design	
Freeboard	Min 0.5 m	
Number of wet well pumps	Working pumps for peak flow and 50% standby (minimum) for peak flow. Turn down ratio minimum 50% at average flow.	Nos
Type of Pumps	Submersible Pumps	
Pump lifting arrangement	Guide rails and lifting chains are both in SS 316.	
MOC of Pumps	Casing: Austenitic Cast Iron with High chromium content/ SS 316 Impeller: SS 316, Shaft: SS 410	
Head of Pumps	As per the Bidder's design	
Type of operation	VFD based	

- 4.3.17 Hydraulic criteria to be adopted in the design of Industrial Wastewater Pumping Station (IWPS) shall be as below:
- Submersible non-clog pumps will be considered for IWPS. The pumps shall be selected for a speed of 1500 rpm or below with VFD.
 - Pumping capacity should be equal to peak flow, and 100% standby of peak flow should be provided in standby.

- c) Equal-sized/Same capacity of multiple pumps will be preferred to be selected for ease of maintenance and spares.
- d) Velocity to be considered as 1.5 m/s for discharge pipes at peak flows.
- e) Minimum residual head to be considered as 3m for pump head design.
- f) Both the Level Indicating transmitter and Level switch shall be provided in the wet well. In the event of a temporary failure of the level-indicating transmitter, the level switch will serve as the backup for pump protection. The contractor shall provide a Level switch with three alarms (Low, Low low and High). Pressure Indicating Transmitter should be provided at the common discharge header of dry well/wet well pumps, pressure gauge shall be provided for each pump discharge line.
- g) The clearance between pumps/piping/valves from adjacent walls shall be not less than 1000 mm.
- h) It is recommended to keep a minimum distance of 1500 mm between the pumps' centre line and increase it as per vendor recommendations.
- i) The sequence of operation of pumps shall be changed every 8 hours. (Contractor to ensure the number of pump selections is accordingly)
- j) +5% margin on the pump capacity shall be provided for all the pumps. The total head of the pump shall be selected based on the peak flow and the minimum design water level in the wet well for normal conditions of operation, and checked for satisfactory operation under extreme conditions.
- k) The pump capacity and head shall be selected such that the total pump output is more than the design flow to ensure free flow at all flow conditions.
- l) Submergence in Wet well/ Dead volume calculation shall be as per the criteria given in the Hydraulic Institute and pump vendor data.
- m) Minimum 15% margin over the power input to pump at the duty point will be kept while selecting the motor rating.
- n) Flanged Ductile iron pipe will be provided at pump delivery. Stainless steel (SS 304) expansion bellows shall be provided between pump delivery valves and at the header connection to facilitate installation and dismantling.
- o) Pump delivery gate valves will be with electric actuators.
- p) A swing check valve will be provided at the pump delivery pipe to prevent backflow. A suitably sized air release valve with an isolation gate valve is to be provided on the highest point in the delivery pipe.
- q) Pumping station shall be provided with an electrically operated travelling crane.
- r) Minimum space of 600 mm from the pipe flange end to the adjacent wall shall be provided inside the Valve Chamber.
- s) Sluice gates in inlet channels shall be of SS construction with a flush bottom and rising spindle arrangement.

- t) VFD pumps to be selected; however, the turn-down operating condition should not be below 30 – 50% of the original speed.

Detailed specification of the pumps and associated pipe work and valves, material of construction details, etc., shall be referred to from the General Mechanical Specification and various other relevant sections of this tender document.

The design, materials, construction, manufacturing, inspection, testing and performance of all equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The equipment shall also conform to the latest applicable Indian or equivalent standards. Other International standards are also acceptable if they are established to be equal to or superior to the listed standards. Nothing in this specification shall be construed to relieve the Contractor of this responsibility.

4.4 CETP Inlet Chamber

- 4.4.1 Wastewater pumped from the wet well will be received in the Inlet/Stilling chamber to control water turbulence.
- 4.4.2 Ammonia Analyser, TSS Analyser, Conductivity/TDS analyser, and auto-sampler should be provided in the inlet chamber.
- 4.4.3 The design requirements for the CETP Inlet chamber are provided in Table 4-2.

Table 4-2 CETP Inlet Chamber Description

Description	Values	Unit
Average Daily flow	7000	m ³ /d
Peak factor	1.5	
Retention time at peak flow	45 to 60	sec
Material of construction	RCC	
Liquid depth	As per the Bidder's design	
Freeboard	As per the Bidder's design	

- 4.4.4 Odour extraction provision should be provided in the Inlet Chamber. An interconnecting duct should be provided between the Inlet Chamber and the Centralised CETP Odour control unit.

4.5 Fine Screen Chamber

- 4.5.1 Wastewater will flow from the silling chamber to the fine screens.
- 4.5.2 Two number of skips/containers should be provided for collecting and storing the screenings generated in the Fine screen chamber.
- 4.5.3 A manual penstock should be provided upstream and downstream of each fine screen chamber for isolation.
- 4.5.4 A level-indicating transmitter should be provided upstream and downstream of each mechanical fine screen.

4.5.5 Odour extraction provision should be provided in the Fine screen chamber. An interconnecting duct should be provided between the Fine screen chamber and the centralised CETP Odour control unit.

4.5.6 The design requirements for the Fine screen chamber are provided in Table 4-3.

Table 4-3 Fine screen chamber Description

Description	Values	Unit
Quantity of the fine screen chamber	3 (2W + 1S)	Nos
Design Flow to each screen chamber	5250	m ³ /d
Type of mechanical screen	Mesh screen	
Screen opening size	6	mm
Angle of Inclination	60-80	Degree
Maximum velocity at peak flow	1.2	m/s
Head loss in the screen during peak flow at 50 % clogging, not to exceed	300	mm
MOC of the screen and related accessories	SS 316 / SS 316 L	
Quantity of conveyor	1	No
Type of conveyor	Screw conveyor	
MOC of Screw conveyor	SS 316 / SS 316 L	
Quantity of compactor (Minimum)	1	No
MOC of Screening Compactor	SS 316 / SS 316 L	
Compactor minimum screening solid content	40% DS	
Wash water arrangement	To be provided	
Odour extraction provision	To be provided	

4.6 Vortex Grit Chamber

4.6.1 After screening, the wastewater shall enter the vortex-type grit chamber.

4.6.2 The Vortex Grit chamber should be designed for the peak flow of 10,500 m³/d.

4.6.3 The grit chamber inlet and outlet configuration should provide a 360-degree flow pattern and shall be operated mechanically.

4.6.4 The vortex grit chamber should be constructed in RCC or SS316.

4.6.5 A vortex-type grit mechanism should be provided with an axial-flow propeller, turbo grit pumps/air lift pumps, and other related equipment.

4.6.6 If Air lift type pumps are selected, two air blowers (1W+1S) should be provided.

- 4.6.7 Two (2) Grit washers/classifiers should be provided with all related equipment and instruments.
- 4.6.8 Two (2) number of skip/containers should be provided for collecting and storing the grits generated in the Vortex Grit Chamber.
- 4.6.9 A manual penstock should be provided upstream and downstream of each Vortex Grit chamber for isolation.
- 4.6.10 Odour extraction provision should be provided in Vortex grit chamber. Interconnecting duct should be provided between Vortex grit chamber and Centralized CETP Odour control unit.
- 4.6.11 The design requirements for Vortex Grit chamber are provided in Table 4-4.

Table 4-4 Vortex Grit Chamber Description

Description	Values	Unit
Type of Grit chamber	Vortex Grit type	
Quantity of Grit chamber	2 (1W+1S)	Nos
Design flow to each Vortex Grit Chamber	10,500	m ³ /d
Size of Grit particle to be removed	0.15	mm
Grit density	2.65	
Free Board	0.5	m
MOC of vortex grit mechanism	SS 316/SS 316 L	
Type of Grit pump	Turbo Grit pump / Air lift pump	
Type of blower (applicable only if air lift type pump is selected)	Rotary blower	
MOC of Grit extraction screw	SS316 / SS 316L	
MOC of Grit washer/classifier	SS316 / SS 316L	
Wash water arrangement	To be provided	
Odor extraction provision	To be provided	
Dewatered grit solids content	> 40	% DS
Dewatered grit volatile content	< 20	%VS
Grit Removal Efficiency required	≥ 95% of 0.15 mm	

4.7 Oil & Grease Removal

- 4.7.1 Corrugated Plate Interceptor (CPI) or Tilted Plate Interceptor (TPI) shall be provided for the removal of Oil and Grease. It should be provided with an adjustable effluent weir for

flexible flow control. The plates shall be arranged in parallel. The API/CPI shall be designed in accordance with API 421 standards. The O&G separator shall have a Primary Oil Coalescer, a Secondary Oil Coalescer and an Oil Skimmer.

Description	Values	Unit
Type	CPI/TPI	
Quantity	2 (1W+1S)	Nos.
Peak factor	1.5	-
HRT	60	Seconds
Design flow	Each @ 100% of Peak flow	
Angle of Plates	As per the bidder's design	
MOC of Tank	RCC or SS316	
Sludge removal pump	Screw pump	
Oil content at the outlet	<10 ppm	

4.8 Equalisation Tank

- 4.8.1 An equalisation tank should be constructed for balancing the flow and concentration coming into the influent from various industries.
- 4.8.2 One number of equalisation tank with two equal compartments should be provided, and the tank should be constructed in RCC M35. Necessary arrangements should be made to make it easy to empty out and clean the tank.
- 4.8.3 Each wet well compartment should be provided with a motorised penstock for isolation. Additionally, a motorised penstock should be provided between the compartments.
- 4.8.4 Each tank compartment shall be equipped with two (2 Nos.) Submersible pumps (1W + 1S) to pump the flow to the Flash Mixing Tank.
- 4.8.5 The Equalisation tank shall be provided with submersible mixers to keep solids in suspension. A fixed, dedicated Lifting Davit crane with suitable capacity shall be provided for lifting each submersible mixer during maintenance.
- 4.8.6 A gantry crane and electrical chain hoist with suitable capacity should be provided for the Equalisation tank pumping station.
- 4.8.7 An Auto sampler should be provided in the equalisation tank pump sump.
- 4.8.8 A level indicating transmitter and pH analyser shall be provided in the Equalisation tank pump sump. Acid/Alkali dosing should be dosed in the equalisation tank for pH adjustment.
- 4.8.9 An electromagnetic flow meter and a Pressure Indicating transmitter shall be provided at the common header of the equalisation tank pump discharge.

- 4.8.10 For coarse bubble aeration, the material of construction of the pipe between the blower house and equalisation tank, drop pipe and air distribution pipe & laterals should be in SS 316.
- 4.8.11 The equalisation tank and the equalisation tank pump sump should be fully covered with GRP covers.
- 4.8.12 Odour extraction provision should be provided in the Equalisation tank and its pump sump. An interconnecting duct should be provided between the Equalisation tank and the CETP Centralised Odour control unit.
- 4.8.13 The design requirements for the Equalisation Tank are provided in the table below

4.9 Flash Mixing Tank

- 4.9.1 One manually operated penstock should be provided at the entrance of each flash mixing tank.
- 4.9.2 A manual penstock should be provided upstream of each Flash Mixing tank for isolation.
- 4.9.3 Plant returns shall be routed back to the flash mixing tank.
- 4.9.4 Acid/Alkali dosing provision line for pH adjustment should be provided in flash mixing tank.
- 4.9.5 Sulphuric acid dosing system and NaOH dosing system should be provided in the chemical building.
- 4.9.6 Alum dosing should be provided as a coagulant in the Flash mixing tank for Phosphorus removal and chemical precipitation of heavy metals.
- 4.9.7 The design requirements for the Flash Mixing Tank are provided in Table 4-5.

Table 4-5 Flash Mixing Tank Description

Description	Values	Unit
Design flow	7000 m ³ /d + Plant returns	m ³ /d
No of tanks (Minimum)	2	Nos
Retention time (Minimum)	5	minutes
MOC of Flash Mixing Tank	RCC	
No of flash mixers per tank (Minimum)	1	No
Type of flash mixer	Rapid speed agitator	
MOC of Flash Mixer	SS 316	

4.10 Flocculation Tank

- 4.10.1 Polymer dosing should be provided as a coagulant aid in the flocculation tank.
- 4.10.2 The design requirements for the Flocculation Tank are provided in Table 4-6.

