Annexure 'E'

Specifications for Sewage Related Jobs

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Chapter 1

General :

The specifications for these project & various components thereof shall be as follows,

1.0 The specifications for various material to be used for the project shall confirm to BIS standards with upto date amendments as given below,

S. No.	IS Code No.	Title
1.	IS 269:1989	33 grade ordinary Portland cement
2.	IS 8112:1989	43 grade ordinary Portland cement
3.	IS 12269:1987	53 grade Ordinary Portland cement
4.	IS 1489:1991	Portland pozzolana cement
	Part I:1991	Fly ash based
	Part II:1991	Calcined clay based
5.	IS 1786:1985	High strength deformed steel bars and wires for concrete reinforcement
6.	IS 875:1987	Code of practice for design loads for building structure
	Part I:1987	Dead loads
	Part II:1987	Imposed loads
	Part III:1987	Wind loads
	Part IV:1987	Snow loads
	Part V:1987	Special loads and load combinations
7.	IS 13920:1993	Ductile detailing of reinforcement concrete structures subjected to seismic forces
8.	IS 1893:2002	Criteria for earthquake resistant design of structures
9.	IS 456:2000	Code of practice for plain and reinforcement concrete(third revision)
10.	IS 1343:1980	Code of practice for pre-stressed concrete (first revision)
11.	IS 3370:1965	Code of practice for concrete structure for the storage of liquids.
12.	Part 1:1965	General requirement
	Part 2:1965	Reinforced concrete structure
	Part 3:1967	Pre-stressed concrete structures
	Part 4:1967	Design tables
13.	IS 6518:1972	Code of practice for control of sediment in reservoirs
14.	IS 5330:1984	Criteria for design of anchor block for penstock with joints (first revision)
15.	IS 7357:1974	Code of practice for structural design of tanks.
16.	IS 3913:1966	Suspended sediment load samplers
17.	IS 3917:1966	Scoop type bed material samplers.
18.	IS 4890: 1968	Method for measurement of suspended sediment in open channels.
19.	IS 4926:1976	Ready mix concrete (first revision)
20.	IS 6295:1986	Code of practice for water supply and drainage high altitude and/or sub-zero temperature regions(first revision)
21.	IS 8062	Code of practice for cathodic protection for steel structure
	Part1:1976	General principles
	Part2: 1976	Underground pipelines
22.	IS 10221:1982	Code of practice for coating and wrapping of underground steel pipes
23.	IS 8329: 2000	Centrifugally cast(spun) ductile iron pressure pipes for water, gas, and sewerage

S. No.	IS Code No.	Title
24.	IS 9523:1980	Ductile iron fittings for pressure pipes for water, gas, and sewerage
25.	IS 11906:1986	Recommendation for cement mortar lining cast iron, mild steel and ductile iron pipes
26.	IS 12288:1987	Code of practice for laying of ductile iron pipes
27.	IS 16098(part 2): 2013	Structured Wall Plastics piping Systems for non-pressure drainage and sewerage-Specification Part 2: Pipes and fittings with non-smooth external surface, Type B
28.	IS 7634 Part2:1975	Laying and jointing polyethylene (PE) pipes.
29.	Part1:1976	General requirement
30.	IS 14333	High Density Polyethylene Pipes for sewerage
31.	IS 2530	Methods of test for polyethylene moulding materials and polyethylene compounds DI K7 Pipes, Joints and Fittings for use for Sewerage applications
32.	IS 5382	Rubber sealing rings for gas mains, water mains and sewers.
33.	IS 4905	Methods for random sampling
34.	IS 7328	High density polyethylene materials for moulding and extrusion
35.	IS 7634	Laying & Jointing of Polyethylene (PE) Pipes
36.	IS 458:2003	Precast concrete pipes with and without reinforcement

NOTE:- Any other BIS standards as may be required will also be applicable. Quality assurance program of the manufacturer shall have to be enclosed with the detailed design and drawings.

2.0 The other part of the specifications for various components of the project shall be as per provisions of clauses and sub clauses of chapters of Manual on Sewerage and Sewage Treatment (second edition), CPHEEO Ministry of Urban Development Govt. Of India

Design of Sewer and Sewer appurtenances	Chapter 3
Sewage Pumping Station	Chapter 4
Sewage Treatment Facilities	Chapter 5
Sludge Treatment Facilities	Chapter 6
Recycling and reuse of sewage	Chapter 7
Basic Design Considerations	Chapter 2
Pre-treatment Screening, Sedimentation and Grit Removal	Chapter 5
Sludge Thickening, Dewatering, Digestion and Disposal	Chapter 6
Sludge Pumping	Chapter 6
Tertiary treatment Technology	Chapter 5
Decentralized Sewerage System	Chapter-8
Disposal of Effluent	Chapter 9
Operation and Maintenance	Part-B
Management of Sewerage System	Part-C

Disclaimer : Any specifications not covered above shall be as per best Engineering practice or as directed by Engineer In Charge. In the event of any disparity between the written specifications and BIS provisions, the provisions in BIS shall prevail.

The item wise specifications to be followed by the Contractor are given in the subsequent Chapters.

Chapter 2

Providing, Laying and Jointing of Pipelines

1.0 Laying of Pipe Line

Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Engineer in charge shall be laid. While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones.PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done. When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern. However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus, site conditions study is necessary to ensure the avoidance of flotation.

1.1. Excavation for Pipe Line Trenches/ Horizontal drilling

The pipeline shall be laid by open excavation. Horizontal drilling is adopted where permission is not obtained for open excavation such as Railway, NHAI crossing etc . Tendered rate is suppose to cover cost of all such means i.e, either drilling or excavation (soil, rock) by manual, mechanical or blasting.

1.2. Site Clearance

The pipe line alignment shall be cleared of all bushes, shrubs, roots, grass, weeds and if required trees, coming in the alignment of pipe line in the trench width portion. The rates for excavation shall cover all such site clearance work and no extra payment will be allowed on this account.

1.3. Alignment marking

After the work site is cleared as above, pipe line alignment with required trench width shall be marked on the ground with apex points, curves etc, as shown on the drawings or as directed by the Engineer-in-Charge in charge for the stretch where the work is to be started. The contractor shall provide all labour, survey instruments, and materials such as strings, pegs, nails, bamboos, stones, mortar, concrete etc. required for setting out and establishment of bench marks. The contractor shall be responsible for the maintenance of bench marks and other marks and stakes as long as they are required for the work in the opinion of the Engineer-in-Charge.

1.4. Working survey

Working survey of the pipeline alignment shall be carried out by the contractor before start of the excavation work. The contractor shall provide all the instruments such as leveling instruments, steel tape, ranging rods, strings, pegs etc for carrying out the survey. Based on the working survey, the alignments, L-section (depth of laying), grade, and location of specials, valves and chambers shall be finalized and got approved from the engineer in charge. The gradient and alignment shall be such that minimum horizontal and vertical bends shall be required.

1.5. Use of Machinery :

All excavations shall be carried out by mechanical equipment's / machinery unless, in the opinion of the Engineer-in-Charge, the work involved and time schedule permit manual excavation.

1.6 Trench Width and Depth :

All buried pipelines shall be minimum 1 meter +/- 0.2 mtr below ground level to maintain proper grade unless other depths are approved by the engineer in charge. The trench width for respective pipe diameters permissible as required under respective IS code for Pipeline laying and installation.

The trench width shall be constant throughout the trench depth, which will provide a clearance of about 0.30 m on either side of the pipe line.

The contractor may, for the facility of work or similar other reasons, excavate and also backfill later, if so approved by the Engineer-in-Charges, at his own cost, outside the allowable trench width specified above. Should any excavation be taken below the specified trench bottom, contractor shall fill it up to required level, at his own cost, with the same material available at the trench bottom including watering and compaction.

The excavation shall be taken down to such depths as shown in drawings. Excavation for extra depth equal to the thickness of proposed pipe bedding shall be done below pipe soffit level for providing bedding below pipeline wherever bedding is required. The trench bottom shall be excavated to proper grade as shown on drawings. The contractor shall provide site rails and levelling instruments required for checking the grade during excavation, bottom bedding and pipe laying Projections in rock excavation shall be removed by chipping.

The contractor shall carryout extra excavation at the pipeline joints to be welded in the trench, as required (minimum 0.6 m deep and 0.9 m lengthwise, all around the pipe), for facilitating proper welding of the bottom joint from outside. The work of trench excavation should be commensurate with laying and jointing of the pipeline. It should not be dug in advance for a length greater than 500 m ahead of work of laying and jointing of pipeline unless otherwise permitted by the Engineer-in-Charge.

The minimum cover on pipe is to be maintained 1 meter+/- 0.2 mtr. However, the cover on pipe may be modified to suite gradients and site conditions as per direction of Engineer-in-Charge.

1.7 Barricading and Guarding:

To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, red lanterns and guards as required shall be placed and maintained

During the progress of work, till filling of the trenches after pipes are laid and jointed. The lighting, barricading, guarding of the trenches and the maintenance of watchman shall be done by the contractor at his cost.