Table 4-6 Flocculation Tank Description

Description	Values	Unit
Design flow	7000 m ³ /d + Plant returns	m ³ /d
No of tank (Minimum)	2	Nos
Retention time (Minimum)	30	minutes
MOC of Flocculation Tank	RCC	
No of flocculator per tank (Minimum)	1	No
Type of flocculator	Slow speed Paddle type flocculator	
MOC of flocculator	SS 316	

4.11 Distribution Chamber for Primary Clarifier

- 4.11.1 The distribution chamber for the primary clarifier should be designed for average flow.
- 4.11.2 Two manually operated weir penstocks should be provided in distribution chamber of the primary clarifier.
- 4.11.3 The distribution chamber should be constructed in RCC.

4.12 Primary Clarifier

- 4.12.1 Heavy metals present in the wastewater should be removed in the primary clarifier.
- 4.12.2 An alum dosing system should be provided for Phosphorus removal. Some amount of Phosphorus concentration will be removed through chemical precipitation in the primary clarifier, and the remaining phosphorus shall be removed biologically in the bioreactor.
- 4.12.3 Chemical sludge should be considered in addition to the primary sludge contributed by suspended solids.
- 4.12.4 The design requirements for the Primary Clarifier are provided in Table 4-7.

Table 4-7 Primary Clarifier Description

Description	Values	Unit
Primary Clarifier		
Design flow	7000 m ³ /d + Plant returns	m ³ /d
No of Primary Clarifier	2	Nos
MOC of Primary Clarifier	RCC	
Surface Loading rate (maximum)	< 35	m ³ / m ² /d
Weir Loading rate (maximum)	< 185	m ³ / m ² /d
Side water depth (Minimum)	3.5	m
Freeboard (Minimum)	0.5	m
Bottom slope	1:12	
Expected primary sludge consistency (Minimum)	3	%
Type of bridge	Half bridge	
Drive mounting	Central Driven	
Width of walkway (Minimum)	1.2	m
Influent feed and type of inlet	Bottom feed and pipe	

Type of weir with V notch	Single weir	
Type of launder	Internal	
MOC of Launder	RCC	
MOC of Scraper mechanism	SS 316	
MOC of bridge	SA21/2 sand blasted & CSEP	
MOC of weir and fasteners	SS 316	
Epoxy coating Minimum DFT	250	Microns
MOC of telescopic valve	SS 316	

4.12.5 The design requirements for Alum dosing system are provided in Table 4-8.

Table 4-8 Alum Dosing System Description

Description	Values	Unit
Type of coagulant	Liquid Alum	
Alum Bulk storage tank		
Alum bulk storage requirement (Minimum)	15	days
No of Alum Bulk storage tank (Minimum)	1	No
Capacity of Tank	As per Bidder's Design	
MOC of Bulk storage tank	RCC/FRP/HDPE	
Level Measurement	Level Indicating Transmitter	
Alum Bulk storage tank agitator		
No of Agitator	1	No
Type of Agitator	Vertical shaft agitator	
MOC of Agitator	SS 316	
Alum Dosing Tank		
No of Alum dosing tank (Minimum)	1	No
Alum dosing concentration	< 10	%
Capacity of Tank	As per Bidder's Design	
MOC of dosing tank	FRP/HDPE	
Level Measurement	Level Indicating Transmitter	
Alum Dosing Tank agitator		
No of Agitator	1	No
Type of Agitator	Vertical shaft agitator	
MOC of Agitator	SS 316	
Alum Dosing Pumps		
No of Alum Dosing pumps (Minimum)	2 (1W+1S)	Nos
Type of pumps	Single Diaphragm	

Capacity and Head of pumps	As per Bidder's Design	
Type of pump operation	VFD based	

- 4.12.6 The design requirements for Polymer dosing system for flocculation are provided in Table 4-9.

Table 4-9 Polymer Dosing System for Flocculation Description

Description	Values	Unit
Type of Polymer	Anionic Polymer	
Polymer bulk storage requirement (Minimum)	15	days
Polymer Dosing Tank		
No of Polymer dosing tank (Minimum)	2	No
Polymer dosing concentration	0.05	%
Capacity of Tank	As per Bidder's Design	
MOC of dosing tank	FRP/HDPE	
Level Measurement	Level Indicating Transmitter	
Polymer Dosing Tank Agitator		
No of Agitator per tank (minimum)	1	No
Type of Agitator	Vertical shaft agitator	
MOC of Agitator	SS 316	
Polymer Dosing Pumps		
No of Polymer Dosing pumps (Minimum)	2 (1W+1S)	Nos
Type of pumps	Single Diaphragm	
Capacity and Head of pumps	As per Bidder's Design	

- 4.12.7 The design requirements for NaOH dosing system are provided in Table 4-10.

Table 4-10 NaOH Dosing System Description

Description	Values	Unit
NaOH bulk storage requirement (Minimum)	15	days
NaOH Bulk Storage Tank		
No of NaOH Bulk tank (Minimum)	1	No
Capacity of Tank	As per Bidder's Design	
MOC of Bulk tank	FRP/HDPE	
Level Measurement	Level Indicating Transmitter	
NaOH Dosing Pumps		
No of NaOH Dosing pumps (Minimum)	2 (1W+1S)	Nos
Type of pumps	Single Diaphragm	
Capacity and Head of pumps	As per Bidder's Design	

- 4.12.8 The design requirements for Sulfuric Acid dosing system are provided in Table 4-11.

Table 4-11 Sulfuric Acid Dosing System Description

Description	Values	Unit
Sulfuric Acid bulk storage requirement (Minimum)	15	days
Sulfuric Acid Bulk Storage Tank		
No of Sulfuric Acid Bulk tank (Minimum)	1	No
Capacity of Tank	As per Bidder's Design	
MOC of Bulk tank	Carbon Steel Epoxy painted	
Epoxy coating Minimum DFT	350	μ
Manufacturing standard	NACE SP0294-2006	
Level Measurement	Level Indicating Transmitter	
Sulfuric Acid dosing pumps		
No of Sulfuric Acid dosing pumps (Minimum)	2 (1W+1S)	Nos
Type of pumps	Single Diaphragm	
Capacity and Head of pumps	As per Bidder's Design	

4.13 Ultra- Fine Screen Chamber

- 4.13.1 Ultra-Fine screen chamber should be designed for average flow of 7000 m³/d.
- 4.13.2 Two number of skip/container should be provided for collecting and storing the screenings generated in the Ultra-Fine screen chamber.
- 4.13.3 A manual penstock should be provided upstream and downstream of each Ultra-Fine screen chamber for isolation.
- 4.13.4 Level Indicating Transmitter should be provided upstream and downstream of each mechanical ultra-fine screen.
- 4.13.5 Odour extraction provision should be provided in the Ultra-Fine screen chamber. An interconnecting duct should be provided between the Ultra-Fine screen chamber and the Centralised CETP Odour control unit.
- 4.13.6 An electromagnetic flow meter should be installed in the pipeline between the ultra-fine screen chamber and the distribution chamber of the pre-anoxic tank to measure the flow going to the bioreactor.
- 4.13.7 The design requirements for the Ultra-Fine screen chamber are provided in Table 4-14.

Table 4-12 Ultra-Fine screen chamber Description

Description	Values	Unit
Quantity of Ultra-Fine screen chamber	2	Nos
Design Flow to each screen chamber	7000 m ³ /d + Plant returns	m ³ /d

Quantity of the mechanical screen	2 (1W+1S)	Nos
Type of mechanical screen	Drum screen	
Screen opening size	2	mm
Angle of Inclination	35	Degree
Maximum velocity at peak flow	1.2	m/s
MOC of the screen and related accessories	SS 316 / SS 316 L	
Quantity of conveyor	1	No
Type of conveyor	Screw conveyor	
MOC of Screw conveyor	SS 316 / SS 316 L	
Quantity of compactor (Minimum)	1	No
MOC of the Screening Compactor	SS 316 / SS 316 L	
Compactor minimum screening solid content	40% DS	
Wash water arrangement	To be provided	
Odour extraction provision	To be provided	

4.14 Biological Treatment

- 4.14.1 The Contractor shall design, provide, install, commission, and ensure the uninterrupted operation of an advanced biological wastewater treatment system incorporating multiple treatment stages. This system shall be capable of achieving efficient and consistent removal of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Biological Nutrient Removal (BNR), including Total Phosphorus, Nitrates, Nitrites, and Ammonia, complying with the 'CETP Treated Water Characteristic.

The treatment scheme shall incorporate an appropriate sequence of anaerobic, aerobic and anoxic biological zones, followed by a Membrane Bioreactor (MBR) system. The MBR shall provide high-efficiency solid-liquid separation, ensuring superior effluent quality with low turbidity and pathogen levels. The various components of the Biological System shall be as follows:

- 4.14.2 Each Bioreactor should consist of pre-anoxic, aerobic, and post-anoxic, followed by a membrane tank with gravity flow.
- 4.14.3 For bioreactor design purposes, TSS, BOD, and COD removal efficiencies in the primary clarifier should not exceed 60%, 30%, and 30%, respectively.

4.15 Distribution Chamber for Anaerobic and Anoxic Tank

- 4.15.1 The distribution chamber for anaerobic and anoxic tank should be designed for an average flow of 7000 m³/d.
- 4.15.2 Two manually operated weir penstocks should be provided in the distribution chamber of the pre-anoxic tank.
- 4.15.3 An acid/Alkali dosing provision should be provided in the distribution chamber for the pre-anoxic tank.
- 4.15.4 A pH analyser should be provided in the distribution chamber.
- 4.15.5 The distribution chamber should be constructed in RCC.

4.16 Anaerobic Tank

- 4.16.1 Enhanced Biological Phosphorus Removal (EBPR) process shall be used, wherein Phosphorus is removed by phosphate-accumulating organisms (PAOs) through a sequence of Anaerobic and Aerobic environments.
- 4.16.2 The retention time of about 2 hours shall be provided in the anaerobic zone. The contents of the Anaerobic Tanks shall be hydraulically mixed to ensure contact with the return-activated sludge and influent wastewater.
- 4.16.3 The nitrified recycle should be recycled back to the anaerobic tank.
- 4.16.4 The anaerobic tank shall be provided with submersible mixers to keep solids in suspension.
- 4.16.5 A fixed Lifting Davit crane with suitable capacity shall be provided for each submersible mixer for lifting during maintenance.
- 4.16.6 Nox-N Analyser should be provided in the anaerobic tank.
- 4.16.7 The design requirements for the pre-anoxic tank are provided in Table 4-14.

Table 4-13 Anaerobic tank Description

Description	Values	Unit
No. of Anaerobic Tank (Minimum)	2.0	Nos
Design Flow	7000 m ³ /d + Plant returns	m ³ /d
MOC of Anaerobic tank	RCC	
Liquid depth (Maximum)	6.0	m
Freeboard (Minimum)	0.6	m
Design of a bioreactor for Minimum wastewater temperature	20.0	°C
Hydraulic Retention Time (Minimum)	2	hrs
Mixing requirement (Minimum)	15	W/m ³
Type of Mixers	Submersible Mixers	
Number of submersible mixers per anaerobic tank (Minimum)	2	Nos
MOC of submersible mixers with guide rails & chains	SS 316	
Type of lifting equipment for mixers	Fixed lifting davit	

4.17 Anoxic Tank

- 4.17.1 De-nitrification in wastewater treatment is the process by which nitrates in the process stream are broken down into nitrogen gas in the presence of specific denitrifying bacteria. Optimum de-nitrification by these bacteria is achieved in anoxic conditions with a readily available carbon-rich food source.
- 4.17.2 Though the sewage is rich in carbon source but there should be dosing provision of Methanol dosing in Anoxic tank in case of less carbon source in influent sewage.

- 4.17.3 Contractor shall provide suitable nos. of submersible mixers in the anoxic zone. MOC of Submersible mixers should be SS 316, and the number of submersible mixers per anoxic tank shall be suitable as per design.
- 4.17.4 The sludge shall be kept in suspension, and a minimum horizontal velocity of 0.3 m/sec shall be maintained by submersible mixers in the anoxic tank.
- 4.17.5 The design requirements for the anoxic tank are provided in Table 4-14.

Table 4-14 Anoxic tank Description

Description	Values	Unit
No. of Anoxic Tank (Minimum)	2.0	Nos
Design Flow	7000 m ³ /d + Plant returns	m ³ /d
MOC of Anoxic tank	RCC	
Liquid depth (Maximum)	6.0	m
Freeboard (Minimum)	0.6	m
Design of a bioreactor for Minimum wastewater temperature	20.0	°C
Hydraulic Retention Time (Minimum)	2	hrs
Dissolved oxygen is to be maintained in the anoxic tank	< 0.2	mg/l
Mixing requirement (Minimum)	15	W/m ³
Type of Mixers	Submersible Mixers	
Number of submersible mixers per anoxic tank (Minimum)	2	Nos
MOC of submersible mixers with guide rails & chains	SS 316	
Type of lifting equipment for mixers	Fixed lifting davit	
Internal recirculation ratio	2 to 4 Q based on contractor design	
Quantity of IR pumps	Suitable with 100% standby	

4.18 Aeration tank

- 4.18.1 The aeration tank shall receive the flow from the pre-anoxic tank. The aeration tank shall be oxygenated using a diffused aeration system with retrievable-type diffusers.
- 4.18.2 Fine bubble aeration with EPDM/PU Tubular diffusers can be provided for a diffused aeration system.
- 4.18.3 For diffuser design purposes, the standard oxygen transfer efficiency should not include more than 5%/meter of submergence depth when calculating the number of diffusers.
- 4.18.4 Dissolved oxygen, MLSS and Ammonia analyser should be provided in the aeration tank.
- 4.18.5 An electromagnetic flow meter should be provided in the common header of RAS pumps and MLR pumps. One Level Indicating transmitter should be provided in each aeration tank.

- 4.18.6 A gantry crane with an electrical chain hoist with suitable capacity should be provided for lifting MLR pumps.
- 4.18.7 CETP Blower house shall be constructed, housing both aeration tank and membrane tank blowers.
- 4.18.8 Each aeration tank blower should be provided with a Variable frequency drive (VFD) and operated based on the DO level in the aeration tank.
- 4.18.9 Each blower should be provided with an acoustic enclosure, and the noise level should not exceed 80 dB(A) at 1 m from the blower building/enclosure.
- 4.18.10 Blower house should be provided with an EOT crane of suitable capacity. The crane's capacity should be 2 times the heaviest equipment to be lifted.
- 4.18.11 Material of construction of pipe between blower house and aeration tank, drop pipe and air distribution pipe & laterals should be in SS 316.
- 4.18.12 Diffuser supports should be in SS 316 material.
- 4.18.13 Pressure Indicating Transmitter, Temperature Indicating Transmitter and an air flow meter should be provided in the common header of the blower discharge line.
- 4.18.14 The design requirements for the aeration tank are provided in Table 4-15.

Table 4-15 Aeration Tank Description

Description	Values	Unit
No. of Aeration Tank (Minimum)	2.0	Nos
Design Flow	7000 m ³ /d + Plant returns	m ³ /d
MOC of Aeration Tank	RCC	
Design of a Bioreactor for Minimum Wastewater Temperature	20.0	°C
MLSS maintained in the aeration tank (max)	8000	mg/l
Maximum MLSS in the RAS recirculation	11000	mg/l
Maximum Liquid depth	6.0	m
Freeboard	0.6	m
F/M ratio	As per Bidder Design	kg BOD/kg MLSS.d
Hydraulic Retention Time	As per Bidder Design	Hrs.
Aerobic SRT (Minimum)	15	Days
Specific Sludge Yield	As per Bidder Design	Kg TSS/Kg BOD removed
RAS Recirculation ratio	As per Bidder Design	
BOD oxidation oxygen requirement	1.2	Kg/kg BOD removed

Nitrification oxygen requirement	4.6	Kg/kg NH ₃ -N nitrified
Minimum DO to be maintained in the aeration tank	2.0	mg/l
Allowable maximum oxygen credit from denitrification	50%	
Total Actual oxygen demand, additional safety factor	20%	
MLR Pumps		
Nitrified Recycle, Mixer Liquor Recycle (MLR) Ratio	As per Bidder's Design	
Quantity of MLR Pumps (Minimum) per tank	2 (1W+1S)	Nos
Type of Pumps	Submersible pumps	
Type of pump operation	VFD based	
Diffused Aeration in Aeration Tank		
Oxygen transfer correction factor for wastewater, α	0.60	
Fouling factor for diffusers	0.80	
Salinity-Surface tension correction factor, β	0.95	
Type of Aeration	Fine bubble diffusers	
Type of Diffusers	EPDM/PU Tubular/Disc Diffusers	
Type of Diffuser Installation	Retrievable	
Maximum air flow through the tubular membrane diffuser	< 10.0	Nm ³ /h
Mounting distance of diffuser from floor level up to its centerline (Minimum)	0.20	m
Air Blowers		
Quantity of Air Blowers provided (Minimum)	2 (1W+1S)	nos.
Capacity and head of blowers	As per Bidder's Design	Nm ³ /h
Type of Blowers	Rotary Type (Tri lobe)	
Type of Blower Operation	VFD based	
Blower design (applicable for all blowers and compressors)		
Altitude of Plant Site	20	m
Maximum Ambient temperature at the site	45	Deg C
Maximum Relative Humidity for design purposes	100	%

4.19 Membrane Bioreactor

- 4.19.1 The Membrane Filtration system shall be a vacuum-driven system with membrane modules submerged in process tanks.
- 4.19.2 MBR should be designed for the average flow of 7000 m³/d.

- 4.19.3 The Contractor shall provide a fully automatic permeate and backwash pumping system, with all controls, instruments, electrical components, valves, actuators, piping, fittings, and mountings.
- 4.19.4 The Contractor shall supply and install a dedicated permeate cum backwash pump to operate with each membrane tank/train. These shall be identical rotary-lobe positive displacement pumps / Horizontal Centrifugal pumps. Each pump shall be equipped with a variable-frequency drive (VFD) to control the pump's operating speed. The Contractor shall also supply a minimum of two standby permeate/backwash pumps provided with a VFD.
- 4.19.5 Permeate pumps should be installed inside the permeate pump house, provided with an EOT crane/Electrical Chain Hoist with suitable capacity.
- 4.19.6 A fully automatic membrane backwash system should efficiently and effectively remove debris, solids, and microorganisms that build up on the membrane surface during filtration.
- 4.19.7 The automatic backwash sequence should be initiated based on the transmembrane pressure level, elapsed run time since the last membrane backwash or chemical cleaning, volume of filtrate produced since the last membrane backwash or chemical cleaning, and/or manual actuation from the control system and local control interface.
- 4.19.8 The backwash/backpulse tank shall receive part of the filtrate water from the common header line of the permeate pumps. From the tank, the water is used to backwash the membranes. The MOC of the back pulse tank should be in RCC.
- 4.19.9 A Level indicating transmitter should be provided in the back pulse tank, and an electromagnetic flow meter should be provided in the backwash line.
- 4.19.10 NaOCl and Citric acid should be dosed in the backwash line for membrane cleaning
- 4.19.11 The RAS withdrawal from each MBR tank should be automatic. Motorised valves should be provided in each RAS withdrawal line and collected in the RAS Sump.
- 4.19.12 RAS should be pumped back to the aeration tank through RAS pumps, and the excess sludge should be transferred to the combined sludge sump.
- 4.19.13 The material of construction of the pipe between the blower house and MBR, drop pipe and air distribution pipe should be in SS 316.
- 4.19.14 Pressure Indicating Transmitter, Temperature Indicating Transmitter should be provided in the common header of the Membrane air blower discharge line.
- 4.19.15 The airline entering each MBR tank should be provided with an airflow meter.
- 4.19.16 A pH analyser and a level-indicating transmitter should be provided in each MBR tank.
- 4.19.17 A pressure-indicating transmitter should be provided in the suction and discharge lines of each permeate pump.

4.19.18 One Turbidity Analyser and an Electromagnetic flow meter should be provided at the discharge line of each permeate pump.

4.19.19 The design requirements for the Membrane Bioreactor are provided in Table 4-16.

Table 4-16 Membrane Bio-Reactor Description

Description	Values	Unit
No of MBR tanks/trains (Minimum)	4	Nos
MOC of MBR Tank	RCC	
Liquid depth	As per the Bidder's design	m
Freeboard (Min)	0.6	m
Type of membrane	Hollow fibre - outside in	
Membrane chemical composition	PVDF	
Nominal Pore size	< 0.05	μ
Maximum MLSS to be maintained in the MBR tank	11000	mg/l
Net Flux during average flow at N condition	< 15	LMH
Backwash flux	As per the Bidder's Design	LMH
MOC of Membrane Cassettes and their support	SS 316	
Permeate cum Backwash pumps		
Number of permeate cum backwash pumps (Min)	6 (4W+2S)	Nos
Capacity & Head	As per the Bidder's design	
Pump type	Horizontal Centrifugal / Rotary Lobe	
Type of operation	VFD based	
Membrane Air Blowers		
No of Membrane air blowers (Minimum)	2 (1W+1S)	Nos
Capacity and Head	As per the Bidder's design	
Type of blowers	Rotary Blowers (Tri lobe)	
Maintenance and Recovery Clean		
Frequency of cleaning	As per the Membrane Manufacturer's guidelines	
Sodium hypochlorite dosage		
Citric Acid dosage		

4.19.20 The design requirements for NaOCl and Citric Acid Dosing System for membrane cleaning are provided in Table 4-17.

Table 4-17 CETP NaOCl and Citric Acid Dosing System Description

Description	Values	Unit
NaOCl Day Tank for Membrane Cleaning		
No of day tank (Minimum)	1	No
Capacity of Tank	As per Bidder's Design	

MOC of the day tank	FRP/HDPE	
Level Measurement	Level Indicating Transmitter	
NaOCl Dosing Pumps for Membrane Cleaning		
No of NaOCl Dosing pumps	2 (1W+1S)	Nos
Type of pumps	Single Diaphragm	
Capacity and Head of pumps	As per Bidder's Design	
Citric Acid Bulk Tank for Membrane Cleaning		
No of Bulk tanks (Minimum)	1	No
Capacity of Tank	As per Bidder's Design	
MOC of Bulk tank	FRP/HDPE	
Level Measurement	Level Indicating Transmitter	
Citric Acid Dosing Pumps for Membrane Cleaning		
No of Citric Acid dosing pumps	2 (1W+1S)	Nos
Type of pumps	Single Diaphragm	
Capacity and Head of pumps	As per Bidder's Design	

4.20 Disinfection system (UV)

4.20.1 The main goal of disinfection is to kill or inactivate harmful microorganisms, such as bacteria, viruses, and protozoa, that may remain in the water even after other treatment steps. The treated water from the MBR will flow by gravity to the UV system for disinfection.

4.20.2 Low-pressure, low-intensity UV lamps at a wavelength of 253.7 nm shall be used.

4.20.3 The system shall utilise active control based on the following dose parameters.

- Lamp output intensity
- Quartz sleeve transmittance
- Water quality transmittance
- Water flow

Based on these parameters, the system will automatically adjust the UV lamp power in proportion to the dose requirement.

4.20.4 The dose delivered by the UV system shall be linearly variable within a range of 50% to 100% of maximum power in both manual and automatic operating modes. If the variability differs between modes, the automatic mode of operation shall be the sole mode considered. Power variation in "steps" shall not be permitted.

4.20.5 The system shall be capable of continuous disinfection while automatically cleaning the UV lamp sleeves without reducing or shadowing the lamp output.

- 4.20.6 The lamp array configuration shall be a uniform array with all lamps parallel to each other and to the flow. The lamps shall have equal centreline spacing along the horizontal and vertical axes.
- 4.20.7 The system shall be designed for complete immersion in the effluent of the UV lamps within their protective quartz sleeve. Both electrodes and the full arc length of the lamp shall be below the water surface. Both lamp electrodes shall operate at the same temperature and be cooled by the effluent.
- 4.20.8 The design Parameter for the UV Disinfection system shall be

Parameters	Values	Unit
Flow	4000 + Returns	m ³ /day
Quantity	As per design, with a standby provision	Nos.
Dosing Rate	Minimum 40	mJ/cm ²
Ultraviolet Transmittance 253.7 nm	Minimum 70	%

4.21 UV-Treated Water Storage Tank

- 4.21.1 The UV-treated water should be collected in the UV-Treated Water Storage Tank.
- 4.21.2 RO Feed Transfer Pumps should be installed in a pump house to transfer UV-treated wastewater to the RO plant.
- 4.21.3 Design details of the UV-Treated Water Storage Tank (UV-TWST) and the RO Feed Transfer Pumps are provided in the table below.
- 4.21.4 Provision should be made for the Sodium Hypochlorite dosing for the pumping of this water after UV treatment and Chlorine dosing to the Recycle Water Reservoir

4.21.5	Description	Values	Unit
	Design flow	7000 + Returns	m ³ /d
	HRT for (UV-TWST) based on design flow	2	hr
	MOC	RCC M35	
	Minimum tank freeboard	0.5	m
	Qty of RO Transfer pump	03 (2W+1S)	
	Minimum capacity of disposal/reuse pump	As per the system requirement	
	Pump head	As per the system requirement	
	Type	End-suction centrifugal	
	MOC of the pump	Casing: CI (preferably Austenitic) Impeller: SS316	

	Shaft: SS410	
Operation	VFD to each pump	

4.21.6 A level transmitter should be installed in the tank to control pump operation.

4.21.7 Detailed specification of the pumps and associated pipe work and valves, material of construction details, etc. shall be referred from the General Mechanical Specification and various other relevant sections of this tender document.