All precautions shall be taken during excavation and laying operation to guard against possible damage to any existing structures, underground cables, pipe lines of water, gas, sewage etc. Any damage done to such properties will have to be repaired / rectified by the contractor at his cost. The Contractor has to ensure the following:

- safety protections as mentioned above have to be incorporated in the work process
- hindrances to the public have to be minimized
- the trench must not be eroded before the pipes are laid
- the trench must not be filled with water when the pipes are laid
- the trench must not be refilled before laying of the pipes

The bed for the laying of the pipes has to be prepared according to the L-Section immediately before laying of the pipes.

1.8. Reuse of surface material

All surface materials, which in the opinion of the Engineer-in-Charge, suitable for reuse in restoring the surface shall be kept separate from the general excavation material, as directed by the Engineer-in-Charge.

1.9. Stacking of excavated material

All excavated materials shall be stacked in such a manner that it does not endanger the work and avoids obstructing foot paths and roads. Hydrants under pressure, surface boxes, fire and other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clean or other necessary provisions made for street drainage and natural water courses shall not be obstructed. All the excavated material shall be the property of the Employer and shall be stacked or disposed off as directed by the Engineer-in-Charge.

1.10. Maintenance of traffic

The work of excavation and pipe laying shall be carried in such a manner that it causes the least interruption to traffic and the road / street may be closed in such a manner that it causes the least interruption to the traffic. Where it is necessary for traffic to cross open trenches, suitable bridging arrangement shall be provided. When the street is closed for traffic, suitable signs indicating that street is closed shall be placed and necessary detour signs for proper maintenance of traffic shall be provided.

1.11. Structure protection

Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers and other obstructions encountered in the progress of work shall be furnished under the direction of the Engineer-in-Charge. The structures which have been disturbed shall be restored upon completion of work.

1.12. Protection of property

Trees, shrubbery fences, poles and all other property shall be protected unless their removal is allowed by the Engineer-in-Charge. When it is necessary to cut roots and tree branches, such cutting shall be done under the supervision and direction of the Engineer-in-Charge.

1.13. Avoidance of existing services

As far as possible, the pipeline shall be laid below existing services, such as water and gas pipes, cables, cable ducts and drains but not below sewers. Excavation of the trenches shall be carried out to the required depth accordingly. If it is unavoidable, the pipeline shall be suitably protected and lesser trench depth in such cases can be allowed. A minimum clearance of 150 mm shall be provided between the pipeline and such other services. When thrust or auger boring is proposed for laying pipeline across roads, railway or other utilities, larger clearance as required shall be provided. Adequate arrangements shall be made to protect and support the other services during excavation and pipe laying operations. The work shall be so carried out as not to obstruct access to the other services for inspection, repair and replacement. When such utilities are met with during excavation, the authority concerned shall be intimated and arrangements made to support the utilities in consultation with them.

1.14. Bailing out of Water

During the excavation if subsoil water is met with, contractor shall provide necessary equipment and labour for dewatering the trenches. If pumping out subsoil water is found necessary, contractor shall provide sufficient number of pumps for the same. The tendered rate shall cover all costs for bailing out of water including hire charges of pumps, cost of diesel and labour etc and hence, no extra payment shall be allowed.

1.15. Disposal of loose boulders etc

All loose boulders, semidetached rocks, (along with earthy stuff which might move therewith), not directly in the excavation but close to the area to be excavated, as to be liable, in the opinion of the Engineer-in-Charge, to fall or otherwise endanger the workman equipment's, or the work etc, shall be stripped off and removed away from the area of the excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion which was originally sound and safe. The tendered rate is supposed to cover this job and no extra payment will be allowed on this account.

1.16. Disposal of Excavated Material

All the excavated surplus material shall be disposed off on low lying Government land or as directed by the engineer in charge.

1.17. Moorum / Sand Bedding below Pipeline

In case of hard rock and black cotton soil, before lowering of the pipes in trenches, a layer of selected moorum, available from excavated material under the same contract shall be provided below the pipe line to act as bedding. The bedding shall be compacted properly including required watering and the thickness of well compacted layer shall not be less than 150 mm. The bedding shall be provided for full trench width with proper grade as shown on drawings.

2. Refilling the trenches

2.1. Use of selected excavated material

Filling of excavated material in trenches shall be commenced as soon as the joints of pipes and specials have been tested and passed. The backfilling material shall be properly consolidated by watering and ramming, taking due care that no damage is caused to the pipes and the outer coating.

Selected surplus spoils from excavated material shall be used as backfill. Fill material shall be free from clods, salts, sulphate, organic or other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill up the voids and the mixture used for filling.

2.2. Filling zones

For the purpose of back-filling, the depth of the trench shall be considered as divided in to the following three zones from the bottom of the trench to its top:

Zone A:From the bottom of the pipe (top of bedding) to the level of the centre line of the pipe	Back-filling by hand with selected approved material available from excavation, placed in layers of 150 mm and compacted by tamping. The back-filling material shall be deposited in the trench for its full width on each side of the pipe, specials and appurtenances simultaneously. Special care shall be taken to avoid damage of the pipe and the coating or moving of the pipe.
Zone B:From the level of the centre line of the pipe to a level 300 mm above the top of the pipe	Back-filling and compaction shall be done by hand or approved mechanical methods in layers of 150 mm; special care shall be taken to avoid damage of the pipe and the coating or moving of the pipe.
Zone C:	Back-filling shall be done by mechanical methods in 15 cm.

2.3. All excavations shall be backfilled to the level of the original ground surfaces unless otherwise shown on the drawings or ordered by the Engineer-in-Charge in Charge, and in accordance with the requirements of the specification. The material used for backfill, the amount thereof, and the manner of depositing and compacting shall be subject to the approval of the Engineer-in-Charge in Charge, but the Contractor will be held responsible for any displacement of pipe or other structures, any damage to their surfaces, or any instability of pipes and structures caused by improper depositing of backfill materials.

The back filled layers shall be wetted and compacted to a density of not less than 90 percent of the maximum dry density at optimum moisture content of the surrounding material. Any deficiency in the quantity of material for backfilling the trenches shall be supplied by the Contractor at his expense.

The Contractor shall at his own expense make good any settlement of the trench backfill occurring after backfilling and until the expiry of the defects liability period.

On completion of pressure and leakage tests exposed joints shall be covered with approved selected backfill placed above the top of the pipe and joints in accordance with the requirements of the above specifications. The Contractor shall not use backfilling for disposal as refuse or unsuitable soil.

2.4. Fillings of the trench excavated in rock

In case of excavation of trenches in rock, the filling up to a level of 30 cm above the top of the pipe shall be done with fine materials, such as soft soil, murrum etc. The filling up of the level of the centre line of the pipe shall be done by hand compaction in layers not exceeding 15 cm, whereas the filing above the centre line of the pipe shall be done by hand compaction or mechanical means in layers not exceeding 15 cm. The filling from a level of 30 cm above the top of the pipe to the top of the trench shall be done by mechanical methods with broken rock filing of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

2.5. Consolidation

The consolidation of the filled material shall be done to attain 95 % proctor density. The density of the filled and compacted material shall be tested regularly, and record maintained accordingly.

2.6 Trenchless Technology for Sewer Pipe Laying

For trenchless technology suitable guidelines/ codes from Indian society of Trenchless Technology shall be followed. The bidder has to decide after field investigation and as per the guidelines provided by Indian society of Trenchless Technology for selection of trenchless technology that is best suitable for a particular section. The codes from is trenchless technology are below mentioned.

- Code of practice for Horizontal Directional Drilling Suiting Indian Condition.
- Code of practice for Micro Tunneling and Pipe Jacking Suiting Indian Condition.
- Code of practice for Glass Reinforced Pipe Technique Suiting Indian Condition.
- Code of practice for pipe Bursting Suiting Indian Condition.
- Code of practice for cured in place pipe Technique Suiting Indian Condition.
- Trenchless Technology Selection Guidelines.
- Standard Operating Procedure for Application of Trenchless Technology.
- Manual of site Investigation for Trenchless Projects.
- Trenchless technology Risk Mitigation Manual

3.0 Ductile Iron PIPES (Pipes shall be procured only from the Manufactures.)

3.1 Supply, laying and jointing of DI Pipes and fittings.

The ductile iron pipe to be supplied and laid shall be DI K-7/K-9 as per IS 8329-2000, fittings for the pipe shall conform to the provisions of IS 5382-1985, DI fittings confirming to IS 9523:1980 complete.

3.2 The laying of pipe shall be as per IS 12288:1987 with up-to-date amendments.

3.3 The manufacturer and their associates (if any) should have the facility to carry out the internal coating / lining and external coating / painting at factory for pipes and specials confirming to IS 11906:1986.

3.4 The DI pipe manufacturer should have valid BIS license with an experience of manufacturing and supplying of DI pipe conforming to IS 8329-2000 and with up to date amendment.

3.5 The DI pipe manufacturer should have house facility for carry out the following test for size DN 80-DN1000: -

a) C -value determination arrangement

b) Type test for leak tightness as per ISO 2531:2009/BS EN 545/IS 8329:200.

3.6 DI pipe manufacturer should have the ISO 9001:2008 & ISO 2531:2009 certification for manufacture of DI pipe.

3.7 A certificate for having supplied DI pipe of size proposed in the project for quantity 1/3 of the TENDER requirement during last 3 years to any state/central govt. department /board to be submitted by pipe manufacturer.