4.22 Reverse Osmosis System

4.22.1 The Reverse Osmosis, i.e. membrane-based treatment process, shall be used to separate dissolved solutes from water. The minimum requirements for the design of the RO system are summarised in the table below:

4.22.2	Description	Values	Unit
	Design flow	7000 + Returns	m ³ /d
	Inlet TDS	As per the 'Raw Industrial Effluent Quality' indicated in the tender.	
	Number of RO Filtration Lines	Suitable as per design to achieve at least 90% efficiency.	
	Design Net Flux during average flow at N condition	< 17	LMH
	No. of RO High-Pressure Pumps	Suitable for 100 % standby	Nos
	Cleaning in Process	As per the RO membrane manufacturer	
	Minimum capacity of the disposal/reuse pump	As per the system requirement	
	Pump head	As per the system requirement	
	Type	End-suction centrifugal	
	MOC of the pump	Casing: CI (preferably Austenitic) Impeller: SS316; Shaft: SS410	
	Operation	VFD to each pump	
	Chemical Dosing System	Dosing of SMBS, Anti-scalant, Acid, etc, as per the contractor's design	
	No. of Chemical dosing tanks	Suitable for 100% standby	
	No. of Chemical dosing pumps	Suitable for 100% standby	

4.23 Recycle Clear Water Reservoir and Pumping Station

4.23.1 Permeate from the RO system should be collected in the Recycle Clear Water Reservoir (Re-CWR), in accordance with the design requirements in the table below. Adequate arrangements to prevent contamination of the RO-treated water shall be made.

4.23.2 A Sodium Hypochlorite dosing system with an adequate dosage rate and suitable mixing mechanism before the Re-CWR shall be provided to maintain Free Residual Chlorine (FRC) of at least 0.5 ppm in the distribution network.

4.23.3	Description	Values	Unit
	Design flow	4000 + Returns	m ³ /d
	Re-CWR HRT based upon design flow	4	hr
	MOC	RCC M35	
	Minimum tank freeboard	0.5	M
	Tank cover	Slab in RCC M35	
	Number of Compartments	2	Nos.
	Sodium Hypochlorite dosing system		
	Free Residual Chlorine (FRC) to maintain	Average 0.5	ppm
	Dosing Pumps	2 (1W+1S)	Nos.
	Type	Positive displacement	
	Dosing tank	1 No.	
	MOC	HDPE	

4.23.4 The Recycle Clear Water Reservoir shall be provided with a pumping station suitable to pump water to the Recycle Water Service Reservoir (Re-SR).

4.23.5	Description	Values	Unit
	Recycle water transfer pumps	04 (2W+2S)	No.
	Type of pumps	Submersible	
	Pump lifting arrangement	Guide rails and lifting chains, both in SS 316 and EOT Crane	
	Capacity of the pump	as per the Contractor's design	m ³ /hr
	Pump head	as per the Contractor's design	
	MOC of Pumps	Casing: SS 316; Impeller: SS 316; Shaft: SS 410	
	Pump operation	VFD based	

- 4.23.6 An adequate area should be available at the pumping station for pump maintenance and the installation of electrical panels. The pumping station should be provided with an EOT crane with suitable capacity. The lifting capacity of lifting equipment should be at least twice the weight of the heaviest piece to be lifted. An electromagnetic flowmeter should be provided at the common discharge header of the Recycle Water pumps.

4.24 Brine Treatment System

- 4.24.1 The design of the brine management systems shall be modular. The design capacity of the brine treatment system shall be calculated considering the RO recovery of not more than 80%. The TDS of brine water shall be as per the Contractor's design of the RO system.

4.24.2 Brine Softening

The brine from the RO reject shall be softened before being directed to the Brine Concentrator and Thermal Evaporation. The softening is essential to reduce brine hardness and remove iron and silica, thereby minimising scaling issues in the downstream treatment units and ensuring stable plant operation.

The softening is performed with the controlled dosage of lime and soda ash solutions to cause precipitation of the following compounds, which are mainly responsible for scaling issues in the downstream units:

- a) Calcium and Magnesium compounds;
- b) Iron compounds;
- c) Silica compounds;
- d) Barium and fluoride compounds (if any).

Co-precipitation of heavy metals (if any) shall also be achieved through the brine softening process.

Removal rates of the above compounds shall be 90% or higher of the feed concentrations.

The brine softening plant shall be designed by the contractor.

4.24.3 Brine Concentrator

The brine concentrator unit shall reduce the volume of softened brine to be fed to the downstream Thermal Evaporation (ZLD) unit. The brine from the RO plant, measuring up to 8000 parts per million (ppm), shall be concentrated before being subjected to thermal evaporation. The Electrodialysis Reversal (EDR) unit shall be used for brine concentration.

Influent brine shall be fed to the EDR unit by a feed pump that provides the pressure to drive brine through the stacks and exit as product water after electro dialysis and permeation through the membranes.

A dedicated concentrate pump recirculates the concentrate stream at the stack's inlet to improve recovery.

Membrane stack assemblies shall be provided in sufficient number and staged to deliver the specified product water quantity and quality at the specified product water recovery.

The assemblies shall contain alternating pairs of anion and cation membranes, separated by a flow spacer to maximise turbulence and demineralisation efficiency.

Stack assemblies shall include the following:

- a) anion and cation membranes,
- b) intermembrane and electrode spacers,
- c) electrodes,
- d) end blocks and end plates,
- e) tie rods and protected covers.

Two types of cleaning procedures shall be used in the EDR unit, viz.

- a) CIP (Clean in Place) for membrane maintenance: frequency shall be dependent on the specific case (typically performed on a monthly basis), and the procedure requires system shutdown;
- b) ECIP (Electrode Clean in Place) for electrode maintenance: this shall be a cleaning procedure which shall be performed during normal operation (shutdown not required) for about 1 hour every 24 hours of operation.

The package shall be provided in a single desalting train, consisting of a membrane stack with at least three hydraulic stages and a single hydraulic control skid with a single flow control system.

The train shall be capable of operating at between 50 and 100 per cent of its maximum rated capacity.

The minimum design requirements for EDR shall be as per the table below:

Description	Values	Unit
Configuration	3 stages minimum, with concentrated recycling	Nos.
Capacity (throughput):	As per the contractor's design approved by the Engineer in charge	Cum/hr
Inlet parameters	As per the RO reject parameters after softening, approved by the Engineer-in-Charge	
EDR Product Water	TDS < 500 mg/L, Cl <100 mg/L, Alkalinity <45 mg CaCO ₃ /L	mg/L
Overall permeate recovery of the package (minimum)	(minimum) 90%	%
Rejection required	90%	%

Maximum TDS in permeate	500	ppm
Membrane type:	As per the contractor's design	
Material of construction:	membrane in a polymer with an ion-exchange resin	
Main ancillary equipment	Upstream screening with 200 µm cartridge filters CIP cleaning system ECIP cleaning system In-line dosage system with sodium chloride, hydrochloric acid and chlorine solution and acid solution Reversal timing for polarity reversal	
Main instruments:	pressure transmitter, flow transmitter, pH transmitter, conductivity transmitter	
Pumps:	CIP pumps, ECIP pumps, Concentrate recirculation pump equipped with VFD	

4.24.4 Thermal Evaporation

Contractor's scope of work for the Zero Liquid Discharge package shall constitute the Mechanical Vapour Recompression (MVR) crystallizer unit for separation of salt solids from water, followed by a solid bowl centrifuge for dewatering of concentrate brine and production of semi-solid waste to be disposed of at the disposal site, as approved by MPCB.

As a part of the ZLD process, the Mechanical Vapour Recompression (MVR) shall be used for the evaporation and crystallisation to treat highly concentrated RO reject. MVR control shall be automatic and designed using PLC/SCADA with a redundant PLC. The crystallisation process shall involve the mass transfer of a solute from the liquid solution to a pure solid crystalline through nucleation and crystal growth.

Based on steam availability on the plant, the contractor may provide a thermal vapour recompression (TVR) system as an alternative to the mechanical vapour compression crystallizer described herein.

The crystallizer outputs will be:

- Distillate stream, low TDS, suitable for reuse as recycle water,
- Concentrated brine, high TDS, semi-solid waste to be disposed.

The crystallizer feed shall be collected in a feed tank from which it shall be pumped to a heat exchanger that pre-heats the feed using the hot effluent overhead as an energy source.

After deaeration, the liquor entering the crystallizer vapour body flash-boils, releasing heat as water vapour. As the evaporation process continues, liquor contained in the vapour body shall be concentrated.

Crystallizer overhead shall be extracted from the top of the crystallizer unit as vapour by means of a high-speed centrifugal compressor. Overhead shall be fed to the crystallizer heat exchanger tubes, where it condensates, releasing its latent heat to the brine recirculated from the vapour body.

The overhead condensate, along with EDR product water, shall then be sent to the Recycle Clear Water Reservoir.

The concentrated brine shall be purged from the crystallizer re-circulation loop and sent to a solid bowl centrifuge to obtain a semi-solid waste (85% w/w solid content) for disposal at the disposal site, as approved by MPCB.

Antifoam solution storage and dosage shall be included to allow antifoam to be dosed to the crystallizer unit and crystallizer feed, if needed.

Caustic shall also be dosed in order to control the pH drop in the system.

The unit shall include provision for periodic chemical cleaning and hydroblasting. The need for other chemical dosages shall be evaluated by the contractor.

The crystallizer unit shall operate at atmospheric pressure or under vacuum.

Contractor shall provide auxiliary steam, if needed, for the Crystallizer start-up.

4.24.4.1 MVR Plant Components

The main electro-mechanical equipment and components included in the ZLD package shall include, but not be limited to, the following:

- a) Crystallizer feed tank (1 duty)
- b) Crystallizer feed tank mixer (1 duty)
- c) Crystallizer feed pump (1 duty, 1 spare)
- d) Feed Pre-heat exchanger (1 duty)
- e) Deaerator with condenser (1 duty)
- f) Crystallizer vapour body (1 duty)
- g) Crystallizer heat exchanger (1 duty)
- h) Concentrate recycle pump (1 duty, 1 spare)
- i) Overhead pump (1 duty, 1 spare)
- j) Lobe blower (1 duty, 1 spare)
- k) Antifoam dosing system (1 pump on duty, 1 uninstalled spare)
- l) Caustic dosing system¹ (1 pump on duty, 1 uninstalled spare)
- m) Solid bowl centrifuge (1 duty)
- n) Centrate pump (1 duty, 1 uninstalled spare)

- o) Centrate tank (1 duty)
- p) Dewatered brine container (1 duty)

Contractor shall provide a complete and workable piping system, including all valves, pipe supports, expansion joints, and appurtenances required for the proper completion of the work and the proper operation of the ZLD package.

4.24.4.2 The specifications for MVR Plant Components are

a) Crystallizer Feed

The crystallizer feed brine shall be collected in the feed tank that also receives the liquid stream (centrate) from the concentrated brine dewatering centrifuge. The crystallizer feed tank shall be sized to provide a minimum of 24 h of residence time for incoming feed to the package to ensure consistent feed quality and allow for short maintenance periods in the ZLD system.

The inlet brine from the feed tank shall be pumped to the heat exchanger by a centrifugal pump (casing and impeller in CD4MCu or equivalent material).

The feed tank shall be equipped with a low-speed mixer. The MOC of the feed tank shall be FRP, and that of the mixer shall be in MS+FRP Lining or equivalent material.

The feed shall be preheated for start-up of the process unit, as per the contractor's design.

b) Feed Preheater

The brine shall be preheated in a plate-and-frame heat exchanger. Crystallizer condensate overhead from the main heat exchanger may be used as a heat source. All parts in contact with the feed shall be of MOC Alloy 31.

c) Deaerator

Pre-heated feed shall pass through a deaerator vessel fed with part of the overhead vapour from the crystallizer. In the deaerator, excess CO₂ and other non-condensable gases shall be removed. The deaerator shall be equipped with a vent condenser.

d) Crystallizer Vapour Body and Heat Exchanger

Crystallizer vapour body shall be cylindrical with top and bottom conical heads, equipped with a manhole, demister and accessories.

Brine shall be recycled from the vapour body to the crystallizer heat exchanger, shell and tube type. A propeller axial pump shall be used to recirculate the brine (case and impeller in Alloy 31 or equivalent corrosion-resistant material). Heat media in normal operation shall be provided by compressed overhead from the crystallizer and steam from the net during system start-up. In the heat exchanger, the overhead condenses and is fed to the pre-heater for heat recovery. Distillate shall also be used for a hot water rinse to periodically clean the vapour body.

All surfaces in contact with concentrated brine shall be directly accessible for inspection and, when necessary, can be cleaned by either chemical or mechanical means. Chemical

cleaning can be accomplished by circulating a cleaning solution into the brine recirculation loop.

All parts in contact with the feed and concentrate of the crystallizer vapour body and the heat exchanger are made of Alloy 31.

e) Overhead compression and distillate pumping

Crystallizer overhead passes through a mesh-type mist eliminator (demister) to remove droplets. Demister shall be located at the top of the crystallizer vapour body.

A lobe-type positive displacement blower compresses the vapours and directs them to the crystallizer heater. The blower casing and impeller are made of AISI 316L or equivalent material.

After condensation in the heat exchanger, the produced distillate shall be pumped by a centrifugal pump to the feed pre-heater for heat recovery and then routed to the existing permeate tank.

The distillate pump casing and impeller are made of AISI 316L or equivalent material.

f) Dewatering unit

Concentrated brine shall be automatically purged from the brine recirculation line by a control valve to feed a horizontal bowl decanter centrifuge operated continuously or in batch cycles. The purge rate of concentrated brine can be adjusted manually with periodic batch tests or automatically with a density meter to control the crystallizer's brine suspended solids level.

The Centrate shall be collected in a buffer tank from which it shall be pumped back to the crystallizer feed tank by a centrifugal pump. Centrifuge shall be made in Hastelloy/Duplex SS2205, the centrate buffer tank shall be made of 25-6 Mo (or equivalent material) and the centrate pump casing and impeller are in CD4MCu (or equivalent material).

In case dewatering is operated in batch mode, a mixed buffer tank and a centrifugal pump shall be provided to feed the centrifuge.

The dewatered salty waste discharged from the centrifuge shall be collected in suitable containers or bags and disposed of as per the classification of the sludge, at the landfill site approved by MPCB.

g) Chemical dosing

The package shall be provided for dosing of antifoam and sodium hydroxide in the vapour body.

Antifoam shall be provided in a bulk container and fed to the crystallizer unit by a dosing pump (1 duty, 1 uninstalled spare). Dosage shall be manually adjusted by the operators based on process needs.

Caustic soda shall be provided in a bulk container and fed to the crystallizer unit by a dosing pump (1 duty, 1 uninstalled spare). The dosage rate shall be automatically adjusted using pH control in the crystallizer to prevent a pH drop.

h) Basis of control philosophy

All units in the package shall be controlled with a programmable logic controller (PLC) that will also manage the interconnections with other packages and units.

Main loops of the package shall be

- i. The level in the brine feed tank provides start/stop signals to the brine feed pump,
- ii. The crystallizer vapour body feed shall be automatically controlled by a flow rate set-point adjusting the crystallizer feed pump,
- iii. The distillate buffer tank level shall be controlled by regulating the discharge of distillate from the tank with level set-point control,
- iv. The centrifuge centrate tank level shall be controlled by regulating the discharge from the tank with level set-point control,
- v. The crystallizer recirculating slurry shall be automatically controlled with a flow rate set-point and by the operation of the control valve on the purge concentrate
- vi. The purge of concentrated brine to the centrifuge shall be automatically controlled with a density set-point that adjusts the opening of the purge valve to the centrifuge.

Main process parameters (inlet and outlet temperatures, conductivity, pH) shall be automatically monitored with proper instrumentation. The minimum design requirements for the MVR System shall be as per the table below

Description	Values	Unit
Design flow	As per the contractor's design for the concentrated brine flow from EDR, approved by the Engineer-in-Charge	m ³ /h
Inlet parameters	As per the contractor's design parameters for the EDR reject, approved by the Engineer-in-Charge	
ZLD distillate	TDS < 500 mg/L, Cl <100 mg/L, Alkalinity <45 mg CaCO ₃ /L	mg/L
Total water recovery of the package (as volumetric ratio of distillate produced / feed brine)	Minimum 95%	
Concentration factor	25	
Rejection	99.5%	
Dry content of dewatered brine to disposal (after dewatering)	85%	

Operating pressure	As per the contractor's design	
Type of thermal unit	Forced circulation crystallizer, mechanical vapour compression	
Type of dewatering unit	Horizontal solid bowl centrifuge	

All Consumables, Chemicals, Cleaning requirements, and Material handling shall be in the scope of the contractor.

4.25 RAS Sump

- 4.25.1 The RAS withdrawn from the MBR tank will be received in this RAS sump.
- 4.25.2 RAS should be pumped back to each aeration tank.
- 4.25.3 MLSS Analyser and Level indicating transmitter should be provided in the RAS Sump.
- 4.25.4 RAS sump should be provided with Submersible / Horizontal Centrifugal pumps.
- 4.25.5 If submersible pumps are selected, the RAS sump should be provided with a Gantry crane and an electrical chain hoist. If centrifugal pumps are selected as the pump type, they should be provided inside the pump house with an electrical chain hoist of suitable capacity.
- 4.25.6 A minimum of three (2W+1S) pumps should be provided, and each pump should be operated with a VFD.
- 4.25.7 Excess sludge can be removed from the common header of RAS pumps, and both the RAS line and Excess sludge line should be provided with motorised valves and an electromagnetic flow meter. The contractor can also propose dedicated excess sludge pumps to pump the sludge to the combined sludge sump.
- 4.25.8 The design requirements for the RAS Sump are provided in **Error! Reference source not found..**

Table 4-18 RAS Sump Description

Description	Values	Unit
Number of RAS Sump (Minimum)	1	No
MOC of the sump	RCC	
Retention time	As per the Bidder's design	
Liquid depth	As per the Bidder's design	
Freeboard (Minimum)	0.5	m
Solids consistency of RAS Sludge (maximum)	1.1%	
RAS Pumps		
Quantity of RAS pumps	3 (2W+1S)	Nos
Type of RAS pumps	Submersible/ Horizontal Centrifugal	

Capacity and Head of pumps	As per the Bidder's design	
Type of pump operation	VFD based	

4.26 Combined Sludge Sump

- 4.26.1 Primary sludge from the Primary Clarifier and Excess sludge removed from the RAS pump discharge should be collected in the combined sludge sump.
- 4.26.2 A combined sludge sump should be provided with submersible mixers to keep the solids in suspension.
- 4.26.3 A fixed Lifting Davit crane with suitable capacity shall be provided for each submersible mixer for lifting during maintenance.
- 4.26.4 An MLSS analyser and a level-indicating transmitter should be provided in the combined sludge sump.
- 4.26.5 Thickener feed pumps shall be of Eccentric screw pumps.
- 4.26.6 A minimum of two (1W+1S) pumps should be provided in the Thickener feed pump house, and the pump house should be provided with a manual/electrical hoist with suitable capacity.
- 4.26.7 The thickener feed line should be equipped with an electromagnetic flow meter to measure flow.
- 4.26.8 The design requirements for the combined sludge sump are provided in **Error! Reference source not found..**

Table 4-19 Combined Sludge Sump Description

Description	Values	Unit
Number of Combined sludge sump (Minimum)	1	No
MOC of the sump	RCC	
Retention time	As per the Bidder's design	
Liquid depth	As per the Bidder's design	
Freeboard (Minimum)	0.5	m
Thickener Feed Pumps		
No of Thickener feed pumps	2 (1W+1S)	Nos
Type of pumps	Eccentric screw pumps	
Capacity and Head of pumps	As per the Bidder's design	

4.27 Sludge Handling System

The scope of the contractor shall include separate sludge treatment and dewatering systems for the Chemical Sludge and the Biological Sludge. The sludge handling system shall be designed to treat sludge generated from CETP and STP. The Chemical sludge shall be collected from the Primary Clarifier/Clariflocculator, whereas the Biological Sludge from the MBR tank.

4.27.1 Sludge Thickener

The sludge thickener can be a Gravity Sludge thickener or a Gravity Belt thickener (GBT), gravity or mechanical, as per the contractor's design.

If a Gravity Sludge thickener is proposed, it should include a picket fence thickener mechanism.

The Gravity sludge thickener shall be of radial flow type. The flow shall be received in the RCC central pier of the tank, from where it shall flow radially towards the periphery through the openings of the central pier at the top. At the periphery, the flow shall pass through 'V' notch weirs and then shall be collected into an outside RCC launder provided all around the outer periphery of the tank. The 'V' notch weir shall be made out of SS 316 material. The thickener shall be constructed in RCC.

Wash water provision should be provided for each thickener for dilution purposes.

The sludge withdrawal line from the clarifier should consist of a motorised valve. A telescopic valve chamber should be provided in each sludge thickener with a telescopic valve.

If a Gravity Belt thickener is proposed, it should be located inside the thickener building and equipped with an Electric Chain Hoist / EOT crane. GBT should include all related equipment, such as an air compressor for belt tracking, a limit switch, etc.

The design requirements for the sludge thickener are provided

Description	Values	Unit
Gravity Sludge Thickener		
No of Gravity sludge thickener	2	No
Solid loading rate	<50	Kg/m ² /d
Expected thickened sludge consistency (Minimum)	5	%
Solids capture ratio (Minimum)	90	%
Side water depth (Minimum)	3.5	m
MOC of thickener	RCC	
Bottom slope	1:8	
Type of bridge	Half bridge	

Drive mounting	Central Driven	
Width of walkway (Minimum)	1.2	m
Influent feed and type of inlet	Top feed and pipe	
Type of weir with V-notch	Single weir	
Type of launder	External	
MOC of Launder	RCC	
MOC of Thickener Mechanism	SS 316	
MOC of the bridge	SA21/2 sand blasted & CSEP	
MOC of weir	SS 316	
MOC of fasteners	SS 316	
Epoxy coating Minimum DFT	250	Microns
MOC of telescopic valve	SS 316	
Gravity Belt Thickener (GBT)		
No of Gravity Belt Thickener	2 (1W+1S)	Nos
Expected Thickened Sludge Consistency (minimum)	5%	
Solid capture ratio for thickener	90 %	
MOC of GBT	Wetted Parts: SS 316, Roller: Carbon steel epoxy painted	

4.27.2 Thickened Sludge Holding Tank

A thickened sludge holding tank should be provided with a submersible mixer to keep the solids in suspension. The thickened sludge holding tank should be designed for a 1-day retention time. Overflow from the thickened sludge holding tank shall be routed to the plant return sump.

Thickened sludge pumps shall be provided in the thickened sludge pump house.

An A Level indicating transmitter and an MLSS analyser should be provided in the thickened sludge holding tank.

An electromagnetic flow meter should be provided in the common header of thickened sludge pumps.

A manual/Electric hoist of suitable capacity shall be provided for the pump house. The capacity of the hoist should be 2 times the heaviest equipment to be lifted.

The minimum design requirements for a thickened sludge holding tank are provided

Description	Values	Unit
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Number of Thickened Sludge Holding tank	1	No
MOC of the tank	RCC	
Retention time	24	Hrs
Liquid depth	As per Bidder's design	
Freeboard (Minimum)	0.5	m
Thickened sludge consistency	5	%
Mixing requirement (Minimum)	20	W/m ³
Type of Mixers	Submersible Mixers	
Number of submersible mixers (Minimum)	1	No
MOC of submersible mixer with guide rails & chains	SS 316	
Type of lifting equipment for mixers	Fixed lifting davit	
Number of thickened sludge pumps	2 (1W+1S)	Nos
Capacity and Head of pumps	As per Bidder's design	
Type of pumps	Eccentric screw pumps	
Type of pump operation	VFD based	

4.27.3 Sludge Dewatering

The Dewatering building should be constructed with two floors (G+1). An EOT crane with suitable capacity should be provided for the dewatering building. The Dewatered sludge shall be conveyed to the sludge container through the sludge conveyor and chute. Centrate coming from the centrifuge shall be routed to the plant return sump.