The manufacturer should be able to demonstrate the conformity of the product to the requirement by controlling the manufacturing process and by carrying out the various tests as specified in IS wherever possible, statistical sampling techniques should be used to control the process so that the product is produced within the specified limit. Quality assurance program of the manufacturer shall be enclosed with the Tender.

NOTE — A test report or conformity certificate may be obtained from the manufacturer of the sealing ring for conformity to IS 5382.

4. Supply, laying and jointing of Double Wall (Non-Smooth External Annular Corrugated wall & Smooth Internal wall) Polyethylene Class SN 8 /HDPE PN 2.5 PE 100 for Piping System for non-pressure underground Sewerage & Drainage Applications

4.1 Scope

The specification for manufacturing, supplying, transportation, handling, stacking, installation, jointing, and testing of Piping System for non-pressure underground Sewerage & Drainage Applications shall be as below,

4.2 Applicable Codes

The manufacturing, testing at factory, supplying, transportation, handling, stacking, installation, jointing, and testing at sites shall comply with all currently applicable National statutes, standards & codes. If requirements of these specifications are at variance with any other standards, this particular document shall be governed by the proceedings of:

IS 16098(Part-2) : 2013	Structured Wall Plastics piping Systems for non-pressure drainage and sewerage- Specification Part 2: Pipes and fittings with non-smooth external surface, Type B
ISO 9001: 2008	Quality Management Systems

The testing, supplying, laying, jointing and testing at work sites of HDPE pipes shall be as per standards and Codes. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern.

Code No.	Title/Specification
IS 14333	High Density Polyethylene Pipes for sewerage
IS 2530	Methods of test for polyethylene moulding materials and polyethylene compounds DI K7 Pipes, Joints and Fittings for use for Potable Water Supply
IS 5382	Rubber sealing rings for gas mains, water mains and sewers.
IS 4905	Methods for random sampling
IS 7328	High density polyethylene materials for moulding and extrusion
IS 7634	Laying & Jointing of Polyethylene (PE) Pipes
IS 12235	Methods of test for thermoplastics pipes & fittings.
IS 12235 (Part 1): 1986	Method of measurement of outside diameter
IS 12235 (Part 5):1986	Reversion test
IS 12235 (Part 8):1986	Internal hydrostatic pressure test

Other Indian standards which are integral part of above standard as normative references form a significant portion of this specification document.

4.3 General Marking

Marking shall be labelled, printed or formed directly on the pipe or fitting, in such a way that after storage, weathering and handling the legibility shall be maintained. Marking shall not initiate cracks or other types of defects which adversely influence the performance of the pipes or the fitting. Minimum Required Marking.

4.3.1 Pipes

Each pipes shall be marked at intervals of maximum 3 m, at least once per pipe, with the following information: a) Manufacturer's name/Trade-mark; b) Diameter series, nominal size; c) Stiffness class; d) Material; and e) Lot number/batch number containing information regarding period of manufacture.

4.3.2 Fittings

Each fitting shall be marked with the following information: a) Manufacturer's name/Trademark; b) Diameter series, nominal size; c) Nominal angle; d) Stiffness class; e) Material; and f) Lot number/batch number containing information regarding period of manufacture. g) BIS Certification Marking each pipe or fittings may also be marked with the standard Mark. The use of the Standard mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there under.

4.4 Inspection

The Contractor shall be responsible for the performance tests at the Manufacturer's place in presence of the Engineer-in-charge or the authorized representative(s) of the client and/or by the authorized 'Third Party' deployed by the client.

The Pipe Manufacturer shall produce all necessary test certificates related to relevant Material Characteristics of PE Material in Granular Form for each lot of Pipes as specified in the IS code. At the time of inspection, before supply of the designated lot to the contractor, such certificates from the manufacturer, duly supported by the purchaser's invoices shall be made available to the employer with proper endorsement from the third party (if any).

The employer reserves the right to inspect the Pipe Manufacturer's unit if required to evaluate the capacity/ capability/ Quality Assurance before extending their clearance to the contractor towards procurement of pipes.

The Employer reserves the right to test Pipe samples of Pipe & Fittings picked up at random from project site stack yard/storage for performance test at any Govt. authorized National Testing Laboratories.

4.5 Transportation

While loading the pipes onto the truck, care should be taken that the coupler- end should be arranged alternatively in the corresponding layers to avoid the damage to the coupler/ socket ends.

4.6 Handling

Following Recommendations shall be followed while handling the pipes:

- Adherence to National Safety requirements
- Pipes to be smoothly lowered to the ground
- Pipes should not be dragged against the ground to avoid the damages to the Coupler/pipes.
- 2500mm and larger diameter pipes are carried with Slings at two points spaced approximately at 3 Meters apart
- For smaller diameters (less than 250 mm) one lift point shall be sufficient & can be handled either manually or mechanically
- Do not use a loading Boom or Forklift directly on or inside pipe.

4.7 Pipe Storage at Site

- Stockpiling shall be done temporarily on a Flat Clear Area as per Fig. 1 & 2.
- For avoiding collapse of Stacks, use Wooden Posts or Blocks
- Stacking shall not be higher than 2.5 Meters
- While stacking, alternate the socket/coupler ends at each row of stacked pipes.

5.0 Lowering, Laying & jointing of Pipes

The width of a Sewer Trench depends on the soil condition, type of side protection needed, and the working space required at the bottom of Trench for smooth installations. The Minimum Trench Width is specified as per Table below:

Indicative Trench Widths**	
Pipe Diameter (mm)	Trench Width (M)
75-200	0.6
250	0.7
300	0.8
400	0.9
600	1.2
800	1.3
1000	1.8

The pipe segment between two manholes shall be laid approximately in straight line without any vertical undulations (at prescribed Gradient) only in case of curve if found necessary. The piping system shall rest on the carefully prepared bedding portion of the Backfill Envelope (ref. Annexure A) and at appropriate jointing locations the trenches shall be excavated deeper to accommodate the bulges of coupler-spigot joints. However, special care shall be ensured as mentioned below: -

- Excavation of trenches shall be carried out in accordance with the approved drawing & specifications and as directed by the engineer-in-charge as well.

- The piping system shall be laid and jointed in true to gradient with the help of sight rails and boning rods as detailed in CPHEEO, MoUD, GoI Manual on Sewerage and sewerage treatment. The levels need be checked with calibrated modern Levelling Instrument. Specific care shall be taken to prevent entry of sand / mud /slush/ any other foreign material etc into the system during the installation operation.

A minimum cover of 600 mm should be maintained or as directed Engineer In Charge.

The bedding area (ref. Annexure A) is an essential portion of Back fill Envelope and shall be constructed with proper bedding material as computed in accordance with appropriate national code of practice for structural bedding design mentioned in the list of normative references under IS 16098-2. The bedding shall be laid to specified thickness and gradient with proper manual compaction of the aggregate. Indicative installation details with suggestive 'Backfill Envelop' have been shown in Annexure A.

The moulded on-line coupler (or separate coupler integrated to the pipe in case of lower sizes) will have a suitable internal surface to push-fit the said end over the spigot end of the next pipe. On first valley of the corrugation of said spigot end (destined to receive the pushed coupler), the sealing rubber ring of standard quality (as specified in Cl 8.3 of the mentioned IS Code) shall be placed so that the coupler end of the pipe smoothly but tightly slides over the sealing ring for making an absolute watertight joint. Similar system is also used for fabricated accessories or moulded fittings required such as Tee, Bends, Elbows, Reducer end caps for the purpose of installation of the system related to drainage/sewerage.

For quality connections following steps are to be ensured, failing which the performance aspects are to be severely compromised: -

- The non-coupler (socket) end needs to be thoroughly cleared and shall be free from any foreign material
- Clean and lubricate the coupler end of the pipe, if required.
- Lubricate the exposed Gasket in the same manner, if required.
- Keep the non-coupler end free from dirt, backfill material, and foreign matter so that the joint integrity is not compromised.
- Push the coupler onto the non-coupler end and align properly. Always push coupler end onto non-coupler end.

For smaller diameter pipes simple manual insertion shall be sufficient. It should be ensured that the coupler end is adequately 'homed' on non-coupler end to ensure installation and tight joining seal. Therefore prior to insertion always place a 'Homing Mark' on appropriate corrugation of the 'Non-Coupler End'.

6.0 RCC Pipe

Scope:

This Specification covers the requirements for manufacturing, testing, supplying, jointing and, testing at work sites, of Reinforced Cement Concrete (RCC) pipes, of both pressure and non pressure varieties used for pumping mains, sewers, and storm water drains.

Applicable Codes

The manufacturing, testing, supplying, jointing and testing at work sites of RCC pipes shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the Codes shall be referred to. If requirements of this Specification conflict with the requirements of the Codes and standards, this Specification shall govern.

Materials

S: 456	Code of Practice for Plain and Reinforced Concrete.
IS: 783	Code of Practice for Laying of Concrete Pipes.
IS: 376	Safety Code for Excavation Work.

Design

Design of RCC pipes shall be in accordance with the relevant clauses of IS: 458. The details of reinforcement shall be as per Clause 5.2 of IS: 458. The ends of pipes shall be in accordance with relevant clauses of IS: 458.

Manufacturing

General

1. The method of manufacture shall be such that the form and the dimensions ofthe finished pipes are accurate within the limits specified in relevant IS: 458. The surfaces and edges of the pipes shall be well defined and true, and their endsshall be square with the longitudinal axis. The ends of the pipes shall be further reinforced by an extra ring of reinforcement to avoid breakage during transportation.
2. The RCC pipes and rubber rings shall be systematically checked for any manufacturing defects by experienced supervisors so as to maintain a high standard of quality.
3. Engineer shall at all reasonable times have free access to the places where the pipes and collars / rubber rings are manufactured for the purpose of examiningand testing the pipes and collars / rubber rings and of witnessing the test and manufacturing.
4. All tests specified either in this Specification or in the relevant Indian Standards shall be performed by Supplier / Contractor at his own cost and in presence of Engineer if desired for this, sufficient notice before testing of the pipes shall be given to Engineer.
5. If the test is found unsatisfactory, Engineer may reject any or all pipes of that lot. The decision of Engineer in this matter shall be final and binding on Contractor and not subject to any arbitration or appeal.

Curing

Pipes manufactured in compliance with IS: 458 shall be either water cured, or steam cured in accordance with the relevant requirements of IS: 458.

Dimensions

1. The internal diameter, wall thickness and length of barrel and collar of pipes, reinforcement (longitudinal and spiral), type of ends and minimum clear cover to reinforcement and strength test requirements shall be as per the relevant clauses/ tables of IS: 458 for different class of pipes.
2. The tolerances regarding overall length, internal diameter of pipes or socket and barrel wall thickness shall be as per relevant clauses of IS: 458.

Workmanship and finish

1. Pipes shall be straight and free from cracks except that craze cracks may be permitted. The ends of the pipes shall be square with their longitudinal axis sothat when placed in a straight line in the trench no opening between ends in contact shall exceed 3 mm in pipes up to 600 mm diameter (inclusive), and 6 mmin pipes larger than 600 mm diameter.
2. The outside and inside surfaces of the pipes shall be smooth, dense and hard,and shall not be coated with cement wash or other preparation unless otherwise agreed to between Engineer and the manufacturer or supplier.
3. The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or molding.
4. The pipes shall be free from local dents or bulges greater than 3.00 mm in depth and extending over a length in any direction greater than twice the thickness of barrel.
5. The deviation from straight in any pipes throughout its effective length, tested by means of a rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed, for all diameters, 3 mm for every meter run.

Testing

1. All pipes for testing purposes shall be selected at random from the stock of the manufacturer and shall be such as would not otherwise be rejected under the criteria of tolerances as mentioned in IS: 458.
2. During manufacture, tests on concrete shall be carried out as per IS: 456. The manufacturer shall supply, when required to do so by Engineer the results of compressive tests of concrete cylinders or cubes made from the concrete used for the pipes. Every pressure pipe shall be tested by the manufacturer for the hydrostatic test pressure.

3. The specimen of pipes for the following tests shall be selected in accordance with Clause 9.1 of IS: 458 and tested in accordance with the methods described in IS: 3597.
    a. Hydrostatic test.
    b. Three edge bearing test or sand bearing test.
    c. Absorption test.
    d. Bursting test.

Sampling and inspection

1. In any consignment, all the pipes of same class and size and manufactured undersimilar conditions of production shall be grouped together to constitute a lot. The conformity of a lot to the requirements of this Specification shall be ascertained on the basis of tests on pipes selected from it.
2. The number of pipes to be selected from the lot shall be in accordance with column 1 and 2 of Table 9 of IS: 458.
3. Pipes shall be selected at random. All the pipes selected shall be inspected for dimensional requirements, finish, and deviation from straight.
4. The number of pipes to be tested for tests shall be in accordance with column of Table 9 of IS: 458. These pipes shall be selected from pipes that have satisfied the requirements mentioned above.
5. A lot shall be considered as conforming to the requirements of IS: 458 if the following conditions are satisfied.

a) The number of defective pipes (those not satisfying one or more of therequirements for dimensions, finish, and deviation from straight) shall not be morethan the permissible number given in Column 3 of Table 9 of IS: 458.
b) All the pipes tested for various tests shall satisfy corresponding requirements of the tests.
c) In case the number of pipes not satisfying requirements of any one or more tests,one or two further sample of same size shall be selected and tested for the test or tests in which failure has occurred. All these pipes shall satisfy the corresponding requirements of the test.

Marking

The following information shall be clearly marked on each pipe including the details given by Engineer In charge.

I. Internal diameter of pipe.
II. Class of pipe.
III. Date of manufacture, and
IV. Name of manufacturer or his registered trademark or both.

Carting and Handling

1. Pipes and fittings / specials shall be transported from the factory to the work sites, at places along the alignment of pipeline as directed by Engineer. Contractor shall be responsible for the safety of pipes and fittings / specials in transit, loading / unloading. Every care shall be exercised in handling pipes and fittings / specials to avoid damage. While unloading, the pipes and fittings / specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber with steadying ropes or by any other approved means.
2. Padding shall be provided between coated pipes, fittings / specials and timber skids to avoid damage to the coating. Suitable gaps between pipes should be left at intervals in order to permit access from one side to the other. In case of spigot socket pipes while unloading, as far as possible pipes shall be unloaded on one side of the trench only. The pipes shall be checked for any visible damage (such as broken edges, cracking or splaying of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage to preclude it

from being used shall be discarded. Dragging of pipes and fittings / specials along concrete and similar pavement with hard surfacesshall be prohibited. Wherever a section of pipe, or a fitting is to be lifted or moved, it shall be handled carefully with belt slings. The belts shall be constructed so that no metal bears against the pipe and so that the bearing is uniform. The width of the belts shall be adequate to prevent any damage to the pipe coating. The pipe section may at no time be dropped but shall be lowered carefully into position and may not be slide along theground. If it is to be rolled, it may be done only on slides or ground specially prepared soas to prevent any damage to the coating.

3. All State and local laws be observed during transportation. The Contractor shall secure permits and licenses and provide all signals, guards and lights that may be required.Upon delivery the pipe sections and fittings shall be placed on specially prepared groundto protect them from distortion and damage. The ground shall be prepared so that they will rest evenly and will have uniform bearing throughout their lengths.

Storage

Each stack of pipes shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars of suppliers wherever possible. Storage shall be done on firm level and clean ground and wedges shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes laid lengthwise and crosswise in alternate layers. The pyramid stack shall be made for smaller diameter pipes for conserving space in storing them. The height of the stack shall not exceed 1.5m.

Fittings / specials shall be stacked under cover and separated from pipes. Valves and sluice gates shall be placed on blockings.

Rubber rings shall be stored in a clean, cool store away from windows, boiler, electrical equipment and petrol, oils or other chemicals. Particularly in the field where the rubber rings are being used it is desirable that they should not be left out on the ground in the sun or overnight under heavy frost or snow conditions.

Jointing

1. Jointing of RCC pipes shall be done as per the requirements of following Specifications and as per the relevant IS. The type of joints shall be as specified in the Contract / Drawing. After jointing extraneous material if any, shall be removed from the inside of the pipe and newly made joints shall be thoroughly cured. In case, rubber sealing rings are used for jointing, these shall conform to IS: 5382.
2. Spigot and Socket Joint (Rigid)

   The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar in the proportion of 1:1, which shall be rammed with caulking tool.
3. Collar Joint (Rigid)

   After laying the RCC pipes at proper alignment and gradient their abutting faces shall be coated with hot bitumen in liquid condition by means of a brush. The wedge-shaped groove in the end of the pipe shall then be filled with a tarred gasket in one length for each joint. The collar shall then be slipped over the end of the pipe and the next pipe butted well against the tarred gasket by suitable appliances approved by Engineer so as to thoroughly compress the tarred gasket into the grooves, care being taken that the concentricity of the pipes and levels are not disturbed during this operation. The collar shall then be placed symmetrically over the end of the two pipes and the space between the inside of the collar and the outside of the pipe filled with a mixture of cement and sand in the proportion of 1:1, tempered with just sufficient water to have a consistency of the semi dry conditions, well

packed and thoroughly rammed with caulking tools. The joints shall be finished off with a filled sloping at 45o to the side ofthe pipe. The finished joints shall be protected and cured thoroughly as directed by Engineer. Any plastic solution or cement mortar that may have been squeezed into the inside of the pipe shall be removed so as to leave the inside of the pipe perfectly clean.

4. Spigot and Socket Joint (Semi-flexible)

   This joint is composed of specially shaped spigot and socket ends on the RCC pipes. A rubber ring shall be lubricated and then placed on the spigot which is forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and socket, stiff mixture of cement and mortar in the proportion of 1:1, shall then be filled into the remaining annular space and rammed with a caulking tool.

5. Collar Joint (Semi-flexible)

   This joint is made up of a loose collar which covers two specially shaped pipe ends.Each end shall be fitted with a rubber ring, which when compressed between the spigots and collar, seal the joint. Stiff mixture of cement mortar in the proportion of 1:1, shall then be filled into the remaining annular space and rammed with a caulking tool.