Chemical Sludge having 1.5-2% solids consistency from Clarifiers/Clariflocculator shall be collected into a Chemical Sludge Sump. The sludge shall be then pumped to pumped to Centrifuge unit through centrifuge feed pumps which shall be of positive displacement type Screw Pumps. The centrifuge should be sized for 16 hours per day operation.

Dewatering Polymer shall be dosed online prior to the dewatering unit. The dosing system shall include two dosing tanks equipped with slow-speed mixers and metering-type positive displacement dosing pumps. The sludge in the form of wet cake, having at least 20% solids consistency from the dewatering unit, shall be collected and disposed off suitably as per the classification of the sludge, on landfill sites approved by MPCB.

Filtrate from the dewatering unit shall be collected in a common centrate sump from where it shall be recycled to the stilling chamber via Centrate transfer pumps.

Biological sludge after MBR tanks having 0.8 - 1% solids consistency shall be withdrawn and collected in the Biological Sludge Sump. The sludge shall be then pumped to centrifuge unit through centrifuge feed pumps which shall be of positive displacement type Screw Pumps. The centrifuge should be sized for 16 hours per day operation. Dewatering Polymer shall be dosed online prior to the dewatering unit. The dosing system shall include

two poly dosing tanks equipped with slow-speed mixers and metering type positive displacement dosing pumps.

The sludge in the form of wet cake having atleast 20% solids consistency from the dewatering unit will be collected and disposed of suitably. Filtrate from the dewatering unit shall be collected in a common centrate sump from where it shall be recycled to the stilling chamber via Centrate transfer pumps.

An EOT crane of suitable capacity should be provided for the centrifuge lifting. Dry polymer should be stored for a minimum of 30 days requirement in a chemical building room.

Necessary valve chambers, flushing lines should be provided on each sludge-carrying line.

A polymer dosing system should be provided for the centrifuge. There should be multiple polymer dosing points on the centrifuge feed line.

The design requirements for the sludge dewatering system are provided in Table 4-22

Table 4-22: Sludge dewatering design Description

Parameters	Values	Unit
Chemical Sludge Dewatering		
No. of Centrifuges	2 (1W+1S)	Nos
Solids Consistency of Waste Sludge	As per the bidder's design of the gravity sludge thickener/GBT.	w/w
Design hours of operation per day	16	Hrs
Number of operating days per week	6	Days
Solids Recovery in Centrifuge (Min)	95.0	%
Dewatered Sludge Consistency (Min)	20.0	%
MOC of centrifuge Bowl, Scroll and other wetted parts	SS 316 / SS 316L	
Type of conveyor	Screw conveyor	
MOC of screw conveyor	SS 316 / SS 316L	
MOC of the discharge chute	SS 316 / SS 316L	
No. sludge containers	2	Nos
Biological Sludge from MBR		
No. of Centrifuge	2 (1W+1S)	Nos
Solids Consistency of Waste Sludge	As per the bidder's design of the gravity sludge thickener/GBT.	w/w
Design hours of operation per day	16	Hrs
Number of operating days per week	6	Days
Solids Recovery in Centrifuge (Min)	95.0	%
Dewatered Sludge Consistency (Min)	20.0	%

MOC of centrifuge Bowl, Scroll and other wetted parts	SS 316 / SS 316L	
Type of conveyor	Screw conveyor	
MOC of screw conveyor	SS 316 / SS 316L	
MOC of the discharge chute	SS 316 / SS 316L	
No. sludge containers	2	Nos

4.27.4 Polymer Dosing for Dewatering Centrifuge

A manual polymer dosing system with a dry polymer feeder should be provided for Polymer dosing.

Two polymer dosing tanks should be provided, each designed to meet 60% of the daily storage requirement.

Each Polymer dosing tank should be provided with a dosing tank agitator and a level-indicating transmitter. Each polymer dosing pump should be provided with a VFD. An electromagnetic flowmeter should be provided in the common discharge header of polymer dosing pumps. 30 days of dry polymer bulk storage are required in the chemical building.

The minimum design requirements for the Polymer dosing system are provided in the table below

Description	Values	Unit
Type of chemical	Cationic Polymer	
Polymer Bulk storage requirement	30	Days
Dewatering Polyelectrolyte dosage (Minimum)	6.0	kg/ MT of solids
DWPE solution strength	0.05	%
No of days operating/week	6.0	Days
Actual no. of hrs. of operation of the polymer dosing pump	16.0	h
Polymer Dosing Tanks		
No of polymer dosing tanks (Minimum)	2	Nos
Capacity of Tank	As per Bidder's Design	
MOC of dosing tank	FRP/HDPE	
Polymer Dosing Tanks Agitator		
No of Agitator per tank	1	No
Type of Agitator	Vertical shaft agitator	

MOC of Agitator	SS 316	
Polymer Dosing Pumps		
No of Polymer Dosing pumps	2 (1W+1S)	Nos
Type of pumps	Single Diaphragm	
Capacity and Head of pumps	As per Bidder's Design	
Type of pump operation	VFD based	

4.27.5 Dewatered sludge disposal (off-site)

The Contractor shall be responsible for identifying suitable MPCB-approved Chemical Hazardous Waste Disposal and Treatment Facility (CHWSTF) disposal location/land/site and route(s) for all sludge arising from the Works and disposing of the sludge and for paying all tipping & transportation charges and other associated costs, including that for land/site. The Contractor shall dispose of any hazardous materials off-site in accordance with existing laws and regulations. All permissions and consents from respective authorities shall be obtained by the contractor.

Contractor shall dispose of the biological sludge at a suitable facility (as approved by MPCB) for all sludge arising from the works, and shall dispose of the sludge and pay all tipping & transportation charges and other associated costs, including that for land/site.

4.27.6 Sludge storage facilities

The Contractor shall, from the start of Commissioning, provide sludge storage facilities for dewatered sludge at the Works. The storage volume for hazardous & Non-hazardous sludge shall be 7 & 10 days, respectively. Sufficient capacity should be provided in the event of inclement weather or other factors that prevent transport or disposal. The dewatered sludge may be stored in steel or concrete containers, stockpiled on concrete slabs or other impervious pad areas, or stored in other approved means. It should be located and stored to preclude re-wetting by rainfall and groundwater contamination.

4.28 CETP Plant Return Sump (Centrate Sump)

4.28.1 Overflow from the thickened sludge holding tank, Supernatant from the thickener, Centrate from the Dewatering centrifuge and chemical drains shall be received in the Plant return sump.

Submersible pumps shall be provided with Guide rails and lifting chains. MOC of Guide rails and lifting chains should be in SS 316.

The plant returns should be pumped back to the inlet works (stilling chamber) or to the flash mixing tank.

A level indicating transmitter should be provided in the Plant return sump.

An electromagnetic flowmeter should be provided in the plant return pumps' common discharge header. A gantry crane with a manual/electrical hoist with suitable capacity should be provided for the plant return pumping station.

The design requirements for the Plant return sump are provided in Table 4-20.

4.28.2 **Table 4-20: Plant Return Sump Description**

Description	Values	Unit
No of Plant return sump	1	No
MOC of tank	RCC M35	
Retention time (Minimum)	Two	Hrs
Maximum Liquid depth	3	m
Number of Plant return pumps	2 (1W+1S)	Nos
Capacity and Head of pumps	As per the Bidder's design	
Type of pumps	Submersible	

4.29 **CETP Odour Control Unit (OCU)**

4.29.1 A centralised odour control unit should be provided for the odour generated by the CETP Inlet works area.

4.29.2 CETP Odour control unit shall extract the odour from the following areas:

- CETP Receiving chamber
- Coarse Screen Chamber
- Wet well
- CETP Inlet Chamber
- Fine Screen Chamber
- Distribution chamber for vortex grit chamber
- Vortex grit chamber
- Outlet Grit channel
- Equalisation Tank
- Equalisation Tank pump sump
- Distribution chamber for ultra-fine screen chamber
- Ultra-fine screen chamber

4.29.3 12 Air changes per hour should be considered for designing the air volume extracted at each odour point mentioned above.

4.29.4 Two stage Odour control system should be provided. Biological Odour Control Unit should be followed by an Activated carbon type Odour control Unit to be provided.

4.29.5 Dampers and non-return valves shall be provided for each odour extraction point.

- 4.29.6 The Contractor shall design and supply all necessary supports for the odour control covers, with adequate sealing. A negative pressure must be maintained below the covers to avoid the escape of odorous air to the atmosphere.
- 4.29.7 OCU needs to achieve $< 500 \text{ OU/m}^3$ at the OCU outlet & 5 OU/m^3 on a 99.8% ile, on a one-hourly average basis measured at the site boundary.
- 4.29.8 A fixed H₂S Analyser should be provided at the inlet of the 1st stage OCU, at the inlet of the 2nd stage and at the stack of the 2nd stage OCU.
- 4.29.9 OCU Extraction fans shall be provided in SS 316 L material, and an acoustic enclosure should be provided for each fan to achieve $< 80 \text{ dB (A)}$ at 1 m.
- 4.29.10 OCU should be provided with a chemical dosing system (NaOH and Nutrient) if required for the process.
- 4.29.11 Air velocity in the odour duct should not exceed 5 m/s.
- 4.29.12 MOC of Odour Cover in open channels/chambers and ducts should be in GRP.
- 4.29.13 The design guidance for the Odour Control Unit is provided in the Table Table 4-21 and Table 4-22

Table 4-21 Guidance for Air contaminants concentration

Odor extraction points	Undiluted H ₂ S Concentration (PPM)		Undiluted NH ₃ Concentration (PPM)	
	Average	Peak	Average	Peak
CETP Receiving Chamber	200	300	10	20
Coarse Screen Chamber	200	300	10	20
Wet well	200	300	10	20
CETP Inlet Chamber	200	300	10	20
Fine Screen Chamber	200	300	10	20
Distribution Chamber for Vortex Grit Chamber	200	300	10	20
Vortex Grit Chamber and Grit outlet channel	200	300	10	20
Equalization Tank	200	300	10	20
Equalization Tank pump sump	200	300	10	20
Distribution Chamber for Ultra-fine screen	200	300	10	20
Ultra-Fine Screen Chamber	200	300	10	20

Table 4-22 Required OCU Discharge Quality

Contaminant	Percentage removal of contaminants	Maximum Discharge Concentration at Peak load (ppm)	Maximum Discharge Limit
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Hydrogen Sulphide (H ₂ S)	99.9%	1.0	Total contaminants not to exceed < 500 OU/m ³ at the discharge of stack and < 5 OU/m ³ at the plant boundary
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4.30 Chemical Dosing Systems

- 4.30.1 For all the chemical dosing systems in the plant, the material of construction used shall be compatible with the dosing chemical. All chemical lines shall be colour-banded and suitably labelled to enable individual lines to be identified throughout their run. An appropriate dike wall shall be constructed for each dosing system. All the dosing systems shall have a calibration column, strainer, pressure damper, safe overflow arrangement, drain arrangement, and vent. Chemical dosing systems shall be installed inside the building with appropriate ventilation.

4.31 Sampling and analysis

- 4.31.1 Sampling and analysis shall be performed to measure the physical, chemical, and biological parameters as per design requirements, at the appropriate locations and frequencies. In case of multiple units (Such as clarifiers, aeration tanks, filters), the indicated sampling and analyses shall be performed for each module.

All sampling and analyses shall be performed in accordance with the procedures in the APHA (American Public Health Association) Standard Methods for the Examination of Water and Wastewater, latest edition. An original copy of the APHA Standard Methods shall be procured and permanently stored in the laboratory.

4.32 Laboratory Equipment

- 4.32.1 The following laboratory equipment shall be provided:

- Analytical Balance
- Autoclave
- Portable Dissolved Oxygen meter.
- Drying Oven (Hot Air)
- Hot Plates
- Incubator 20°C (BOD)
- Microscope, Binocular with oil immersion and movable stage counting cell
- Membrane Filter Assembly
- Muffle Furnace
- pH Meter (portable)
- Refrigerator (240 ltrs.)
- Sludge Sampler
- Soxhlet extraction unit

- Jar testing kit
- Turbidity meter
- Heavy metal measurement with Spectrophotometer
- Ammonia & Nitrate
- Total Phosphorus
- Coliform Measurement
- Vacuum pump
- Water bath (thermostat-controlled)
- Glassware and analytical chemicals as required
- COD Apparatus
- Colorimeter & necessary equipment for measurement of Nitrogen and phosphorus

Any equipment other than the above that is required for laboratory analysis shall be provided by the contractor at no additional cost. The flooring and working platforms for the laboratory shall be approved polymer-based wall-to-wall flooring material without any crevices. The laboratory must be designed and maintained in accordance with the best industry practices, and all safety precautions must be implemented and adhered to. White lab coats and appropriate safety gear, such as eyeglasses, breathing masks, and nitrile gloves, are to be provided in the laboratory. The laboratory shall have a temperature- and humidity-controlled chamber for precise weighing.