6. Spigot and Socket Joint (Flexible)

   The RCC pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipes. The manufacturer's instructions shall be used, and the manufacturer's instructions shall be deemed to form a part of these Specifications. The rubber rings shall be lubricated before making the joint andthe lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.

7. Flush Joint (Internal)

   This joint shall be generally used for culvert pipe of 60 cm. diameter and over. The ends of the pipes are specially shaped to form a self centering joint with an internal jointing spaces 1.3 cm wide. The finished joint is flush with both inside and outside withthe pipe wall. The jointing space is filled with cement mortar in the proportion of 1:1,mixed sufficiently dry to remain in position when forced with a trowel or rammer.

8. Flush Joint (External)

   This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends. Each end shall be butted against the other and adjusted in correct position. The jointing space shall then be filled with cement mortar in the proportion of 1:1, sufficiently dried and finished off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

Cleaning of pipes

1. As soon as a stretch of RCC pipes has been laid complete from manhole to manhole orfor a stretch as directed by Engineer, Contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75 mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipeline shall be securely closed as may be directed by Engineer to prevent entry of mud or slit etc.
2. If as a result of the removal of any obstruction, Engineer considers that damages mayhave been caused to the pipelines, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory Contractor shall amend the work and carry out such further tests as are required by Engineer.
3. It shall also be ascertained by Contractor that each stretch from manhole to manhole or the

stretch as directed by Engineer is clear and without any obstruction by means of visual examination of the interior of the pipeline suitably enlightened by projected sunlight or otherwise.

Testing at work site

1. After laying and jointing of RCC pipes is completed the pipeline shall be tested at work site as per the following Specifications and as directed by Engineer. All equipment for testing at work site shall be supplied and erected by the Contractor and shall be rectified by him / her to the full satisfaction of Engineer. Water used for test shall be removed from pipes and not released to the excavated trenches.
2. After the joints have thoroughly set and have been checked by Engineer and before backfilling the trenches, the entire section of the sewer (or storm water drain) shall be proved by Contractor to be watertight by filling in pipes with water to the level of 1.50 m. above the top of the highest pipe in the stretch and heading the water up for the period of one hour. The apparatus used for the purpose of testing shall be approved by Engineer. Contractor if required by Engineer shall dewater the excavated pit and keep itdry during the period of testing. Any leakage including excessive sweating which causesa drop in the test water level will be visible and the defective part of the work should be removed and made good.
3. In case of pressure pipeline site test pressure should not be less than the maximum operating pressure plus the calculated surge pressure, but in no case should it exceed the hydrostatic test pressure, as specified in IS: 458.

7.0 Double Wall Corrugated (DWC) HDPE Pipes

7.1 Lowering, Laying of Pipes

a) Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Project Manager shall be laid.

b) While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones.

c) PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done.

d) When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.

e) However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.

f) Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95% maximum dry density.

7.2 JOINTING OF PIPES

The pipe shall have a jointing system that shall provide for fluid tightness for the intended service conditions. Appropriate jointing for HDPE pipe as specified above shall be selected considering site and working condition, pressure and flow of liquids.

7.3 JOINTS

Elastomeric sealing rings shall be free from substances that can have a detrimental effect on the pipes or fittings used in conjunction with pipes. The design of the profile and dimensions of the sealing ring is left to

the manufacturer, as long as the pipe with the sealing ring meets the requirements of this standard. Where the design of the socket is such that the ring is not firmly fixed in position, the housing for the ring shall be so designed as to minimize the possibility of the ring being dislodged during insertion of the pipe (or spigot or fitting) to complete the joint. Elastomeric sealing rings shall be in accordance with one of the type (Type 1 to Type 6) of IS 5382. The manufacturer should specify the type of sealing ring (namely Type 1, 2, 3, 4, 5 or 6) that is being offered. NOTE — A test report or conformity certificate may be obtained from the manufacturer of the sealing ring for conformity to IS 5382.

7.4 APPLICABLE CODES

The manufacturing, testing, supplying and testing at work sites of HDPE-DWC pipes shall comply with IS 16098 Part-II: 2013 and all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases the latest revision of the Codes shall be referred to. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern:

Code No.	**Title/Specification**
IS 4905:1968	Methods for random sampling.
IS 5382:1985	Specification for rubber sealing rings for gas mains, water mains and sewers (first revision). Type-I & Type-VI
IS 12235	Methods of test for thermoplastics pipes & fittings.
(Part 1): 1986	Method of measurement of outside diameter.
(Part 5):1986	Reversion test
(Part 8):1986	Internal hydrostatic pressure test
IS 16098 Part-II:2013	Structured wall plastics pipes for non-pressure drainage andsewerage-specifications.

8.0 Construction of backfill envelope and final backfilling of the trenches

DWC Piping System with well compacted Backfill Envelope along with the bottom and sides of trench (native soil) work together to support soil overburden and superimposed (traffic) loads. The carefully constructed Backfill Envelop has three distinct but non-isolated stages (ref. Annexure A). The construction need to be done stage by stage as per the sequence stated below:

- Bedding portion
- Up to Haunch level
- Remaining portion

The material for backfill envelop shall be in accordance with the structural design of flexible buried conduit as per relevant National code in meticulous consultation with ISO 21138-1 &3 :2007 and all other referred International Codes such as BS EN 1295-1 that forms an integral part of the said ISO Specifications. It can be the same material that were removed in the course of excavation, or it can be fine sand/course sand/gravel / murrum /other form of course / fine aggregates depending on the effected Design Load [Overburden + Superimposed (Live) load]. However, in no circumstances, the flexible pipe should not be embedded in cement concrete (un- reinforced or reinforced) which invariably induces undesired rigidity in the system. The Manufacturer may also be consulted to provide for the necessary module for the Structural Design of the 'Backfill Envelope'.

- The remaining portion of backfilling which do not contribute to the structural integrity of the system may be the materials that were removed in the course of excavation, or any other foreign material as may be required to suit the particular site condition. These materials shall consist of at least clean earth and shall be free from large clod or stone above 75 mm, ashes, refuse and other injurious materials.
- After completion of bedding portion of the Backfill envelop and subsequent lying of pipes, etc, first the haunch portion & then upper portion of Backfill Envelope shall be constructed as per design around the pipe. Voids must be eliminated by knifing under and around pipe or by some other indigenous tools.
- The compaction, by hand rammers or compactors with necessary watering to a possible maximum level of proctor density shall be ensured.

- Remaining portion of the Construction of 'Backfill Envelope' (above the Bedding Portion) & subsequent final Backfilling of the Trench shall start only after ensuring the water tightness test of joints for the concerned sewer segments. However, partial filling may be done keeping the joints open.
- Precautions shall be taken against floatation (if at all necessary) as per the specified methodology and the minimum required cover. For indicative Drawing See Annexure C.

7.0 Continuity Test /Hydraulic Testing

Since the entire application pertains to Non-pressure (gravity flow) domain, on-field pressure testing of the installed system is not necessary. As per the relevant IS Code, each of the supplied pipe assembly need to be pressure tested at manufacturer's end for ensuring its leakage proof status as per the IS 16098 (Part 2):2013. However, for on-field acceptability, a segment wise continuity test shall be performed by the contractor in the same methodology as depicted in the CPHEEO, MoUD, GoI Manual on Sewerage and Sewage Treatment to the fullest satisfaction of the Employer/Department/Authorized Third Party (if any). The contractor shall arrange the water at his own cost for testing and other requirements.

Notwithstanding the satisfactory completion of the continuity test, if there is any discernible leakage of water from any pipe or joint, the Contractor shall, at his own cost, replace/repair the pipe or re-make the joint and repeat the hydraulic test again.

8. Flow measuring devices:

Electromagnetic Flow Meter of appropriate size shall be provided along with 8 hour Battery back-up, at inlet and outlet of the Raw water and Raw sewage pipeline and Feeder pipeline outlet at RCC Sump well; to check losses and measure the quantity of water. Reading display of all the Flow meters, along with data logging instruments should be made available at single point, wherever decided by the Engineer-in-charge.

All the Electromagnetic Flow meters shall have the same make and salient features as under.

Coil housing of the Electromagnetic flow meters of fully welded SS-316 and Flow-tube lining of PTFE / EPDM / Neoprene.

9. Technical Qualifications for procurement of DWC pipes during construction:

9.1 The Pipe manufacturer should have an annual installed production capacity of quantity equal to this TENDER.

9.2 The manufacture should have BIS License as per IS 16098:2013 Part-2 / IS 14333 1996 and accreditation of ISO 9001: 2008 for Manufacture and supply of DWC / Structured wall PE Pipe and fittings.

9.3 The manufacturer should have manufactured and supplied pipes having minimum DN/ID 150mm or above, a minimum length of 500 Km.; out of which at least 10% length (50Km.) should be of minimum DN/ID 250mm or above.

10. Technical Qualifications for Bidder:

10.1.1 The manufacturer should have required Plant, machinery and equipment to produce

- The manufacturing unit should have minimum annual installed capacity of 10000 tons *(on 3 shift basis)* to produce DWC pipes specified in the bid document.
- The manufacturing unit should be well equipped to demonstrate vital tests like Ring flexibility test, Ring Stiffness test, Creep Ratio test, Water tightness test, Tensile strength test, Felt Flow Index test, Impact test, Environmental Stress Cracking resistance test, Oxidation Induction time test etc.

11.0 Installation and Commissioning of pipes

a. Supplying, laying, jointing, testing and commissioning of pipes shall conform to relevant IS codes, as applicable.

b. The alignment of pipelines shown in drawings of the TENDER documents is only indicative and the exact alignment will be as per drawings and/or as directed by the Engineer or his representative.

c. The HDPE Pipes shall be laid in accordance with the latest BIS specifications.

12.0 Field Hydraulic Test

a. The Sectional Hydraulic Test shall be carried out after the pipeline section to be tested has been laid jointed and backfilled to a depth sufficient to prevent floatation

b. Each length of the pipeline to be tested shall be capped or blanked off at each end and securely strutted or restrained to withstand the forces which will be exerted when the test pressure is applied.

c. Proposals for testing where thrusts on structures are involved, even where thrust flanges on the piping are installed, shall be with the prior approval of the Engineer.

d. The proper method of filling the pipeline with water shall be used. The length under test shall be filled making certain that all air is displaced through an air valve or any other appropriate mechanism. The test length shall then remain under constant moderate pressure as per testing method given in the IS 7634.

e. As per IS code water required to built up allowable drop in pressure during test will be treated as a make up water.

f. The maximum allowable test pressure shall be 1.5 times the system design pressure or pipe rating which ever is higher

g. Notwithstanding the satisfactory completion of the hydraulic test, if there is any discernible leakage of water from any pipe or joint, the Contractor shall, at his own cost, replace the pipe, repair the pipe or re-make the joint and repeat the hydraulic test with cost including the cost of water.

h. Test pressures are to be measured in kg/cm2 at the centre of the blank flange situated at the lowest end of the pipeline under test. Unless otherwise specified the test pressure shall be as stated below.

13.0 INSTALLATION OF VALVES

General

The installation of valves shall be made according to the instructions of the manufacturer and the Engineer.

Installation of valves

Butterfly/Sluice valves shall be installed between flanges according to the instructions of the manufacturer.

Valves shall be placed on a support of concrete so that no shear stress is in the flanges. In case of axial thrust due to closure of a valve against pressure the valve shall be anchored in the support in a suitable manner to transfer the thrust into the floor slab of the chamber.

Air valves shall be installed on top of air valve tees.

SLUICE VALVES

DESIGN REQUIREMENT

A. Sluice valves shall generally conform to IS 14846/BS EN 1171/DIN 3352. Additionally, they should also meet specific requirement as stated.

B. Spindle, thrust collar and operating arrangement including hand wheel should be designed in such a way that one adult male is able to operate the valve against full differential pressure by exerting no more than 8 kgf effort (pull and push) on the hand wheel.

FEATURES OF CONSTRUCTION

a. Valves shall have inside screw, non-rising spindle.

b. Valves shall be with appropriate bushing arrangement for replacement of packing without leakage (350 mm ø and above), up to 350 mm ø valves shall be glanduss.

c. Valves 450 mm ø & above shall be provided with an antifriction device / ball thrust bearing arrangement to minimize friction between spindle collar and casting. These should be housed away from wet chamber and should have facility for periodic greasing.

d. Valves of size 450 mm ø and above shall be provided with enclosed, grease packed spur gear box.

e. Valves 450 mm ø and above shall be provided with a drain and air plug.

f. All valve doors when fully closed would ensure door faces are riding on body seat ring by at least 50% of the width of seat ring and there is sufficient room for wear travel. Applicable for valves 350 mm and above., up to 300 mm valves shall be resilient seated.

g. All face and seat rings will be force/press fitted and additionally riveted (300 ø & above) to the recess in the CI casting. No screws are allowed.

h. Spindle, thrust collar and operating arrangement including hand wheel should be designed in such a way that one adult male is able to operate the valve against full differential pressure by exerting no more than 80 N effort (pull and push) on the hand wheel. Only single start, square threads with a pitch not exceeding 12 mm in the spindle be used.

i. Manufacturer to give details of gear box proposed – no. of spur pair, ratio, efficiency etc.

j. Manufacturer to justify with calculation that the valve proposed is operable within the effort parameters specified and no. of turns to ensure the time required to operate the valve from full open to full close is within reasonable limits. This is a vital requirement.

k. Nominal size of the valve shall be cast on the body of the valve.

DATA :

1.	Size	:	300 mm to 1000 mm
2.	Rating (Kg/sq.cm)	:	PN 1.0
3.	Drilling	:	IS 1538 Table 4 & 6 / relevant ISO with latest amendments/ BS EN 1092-2
4.	**Material of construction**	:	
	Body	:	DI IS 1865 Gr. 500/7 ; 400/15 **or** CI IS 210 Gr. FG 200 for PN 1.0 (all sizes)
	Wedge	:	DI IS 1865 Gr. 500/7 ; 400/15 (fully rubber lived EPDM, upto 300 mm) **or** CI IS 210 Gr. FG 200 for PN 1.0
	Spindle	:	St. St. AISI 410 / 316 / relevant ISO with latest amendments
	Seat & face rings	:	Bronze IS 318 LTB II 6 / relevant ISO with latest amendments (for 350 mm above)
	Drain & air plug	:	Bronze IS 318 LTB II 6 / relevant ISO with latest amendments

Ball thrust bearing	:	SKF or equivalent
Bushing arrangement	:	Halprene on bronze
Rivets	:	Soft annealed brass
Gland packing	:	Teflon coated / graphited asbestos / hemp
Fasteners	:	Carbon Steel

SHOP TESTING :

HYDROTEST

Seat leakage	:	10 Kg/cm² (5 min) – for PN 1.0
Back seat leakage	:	5 Kg/cm² (2 min) – for PN 1.0
Body	:	15 Kg/cm² (5 min) – for PN 1.0

BUTTERFLY VALVES

a. Butterfly valves shall be of double eccentric and resilient sealed type generally as per BS EN 593, BS 5155 and IS 13095. Valves shall be installed in valve chambers. Valves shall be provided with stainless steel extension spindle so that valves can be operated from ground level and without entering the chamber.

b. Material of construction of butterfly valves shall comply with following requirements:

Item	**PN 1.0 Valves**
Body	Ductile IRON DIN 1693 – GGG40/spheriodal graphite icon IS 1865 Gr 400/12
Disk	Ductile IRON DIN 1693 – GGG40/spheriodal graphite icon IS 1865 Gr 400/12
Shaft	Stainless steel BS 970 Grade 431 S 29
Body Seat	Nickel weld overlay micro finished
Disc Seal	EPDM
Seal retaining ring	Ductile icon DIN 1693 – GGG40
Shaft bearing	Bronze with EPDM ‘O’ ring seal
Internal Fasteners	Stainless steel SS 316

Nuts, Bolts & washers for pipe flanges	Tensile steel hot dip galvanized for valve in chamber. Stainless steel SS 316 for buried valves
Coating	Internal and external with power of liquid epoxy coating with minimum dry film thickness of 250 microns

c. Butterfly valves shall be suitable for mounting in any position. The valve shall be free from induced vibration.

d. Butterfly valve shall be suitable foe bidirectional pressure testing with dead tight shut off even after long period of operation of 5 years. The valves shall be of double flanged long type.

e. The valve seal shall be of replaceable design. When the valve is fully closed, the seal shall seat firmly. The seat surfaces shall be machined smooth to provide a long life for the seal. All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.

f. The shaft shall be stainless steel with bronze or equivalent seal with self-lubricating bearings. Disc pin shall be stainless steel. Ring shall be Tender directional seal adjusting suitable for pressure and vacuum service. Removal and replacement of steel shall be possible without removing the operating mechanism, valve shaft and without removing the valve from the pipeline. Valve shaft shall be of one-piece unit extending completely through the valve disc hubs.

g. All valve spindle and head wheels shall be positioned to give access for operational personnel. Valves shall be provided with enclosed gear arrangement for ease of operation. The gear box shall be worm and worm wheel design type totally enclosed grease filled and weatherproof. The operation with gearing shall be such that they can be opened and closed by one man against an unbalanced head of 1.15 times the specified ratings. Valves and gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 200 N. The valve disc shall be 90 deg turn.

h. The disc shall be designed to withstand the maximum pressure differential across the valve in either direction of flow. The disc shall be contoured to ensure the lowest possible resistance to flow and shall be suitable for throttling operation.

i. It should be possible to open the valve with upstream pipe fully filled and downstream pipe fully empty. The shaft shall be designed to withstand the maximum torque that will be imposed by the operator. It shall be secured to the disc by tapered stainless steel cotter pins.

j. Valve shall be provided with mechanism position indicator to show the position of the disc mounted on the driven shaft end.

k. Rigid adjustable stop mechanism shall be provided within the gear box or elsewhere on the valve to prevent movement of the disc beyond the fully opened or closed position (i.e. set points).

l. Valve shall be capable of closing against the maximum flow that can occur in practice. The break way torque against maximum differential head conditions shall be within the manufacturer's limits.

m. All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

n. All hand wheels shall be provided with an internal locking device to prevent operation device by unauthorized person.