5. NEW STP PARTICULAR DESIGN REQUIREMENTS

5.1 General Description

- 5.1.1 The sewage generated in the Dighi Port Industrial Area is contributed to by both the residential and industrial populations. Sewage treatment plant shall be installed to treat the generated sewage and recycle it as a zero liquid discharge.

With 100% collection of sewage & further recycling of the effluent so that it can be utilized for Industrial and non-contact purposes. The aim is to make the overall water supply system sustainable, by reducing freshwater demand to a minimum level by treatment of wastewater collected at the STP and recycling & reusing the treated water for various non-potable purposes as well as for industrial purposes.

The scope under this contract comprises of Data collection and studies, Design, Engineering, Manufacture, Supply, Transportation to site, Storage, Construction, Installation/Erection, Testing, Commissioning and putting into successful operation of the complete Facility on EPC basis with 5 year O&M basis including all Civil, Structural and Architectural, Mechanical, Electrical, Control & Instrumentation and all Infrastructural work covering lighting, all preparatory & temporary works for the purpose of meeting the entire scope of works for plant capacity shall be for 2 x 250 KLD Membrane Bio Reactor Process based Sewage Treatment plant. The plant should be prefabricated and skid-mounted so that it can be easily shifted from one place to another.

The Contractor shall be fully responsible to ensure that the whole of the Works, including each individual component, is designed, and constructed in a manner so that the System as a whole operates as a fully integrated system which is capable of achieving the required output in an efficient and economical manner, and to include all plant, equipment and accessories required for the safe and satisfactory operation of the facilities. To achieve this, the Contractor shall ensure that each individual component performs in a manner which is complementary to that of all other components. Any accessories that are not specifically mentioned in the specifications but are usual or necessary for the completion of the Works and the successful performance of the System and facilities shall be provided by the successful Bidder within the tendered cost. The Contractor shall, to the maximum extent practical and feasible, endeavour to standardise on the manufacture and supply of plant and equipment to minimise the operation and maintenance requirements. The Contractor shall ensure that his designs are "maintenance-friendly" and that all items of plant and equipment are designed and installed in a manner which will facilitate routine and periodic maintenance operations

5.2 STP Receiving Chamber

- 5.2.1 The raw sewage will be received in the STP receiving chamber from the last manhole outside the CETP & STP plot boundary.
- 5.2.2 STP receiving chamber should be designed for the phase peak flow of 1250 m³/d
- 5.2.3 A penstock should be provided in the incoming raw sewage line at the receiving chamber.
- 5.2.4 One H₂S Analyser and pH Analyser should be provided in the STP receiving chamber.

5.2.5 The design requirements for the STP receiving chamber are provided in Table 5-1.

Table 5-1 STP Receiving Chamber Description

Description	Values	Unit
Design flow to Receiving Chamber	1250	m ³ /d
Retention time at peak flow	45 to 60	sec
Material of construction	RCC	
Liquid depth	As per Bidder's design	
Freeboard	As per Bidder's design	

5.3 Coarse Screen Chamber

- 5.3.1 The civil structures of the coarse screen chamber should be designed and constructed for the peak flow (1250 m³/d).
- 5.3.2 2 No (1W+1S) of Mechanical Bar screens should be installed under this contract.
- 5.3.3 Two (2) number of skips/containers should be provided for collecting and storing the screenings generated in the coarse screen chamber.
- 5.3.4 A penstock should be provided upstream and downstream of each coarse screen chamber for isolation.
- 5.3.5 A Level Indicating Transmitter should be provided upstream and downstream of each mechanical coarse screen.
- 5.3.6 The coarse screen chamber of the STP should be fully covered with a GRP cover. Odour extraction provision should be provided in the chamber, and an interconnecting duct should be provided between the coarse screen chamber and the Centralised STP Odour control unit.
- 5.3.7 The design requirements for the coarse screen chamber are provided in Table 5-2.

Table 5-2 STP Coarse Screen Chamber Description

Description	Values	Unit
No of coarse screen chambers	2	Nos
Total design flow to coarse screen chamber	1250	m ³ /d
Design flow for each screen chamber (peak flow)	1250	m ³ /d
Quantity of the mechanical screen	1W+1S	Nos
Type of mechanical screen	Front raked bar screen	
Bar spacing	20	mm
Angle of Inclination of the screen	60 to 75	Degree
Maximum velocity at peak flow	1.2	m/s
Head loss in the screen during peak flow at 50 % clogging, not to exceed	300	mm

MOC of the screen and related accessories	SS 316 / SS 316 L	
Quantity of conveyor	1	No
Type of conveyor	Screw conveyor	
MOC of Screw conveyor	SS 316 / SS 316 L	
Quantity of compactor (Minimum)	1	No
MOC of the Screening Compactor	SS 316 / SS 316 L	
Compactor minimum screening solid content	40% DS	
Wash water arrangement	To be provided	
Odour extraction provision	To be provided	

5.4 Wet Well

- 5.4.1 The wet well should be designed for the phase peak flow of 1250 m³/d.
- 5.4.2 3 Numbers (2W+1S) of submersible pumps should be installed in the wetwell for the transfer of sewage to the inlet chamber. A suitable arrangement for transferring these pumps between compartments should be provided for maintaining continuity of sewage flow to the next unit.
- 5.4.3 Each wet well compartment should be provided with a penstock for isolation. Additionally, a penstock should be provided between the compartments.
- 5.4.4 The effective liquid volume of the sump should not include the dead volume provided for the minimum submergence of the pumps.
- 5.4.5 Submersible-type pumps should be provided for wet well pumps. Each pump should be provided with a Variable Frequency Drive (VFD).
- 5.4.6 The wet well and pumping station should be provided with a suitable lifting arrangement of suitable capacity. The capacity of lifting equipment should be at least 2.0 times the weight of the heaviest piece of equipment to be lifted.
- 5.4.7 A wet well pumping station should have a room adequate for installing electrical panels.
- 5.4.8 Both the Level Indicating transmitter and the Level switch shall be provided in the wet well. In the event of a temporary failure of the level-indicating transmitter, the level switch will serve as the backup for pump protection. The contractor shall provide a level switch with three alarms (Low, Low-Low, and High).
- 5.4.9 A pressure-indicating transmitter should be installed at the discharge of each wet-well pump.
- 5.4.10 An electromagnetic flowmeter should be provided at the common discharge header of the wet well pumps.
- 5.4.11 An emergency bypass line should be provided with a motorised valve in the common discharge header of wet well pumps. The emergency bypass should be discharged into the nearest surface drain through the treated effluent outfall chamber.
- 5.4.12 The Wet well should be fully covered with a GRP cover and protected with a safety railing.

- 5.4.13 The design requirements for the wet well are provided in **Error! Reference source not found..**

Table 5-3 STP Wet Well Description

Description	Values	Unit
No of wet well	1	No
No of wet well compartment	2	Nos
Design peak flow	1250	m ³ /d
Retention time at ultimate peak flow (min)	15	min
Liquid depth	As per Bidder's design	
Freeboard	As per Bidder's design	
Number of wet well pumps	3 (2W+1S)	Nos
Head of wet well pumps	As per Bidder's design	
Type of pumps	Submersible	
Type of operation	VFD based	

- 5.4.14 The sewage shall be pumped to the two package STPs, each with a capacity of 250 cum/day.

5.5 STP Inlet Chamber

- 5.5.1 STP Inlet Chamber for each of the two STP packages should be designed for an average flow of 250 cum/day.
- 5.5.2 Ammonia Analyser, TSS Analyser and Auto sampler should be provided in the inlet chamber.
- 5.5.3 The design requirements for the STP Inlet chamber are provided in Table 5-4.

Table 5-4 STP Inlet Chamber Description

Description	Values	Unit
Design flow	250	m ³ /d
Retention time at average flow	As per Bidder's design	sec
Material of construction	As per Bidder's design	
Liquid depth	As per Bidder's design	
Freeboard	As per Bidder's design	

- 5.5.4 An electromagnetic flow meter should be installed in the pipeline between the ultra-fine screen chamber and the distribution chamber of the anoxic tank to measure the flow entering the bioreactor.

5.6 Fine Screen Chamber

- 5.6.1 Fine screen chamber should be designed for average flow of 250 m³/d.
- 5.6.2 Two (2) number of skips/containers should be provided for collecting and storing the screenings generated in the Fine screen chamber.

- 5.6.3 A manual penstock should be provided upstream and downstream of each Fine screen chamber for isolation.
- 5.6.4 Level Indicating Transmitter should be provided upstream and downstream of each mechanical fine screen.
- 5.6.5 The design requirements for the fine screen chamber are provided in Table 5-5.

Table 5-5 Fine screen chamber Description

Description	Values	Unit
Quantity of the fine screen chamber	2	Nos
Design Flow to each screen chamber	250	m ³ /d
Quantity of mechanical screen	2 (1W+1S)	Nos
Type of mechanical screen	As per vendor's design	
Screen opening size (mm)	6	mm
MOC of screen and related accessories	SS 316 / SS 316 L	
MOC of Screw conveyor	SS 316 / SS 316 L	
Compactor minimum screening solid content	40% DS	
Wash water arrangement	To be provided	

5.7 Combined Grit and Oil Removal Chamber

- 5.7.1 The combined grit and Oil removal chamber in each STP package should be designed for average flow of 250 m³/d.
- 5.7.2 Each of the two Package STP shall be provided with a combined aerated Grit and Oil & Grease Removal Unit of adequate capacity capable of removing not less than 95% of grit particles of size 0.2 mm and above and not less than 90% of oil and grease.
- 5.7.3 The unit shall be fabricated in FRP/SS304/RCC construction, complete with a grit-collection hopper, an oil-skimming arrangement, baffles, an access platform, piping, instrumentation, and all accessories required for satisfactory operation.
- 5.7.4 The treated sewage from the unit shall contain not more than 5 mg/L of oil and grease prior to entry into the biological treatment system. The design shall specifically ensure the protection of MBR membrane modules from abrasion, clogging, and fouling caused by grit and grease carryover.

5.8 Ultra- Fine Screen Chamber

- 5.8.1 The ultra-fine screen chamber should be designed for average flow of 250 m³/d.
- 5.8.2 Two (2) number of skips/containers should be provided for collecting and storing the screenings generated in the Ultra-Fine screen chamber.
- 5.8.3 A manual penstock should be provided upstream and downstream of each Ultra-Fine screen chamber for isolation.

5.8.4 A Level Indicating Transmitter should be provided upstream and downstream of each mechanical ultra-fine screen.

5.8.5 The design requirements for the Ultra-Fine screen chamber are provided in Table 5-6.

Table 5-6 Ultra-Fine screen chamber Description

Description	Values	Unit
Quantity of Ultra-Fine screen chamber	2	Nos
Design Flow to each screen chamber	250	m ³ /d
Quantity of mechanical screen	2 (1W+1S)	Nos
Type of mechanical screen	Drum screen	
Screen opening size	2	mm
MOC of screen and related accessories	SS 316 / SS 316 L	

5.9 Distribution Chamber for Anaerobic and Anoxic Tank

5.9.1 The distribution chamber for each of the anaerobic and/or anoxic tanks should be designed for an average flow of 250 m³/d.

5.9.2 Two (2) manually operated weir penstocks should be provided in the distribution chamber of the anoxic tank.

5.9.3 Plant returns shall be routed back to the distribution chamber of the anoxic tank.

5.10 Anaerobic and Anoxic Tank

5.10.1 The design of the bioreactor tank should be as per the vendor's design. Each Bioreactor should consist of an anaerobic and/or anoxic section, followed by an aerobic section, and then a membrane tank with gravity flow.

5.10.2 The nitrified recycle should be recycled back to each anoxic tank.

5.10.3 The anoxic tank shall be provided with submersible mixers to keep solids in suspension.

5.10.4 A fixed Lifting Davit crane with suitable capacity shall be provided for each submersible mixer for lifting during maintenance.