WALL THIMBLE MOUNTED CAST IRON SLUICE GATES

GENERAL :

The construction of cast iron sluice gates shall be strictly in accordance with the specifications mentioned hereunder. The Sluice gates shall be capable of performing the isolation duties in water / waste water treatment plant & pumping stations for isolation of flow in & out of a closed conduit as well as in those applications where water head is more than the height of shutter / opening. They shall be so constructed that there is no undue wear or deterioration during its operative life and so designed that the maintenance is kept to a minimum. The contractor shall provide these gates manufactured by an ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018 certified company manufacturing the underspecified product for at least 10 years. The preferred manufacturers shall be as stated in data sheet. The specification given hereunder shall supersede other specification in case given elsewhere in tender document.

DESIGN & CONRUCTIONAL DETAILS :

The sluice gates shall be manufactured generally as per IS-13349-1992 Indian standard. The constructional features and details of components of the required gates are to be as under:

GATE FRAME :

The gate frame will be made from cast iron and shall be sufficiently rigid to withstand the designated water head. The gate frame shall either be flat back type or flange back type to suit the designed head and site condition.

Back flange of the gate aperture frame to be precisely machined flat and drilled to engage with the Cast iron wall thimble mounted on the wall. A rubber gasket will be provided between the wall thimble and the gate for ease in future dismounting of the gate for repairs / replacement and seal any leakage between the flange of frame and wall thimble.

The gate frame of these sluice gates shall either be self contained type or non self contained type depending upon site requirement. In case of non self contained gates the frames shall have short length extension guides and shall be without yoke at their top. The length of extension guides in such cases shall be sufficient to engage atleast half the overall vertical height of door when the gate is full open and shall be in accordance with the relevant provisions of IS-13349. In case of self contained gates the frames shall have full length extension guides and shall be provided with a yoke at their top. The length of extension guides in such cases shall be sufficient to engage the overall vertical height of door when the gate is full open position.

WALL THIMBLE :

The Wall thimble will be made from cast iron for placement in the concrete wall. Its front flange will be machined, drilled and tapped to match with the frame flange.

The cross section of the thimble shall be F shaped and the depth of thimble shall be maximum 300 mm long or lesser in case wall thickness is less than 300mm. Gates subjected to high unseating heads shall have thimble cross section shaped E.

To permit entrapped air to escape as the thimble is being encased in concrete, cast holes of 40mm diameter shall be provided at the bottom of wall thimble in each entrapment zone.

GATE SLIDE / SHUTTER / DOOR :

The gate slide / shutter / door will be made from cast iron and shall be sufficiently ribbed to withstand the designated water head.

The gate slide / shutter will be provided with integral pocket to house the thrust nut used to connect the stem with the slide.

SEATING/SEALING FACES :

Materials : These should be of Stainless steel or Bronze or as specified.

Fitment : The facings shall be attached to Plain machined surfaces / rectangular grooves of gate frame and door, depending upon the applicable water head, and be secured in place using taper screws. The taper screws adopted for facings shall be of same material as that of the seat facings.

The front faces of integral extension guides which can come in contact with the sealing faces of door while opening, shall also be fitted with sealing faces of the same material as that of the sealing faces on door. This is required to offer non corroding smooth sliding surfaces to the sealing faces of door/shutter during its vertical travel for opening and enhance the effective life of gate.

Finish : The mating seating/sealing faces on the gate frame and door shall be precisely finished for proper contact. They should be so finished that the clearance or gap, if any, between the mating sealing faces, in gate closed position, does not exceed 0.1mm.

WEDGING DEVICES :

The Sluice gates shall be provided with individually adjustable wedging devices to ensure forced contact between frame and shutter seat facings, when the gate is in closed position.

The gates meant for seating head shall be provided only with side wedging devices. Gates meant for higher unseating head of sizes larger than 600 mm, shall be provided with side, top and bottom wedging devices or with side and top wedging devices and flush bottom closing arrangement as required.

The wedging devices comprise of wedge brackets fitted on gate aperture frame and door. The wedge bracket on frame shall remain in fixed position and those on door shall be adjustable or vice versa. A sort of slot and tennon arrangement shall be provided on base of wedge brackets to prevent any tendency to shift. Provision shall be made to clamp the adjustable brackets firmly in adjusted position.

The wedging devices shall be made of cast iron. If the wedges/wedge blocks of wedging devices are of Cast Iron, then these are to be lined with contacting faces of the same material as that of sealing faces attached to the gate frame and door.

CONVENTIONAL OR FLUSH BOTTOM CLOSING :

The sluice gates shall be provided with conventional or flush bottom closure arrangement as required.

The sluice gates provided with conventional bottom closing arrangement involve corrosion resistant metallic contacting sealing faces at the bottom sill of gate. In such cases, the invert of the gate is required to be kept above the floor of the channel / chamber by at least 200mm to 300mm depending upon the size and type of gate. The contractor should verify whether this clearance is available at the site of installation for fitting a conventional bottom closure gate.

In case of conventional closing gate, if the invert of the gate is kept at the same level as that of the channel/chamber floor, then there remains a slot or a groove at the invert of the gate. Debris, dirt etc. which may settle in this slot and may not allow the gate to close properly and this may give rise to heavy leakages while in operation. With a view to avoid this, in situations where the invert of the gate is to remain at the same level as that of the channel/floor, a Flush Bottom closing gate instead of Conventional Bottom Closing gate should be provided.

Flush Bottom Closing shall involve a flexible rubber seal at the bottom of the gate, mounted either on the shutter or on the frame, ensuring that the sealing face remains flush with the floor. The cast iron bar fitted at the bottom of the frame is required to be embedded in the channel / chamber floor and for this a cut out / recess of ample dimensions is required to be provided beneath the waterway opening along the gate invert, while constructing the floor. The dimensions of this cut out shall be provided depending upon the feasibility to do so as per actual site conditions.

This cut out/recess is to be later on filled up with removable asphalt or loose concrete mixed with sand/saw dust or vermiculate after putting the gate in position so that it is possible to break open this second stage grout for removal of the gate in future.

The rubber seal employed shall be made of EPDM or Neoprene rubber and the rubber seal retainer bar as well as the fasteners for fitting the rubber seal and the retainer bar are of cast iron.

GATE OPERATING HEADSTOCK/LIFT MECHANISM :

The operating headstocks shall be designed in such a manner as to permit the gate operation by a single person under the specified maximum operating head with an effort of less than 18kgs on the crank / handwheel.

The headstock may be ungeared or geared type, as might be necessary to make it convenient for one person to open or close the gate as fast as practicable.

Geared headstock shall be supplied with easily removable crank handle or handwheel with a radius not exceeding 375mm.

All the gears of geared headstock shall be kept completely encased in cast iron housing to protect them from damage, dirt, dust, water etc. and other atmospheric effects and thus ensure their smooth operation. Grease nipples shall be provided at proper places for lubricating with grease.

Headstock meant for mounting on operating platform shall be supplied with a pedestal/floor stand to provide a convenient operating height of approximately 900 mm. The pedestal of the headstock shall be provided with a covered window opening to enable cleaning and greasing of stem threads.

LIFTING SPINDLE/STEM :

The sluice gates shall be supplied with Rising type lifting spindles/stems. The stem shall be provided with acme / square threading, length of threaded portion being about 400 mm more than the height of waterway opening. This much extra length is required to allow for a minor variation of approximately 100mm on either side of the specified height of operating platform.

The design of stem will be done as per the provision in IS-13349.

STEM BLOCK / CONNECTING BLOCK / THRUST NUT :

The rising type stem shall be connected to the door through a stem block/thrust nut housed in a ribbed pocket cast integral with the door. The bottom end of stem shall thread into the stem block and is locked in place by a set screw to prevent the stem from unscrewing. The Stem block shall be cast bronze or Gunmetal.

SAFETY STOP NUT :

The stem shall be provided with a safety stop nut to prevent the chances of over closing of gate which may otherwise damage either the stem or the lifting platform. The stop nut shall be furnished with a set screw for setting it in a fixed position after the gate is installed. Upon installation the safety stop nut should be set in such a way that its bottom remains about 1 to 2 mm away from the top of headstock, in gate closed position.

In case of stainless steel stem, the stop nut shall also be of stainless steel material of the same grade.

STEM/SPINDLE COUPLINGS :

For ease in transportation and handling, maximum length of one piece stem shall be restricted within 5 meter length. Where the stem are required to be furnished in more than one piece, threaded stem couplings shall be furnished to interconnect different sections of the stem. The couplings shall have provision for pinning after inserting in the threaded end of the stem.

In case of stainless steel stem, the couplings shall also be of stainless steel material of the same grade.

STEM GUIDE BRACKETS :

Longer stems shall be provided with sufficient number of stem guides to prevent buckling of stem. The stem guide bracket to be provided shall be Adjustable Channel Type - wherein a separate stem guide is bolted on to the wall bracket. The stem guide shall be adjustable in the slots on wall bracket in a direction perpendicular to the face of wall. Wall bracket should also offers minor adjustment in the direction parallel to the wall.

The stem guides shall have machine bored split journals to facilitate erection. The journal shall be lined with brass/gunmetal bush.