5.10.5 NOx-N Analyser should be provided in the anoxic tank.

5.10.6 The design requirements for an Anaerobic/anoxic tank are provided in Table 5-7.

Table 5-7 Anaerobic/Anoxic Tank Description

Description	Values	Unit
No. of Anaerobic Tank (Minimum)	1.0	Nos
No. of Anoxic Tank (Minimum)	1.0	Nos
Design Average Flow	250	m ³ /d
MOC of Anaerobic/Anoxic tank	FRP/SS	
MOC of submersible Mixers with guide rails & chains	SS 316	
Type of lifting equipment for mixers	Fixed lifting davit	

5.11 Aeration Tank

- 5.11.1 The aeration tank shall receive the flow from the anoxic tank. The aeration tank shall be oxygenated using a diffused aeration system having retrievable type diffusers.
- 5.11.2 Fine bubble aeration with EPDM/PU Tubular diffusers can be provided for a diffused aeration system.
- 5.11.3 For diffuser design purposes, the standard oxygen transfer efficiency should not be considered more than 5%/meter depth of submergence for calculating the number of diffusers.
- 5.11.4 Dissolved oxygen, MLSS and Ammonia analyser should be provided in the aeration tank.
- 5.11.5 An electromagnetic flow meter should be provided in the common header of RAS pumps and MLR pumps. One Level Indicating transmitter should be provided in each aeration tank.
- 5.11.6 Material of construction of pipe between blower house and aeration tank, drop pipe and air distribution pipe & laterals should be in SS 316.
- 5.11.7 Pressure Indicating Transmitter, Temperature Indicating Transmitter and an air flow meter should be provided in the common header of the blower discharge line
- 5.11.8 The design requirements for the aeration tank in each of the Package STP shall be provided as indicated in Table 5-8.

Table 5-8 Aeration Tank Description

Description	Values	Unit
No. of Aeration Tank (Minimum)	1.0	Nos
Design Average Flow	250 m ³ /d	m ³ /d
MOC of Aeration Tank	FRP/SS316	
Design of a Bioreactor for Minimum Wastewater Temperature	20.0	°C
MLSS maintained in the aeration tank (max)	8000	mg/l
Maximum MLSS in the RAS recirculation	11000	mg/l
Liquid depth (Maximum)	6.0	m
Freeboard (Minimum)	0.6	m
F/M ratio	As per Bidder Design	kg BOD/kg MLSS.d
Hydraulic Retention Time	As per Bidder Design	Hrs
Aerobic SRT	As per Bidder Design	Days
Specific Sludge Yield	As per Bidder Design	Kg TSS/Kg BOD removed
RAS Recirculation ratio	As per Bidder Design	
Alum Dose	As per Bidder Design	
NaOH Dose (If required)	As per Bidder Design	

BOD oxidation oxygen requirement	1.2	Kg/kg BOD removed
Nitrification oxygen requirement	4.6	Kg/kg NH ₃ -N nitrified
Minimum DO to be maintained in the aeration tank	2.0	mg/l
Allowable maximum oxygen credit from denitrification	50%	
Total Actual oxygen demand, additional safety factor	20%	
MLR Pumps		
Nitrified Recycle, Mixer Liquor Recycle (MLR) Ratio	As per the bidder's design	
Quantity of MLR Pumps (Minimum) per tank	2 (1W+1S)	Nos
Type of Pumps	Submersible pumps	
Diffused Aeration in Aeration Tank		
Oxygen transfer correction factor for wastewater, α	0.60	
Fouling factor for diffusers	0.80	
Salinity-Surface tension correction factor, β	0.95	
Type of Aeration	Fine bubble diffused aeration	
Type of Diffusers	EPDM/PU Tubular Diffusers	
Type of Diffuser Installation	Retrievable	
Length of each diffuser unit	As per the bidder's design	
Diameter of each diffuser unit	As per the bidder's design	
Maximum air flow through the tubular membrane diffuser	< 10.0	Nm ³ /h
Mounting distance of diffuser from floor level up to its centerline (Minimum)	0.20	m
Air Blowers		
Quantity of Air Blowers provided (Minimum)	2 (1W+1S)	nos.
Capacity and head of blowers	As per Bidder's Design	Nm ³ /h
Type of Blowers	As per Bidder's Design	

5.12 Distribution Chamber of MBR

- 5.12.1 The distribution chamber should be designed for the average flow of 250 m³/d.
- 5.12.2 Each MBR train/tank should be provided with one penstock for isolation and control.
- 5.12.3 The distribution chamber should be constructed in FRP/SS 316.

5.13 Membrane Bioreactor

- 5.13.1 The membrane filtration system shall be a vacuum-driven system with membrane modules submerged in process tanks.
- 5.13.2 MBR should be designed for the average flow of 250 m³/d.
- 5.13.3 The Contractor shall provide a fully automatic permeate and backwash pumping system, with all controls, instruments, electrical components, valves, actuators, piping, fittings, and mountings.
- 5.13.4 The Contractor shall supply and install a dedicated permeate cum backwash pump to operate with each membrane tank/train. These shall be identical rotary-lobe positive displacement pumps / Horizontal Centrifugal pumps. Each pump shall be equipped with a variable-frequency drive (VFD) to control the pump's operating speed. The Contractor shall also supply a minimum of two standby permeate/backwash pumps, each equipped with a VFD.
- 5.13.5 A fully automatic membrane backwash system should efficiently and effectively remove debris, solids, and microorganisms that build up on the membrane surface during filtration.
- 5.13.6 The automatic backwash sequence should be initiated based on the transmembrane pressure level, elapsed run time since the last membrane backwash or chemical cleaning, volume of filtrate produced since the last membrane backwash or chemical cleaning, and/or manual actuation from the control system and local control interface.
- 5.13.7 The backwash / back pulse tank shall receive a part of the permeate water from the common header line of permeate pumps and from the tank, where the water is used for backwashing the membranes. The MOC of the back pulse tank should be in FRP/SS 316.
- 5.13.8 A Level Indicating Transmitter should be provided in the back pulse tank, and an electromagnetic flow meter should be provided in the backwash line.
- 5.13.9 NaOCl and Citric acid should be dosed in the backwash line for membrane cleaning.
- 5.13.10 The RAS withdrawal from each MBR tank should be automatic. Motorised valves should be provided in each RAS withdrawal line and collected in the RAS Sump.
- 5.13.11 RAS should be pumped back to the aeration tank through RAS pumps, and the excess sludge should be transferred to the Sludge Thickener.
- 5.13.12 The material of construction of the pipe between the blower and the MBR, the drop pipe and the air distribution pipe should be in SS 316.
- 5.13.13 Pressure Indicating Transmitter, Temperature Indicating Transmitter should be provided in the common header of the membrane air blower discharge line.
- 5.13.14 Airline coming into each MBR tank should be equipped with an airflow meter.
- 5.13.15 A pH analyser and a level-indicating transmitter should be provided in each MBR tank.

- 5.13.16 A pressure indicating transmitter should be provided in the suction and discharge lines of each permeate pump.
- 5.13.17 One Turbidity Analyser and an electromagnetic flow meter should be provided at the discharge line of each permeate pump.
- 5.13.18 The design requirements for the Membrane Bio-Reactor are provided in Table 5-9.

Table 5-9 Membrane Bio-Reactor Description

Description	Values	Unit
No of MBR tanks/trains (Minimum)	1	Nos
MOC of MBR Tank	FRP/SS 316	
Liquid depth	As per Bidder's Design	m
Freeboard (Min)	0.6	m
Type of membrane	Hollow fiber	
Membrane chemical composition	PVDF	
Nominal Pore size	< 0.05	μ
Maximum MLSS to be maintained in MBR tank	11000	mg/l
Net Flux during average flow at N condition	< 25	LMH
Backwash flux	As per Bidder's Design	LMH
MOC of Membrane Cassettes and its support	SS 316	
Permeate cum Backwash pumps		
Number of permeate cum backwash pumps (Min)	As per Bidder's Design	Nos
Capacity & Head	As per Bidder's Design	
Pump type	Horizontal Centrifugal	
Membrane Air Blowers		
No of Membrane air blowers (Minimum)	2 (1W+1S)	Nos
Capacity and Head	As per Bidder's Design	
Type of blowers	Rotary Blowers	
Maintenance and Recovery Clean		
Frequency of cleaning	As per the Membrane Manufacturer's guidelines	
Sodium hypochlorite dosage		
Citric Acid dosage		

- 5.13.19 The design requirements for NaOCl and Citric Acid Dosing System for membrane cleaning are provided in Table 5-10.

Table 5-10 NaOCl and Citric Acid Dosing System Description

Description	Values	Unit
NaOCl Day Tank for Membrane Cleaning		

No of day tank (Minimum)	1	No
Capacity of Tank	As per Bidder's Design	
MOC of day tank	FRP/HDPE	
Level Measurement	Level Indicating Transmitter	
NaOCl Dosing pumps for Membrane Cleaning		
No of NaOCl Dosing pumps	2 (1W+1S)	Nos
Type of pumps	Single Diaphragm	
Capacity and Head of pumps	As per Bidder's Design	
Citric Acid Bulk Tank for Membrane Cleaning		
No of Bulk tank (Minimum)	1	No
Capacity of Tank	As per Bidder's Design	
MOC of Bulk tank	FRP/HDPE	
Level Measurement	Level Indicating Transmitter	
Citric Acid Dosing Pumps for Membrane Cleaning		
No of Citric Acid dosing pumps	2 (1W+1S)	Nos
Type of pumps	Single Diaphragm	
Capacity and Head of pumps	As per Bidder's Design	

5.14 MBR Treated Water

- 5.14.1 A combined tank shall be provided to collect the MBR-treated water from both package STPs. The MBR-treated water shall be discharged/pumped to the inlet of the UV chamber of the CETP.

5.15 RAS Sump

- 5.15.1 The RAS withdrawn from the MBR tank will be received in this RAS sump.
- 5.15.2 RAS should be pumped back to the aeration tank.
- 5.15.3 MLSS Analyser and Level indicating transmitter should be provided in the RAS Sump.
- 5.15.4 RAS sump should be provided with Submersible / Horizontal Centrifugal pumps.
- 5.15.5 Excess sludge can be removed from the common header of RAS pumps, and both the RAS line and Excess sludge line should be provided with motorised valves and an electromagnetic flow meter. The contractor can also propose dedicated excess sludge pumps for pumping the sludge to the CETP sludge handling system.
- 5.15.6 The design requirements for RAS Sump are provided in Table 5-11.

Table 5-11 RAS Sump Description

Description	Values	Unit
Number of RAS Sump	1	No

MOC of sump	As per Bidder's design	
Retention time	As per Bidder's design	
Liquid depth	As per Bidder's design	
Freeboard (Minimum)	0.5	m
Solids consistency of RAS Sludge (maximum)	1.1%	
RAS Pumps		
Quantity of RAS pumps	3 (2W+1S)	Nos
Type of RAS pumps	Submersible/ Horizontal Centrifugal	
Capacity and Head of pumps	As per Bidder's design	
Type of pump operation	VFD based	

5.16 Excess Sludge Treatment

- 5.16.1 The excess sludge from the STP shall be discharged to the CETP's Sludge Handling System for further treatment by the Gravity Sludge Thickener or the Gravity Belt Thickener.

5.17 STP & CETP Pipe Material and Type of Valve

- 5.17.1 The design requirements for Pipe material and Valve type common for STP and CETP are provided in Table 5-12.

Table 5-12 Pipe Material and Valve Type Specification

S No	Application	Pipe Material	Valve Type
1	Raw sewage / Industrial wastewater	Ductile Iron / GRP	Gate valve
2	Treated effluent	HDPE /GRP	Butterfly valve
3	Sludge	GRP / SS 304	Gate valve
4	Thickened and Dewatered Sludge	SS 304	Knife edged gate valve
5	Grit Line	SS 304	Gate valve
6	Air pipe	SS 316 / SS 316 L	Butterfly valve
7	Chemical	Polymer: SS 316; Alum: uPVC; NaOCl: PVC	Ball valve / Diaphragm valve
8	Odour	GRP	Butterfly valve

5.18 General Specification for Motor

- 5.18.1 The design requirements for Motor common for STP and CETP are provided in Table 5-13.

Table 5-13 Motor Specification

Description	Values	Unit
Motor Design Temperature	50	Deg C
Power supply	415 V/ 3 Ph / 50 Hz	
Enclosure (above water)	IP 55	
Enclosure for submerged installation	IP 68	
Insulation Class	Class F	