PIPE HOOD FOR STEM :

A Pipehood shall be provided on the top of headstock in case of rising spindle/stem gates to cover the spindle threads for protection against damage, dirt, dust, water etc. It shall be made of transparent fracture resistant polycarbonate material. The pipe hood shall have vent holes to prevent condensation.

GATE OPENING INDICATING ARRANGEMENT :

In case of manual operation, Gate opening indicating arrangement shall be provided to indicate the position of the shutter.

MATERIAL OF CONSTRUCTION:

The material of construction for various components shall be as under.

Gate frame, Shutter, Thimble,	: Plain Cast iron IS 210 FG 200
Wedge Blocks	: Plain Cast iron IS 210 FG 200
Seating faces, Wedge Lining	: Stainless Steel ASTM A 240 type 304*
Rubber Seals (If applicable)	: EPDM Rubber to ASTM D 2000
Rubber seal retainer bar (If applicable)	: Plain Cast iron IS 210 FG 200
Assembly bolts, nuts and fastener	: Stainless Steel ASTM A 276 type 304
Stem/Spindle & Stem Coupling	: Stainless Steel ASTM A 276 type 304*
Yoke (If applicable), Stem Guide Bracket	: Mild Steel to IS: 2062 grade A/Br, Epoxy Painted
Stem Block / Thrust nut	: Stainless Steel ASTM A 276 type 304
Pillar, Stem Guides	: Plain Cast iron IS 210 FG 200
Lift nut	: Leaded Tin Bronze IS 318 Type LTB-2 /As per Gear Box Make/ Actuator Make
Pipe hood /Stem Cover	: Polycarbonate / MS galvanized pipe

* Positive Material Identification (PMI) test to be carried out for these components at manufacturer works during the inspection.

PAINTING: Following painting procedure shall be adopted for the gates:

Surface Preparation: Blast clean to near white metal finish.

Priming: 1 coat of epoxy primer before and after shop testing.

Finish Painting for gate assembly: Black coal tar epoxy paint. Minimum DFT 250 microns inclusive of priming.

Painting for headstock pillar/bench/thrust plate/Yoke: Epoxy red oxide primer and epoxy Grey paint. Minimum DFT 150 microns inclusive of priming.

SHOP TESTING: Following shop tests at manufacturers place will be conducted.

Movement Test:

Movement test should be conducted in horizontal/vertical assembled condition using stems & headstock. The gate should be operated once from full close to full open and back to full close condition with a max. force of 135 Newton-meter on the crank or hand wheel.

Shop leakage test:

Shop leakage test by applying unseating hydraulic pressure will be conducted at manufacturer's shop with gate mounted vertically on a test bench. A hydrostatic pressure equal to maximum seating/unseating head shall be applied to gate at centre line of gate opening from the back, ie. Unseating face of the gate in closed position, through pump. A suitable scaled calibrated pressure gauge put on the unseating face of the gate shall indicate reading equal to unseating pressure head. Water leakage through the gate under above condition shall be collected in a collection pan and measured. The leakage so measured should not exceed the limit of 2.5, 3.5 and 4.5 lpm per meter sealing perimeter for class-1, class II and class III sluice gates as stated in the IS:13349-1992.

No alternate testing arrangement will be permitted in place of above method. Gates can be applied with a coat of primer to prevent rusting due to water exposure during testing.

Hydrostatic Body test:

After the leakage test Hydrostatic body test will be conducted at manufacturer's shop. A hydrostatic pressure equal to 1.5 times the maximum operating head should be applied on the gate for 5 minutes continuously. No permanent deformation in casting should be observed.

Torque test at operating Head:

Torque test at operating head would be conducted at applicable head at manufacturer's shop for gates up to 2000x2000 mm size.

Dimensional Check:

Important Dimensions shall be checked with reference to approved GA drawing.

Seat clearance check:

With the gate in closed condition 0.1 mm thick feeler gauge should not pass through between seat facings.

Material Test Certificates:

Positive Material Identification (PMI) test to be conducted for Sealing / Seating Faces & Stem / Spindle during the inspection.

CAST IRON OPEN CHANNEL GATES

GENERAL: The construction of cast iron open channel gate shall be strictly in accordance with the specifications mentioned hereunder. The open channel gate shall be capable of performing the isolation duties in water / wastewater treatment plant for those applications where the height of water is at least 300 mm less than the height of opening / shutter. They shall be so constructed that there is no undue wear or deterioration during its operative life and so designed that the maintenance is kept to a minimum. The contractor shall provide these gates manufactured by an ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018 certified company manufacturing the underspecified product for at least 10 years. The preferred manufacturers shall be as stated in data sheet. The specification given hereunder shall supersede other specification in case given elsewhere in tender document.

DESIGN & CONSTRUCTIONAL DETAILS: The open channel gate shall comprise of frame suitable for mounting in the parallel side walls of the channel. The frame shall be self-contained type with a yoke on top for mounting of the operating arrangement. The shutter shall move within the frame guides and shall be provided with suitable connecting arrangement to enable connect it to the spindle.

Water sealing on sides and bottom shall be affected by means of non-corroding seating faces secured in groves of frames and remaining in forced contact wit h corresponding sealing arrangement mounted on shutter. Bottom sealing arrangement shall be flush bottom type to ensure that invert level of channel on either side of gate remains flush with the invert of the gate.

The spindle shall be rising type and provided with stop nut to avoid over closing of gate. The rising spindle shall be provided with transparent scratch proof and UV resistant polycarbonate cover tube to protect the threaded portion from the effect of dust, dirt, and rain. The operating arrangement shall be manual or electric as specified elsewhere in the tender specifications. In case of manual operation operating mechanism should be such that the effort required to open / close the gate does not exceed 18 kgs with diameter of hand wheel / crank restricted to max. 750 mm.

MATERIAL OF CONSTRUCTION:

The material of construction for various components shall be as under.	
Gate frame, shutter/Door	: Plain Cast iron IS 210 FG 200

Side Guides	: Plain Cast iron IS 210 FG 200
Seating faces	: Stainless Steel ASTM A 240 type 304*
Rubber Seals	: EPDM Rubber to ASTM D 2000
Rubber seal retainer bar	: Stainless Steel ASTM A 240 type 304*
Assembly bolts, nuts, and fasteners	: Stainless Steel ASTM A 276 type 304
Stem & connecting pin	: Stainless Steel ASTM A 276 type 304*
Yoke	: Mild Steel to IS: 2062 grade E250 A/ Br, epoxy painted
Headstock	: Plain Cast iron IS 210 FG 200
Spindle cover tube / pipe hood	: Polycarbonate

* Positive Material Identification (PMI) test to be carried out for these components at manufacturer works during the inspection.

PAINTING: Following painting procedure shall be adopted for the gates:

Surface Preparation: Blast clean to near white metal finish.

Priming: 1 coat of epoxy primer before and after shop testing.

Finish Painting for gate assembly: Black coal tar epoxy paint. Minimum DFT 250 microns inclusive of priming.

Painting for headstock pillar/bench/thrust plate/Yoke: Epoxy red oxide primer and epoxy Grey paint. Minimum DFT 150 microns inclusive of priming.

KNIFE GATE VALVES

GENERAL:

The construction of Knife gate valves shall be strictly in accordance with the specifications mentioned hereunder. The Knife gate valves shall be capable of performing the isolation duties in wastewater treatment plant & pumping stations. These shall be suitable for use at suction and delivery side of pumps as well as in branch lines in sludge handling application of treatment plants and pumping stations and shall be so constructed that there is no undue wear or deterioration during its operative life and so designed that the maintenance is kept to a minimum. The contractor shall provide these valves manufactured by an ISO: 9001-2008 certified company manufacturing the underspecified product for at least 5 years. The preferred manufacturer shall be as stated in data sheet. The specification given hereunder shall supersede other specification in case given elsewhere in tender document.

DESIGN & CONRUCTIONAL DETAILS :

The Knife gate valves shall be manufactured generally as per the latest AWWA C520-14 standard. The valve should be bonneted up to 600 mm size and bonnetless for higher sizes. Valves should be lug type construction up to 600 mm size and full flanged construction for higher sizes. The valves should be provided with flange drilling suitable to mount between flanges as per ANSI B 16.5 150# with raised face or DIN PN10 or IS 1538-1993 Table VI.

Other constructional features and details of components of the required valves are to be as under:

The valve body should be of Cast ductile iron construction as specified. Valves up to 600 mm size should be designed to withstand 10 bar pressure and valves above 600 mm size should be designed to withstand 4 bar pressure generally applicable in sewerage pumping stations and treatment plants. If the line / system pressure is more than 4 bars, then valve design / material of construction should be suitably modified to meet this requirement when specifically pre-informed by the client.

The valve should be provided with gate made of stainless steel of grade as specified and the gate should have bevelled knife edge at the bottom to cut through and easily enter in the solids settled in the bottom and ensure positive shut-off / closure in sewage environment.

The Valve should be designed for sealing in uni-directional flow application.

The valve should be provided with replaceable type flexible sealing arrangement to offer drop tight shut off. The seals should be made of EPDM rubber and should be held in place by an easily removable type of seal retainer ring. The sealing system should be field replaceable at site.

The valve housing should have integral as cast tapered lugs provided for pushing the gate towards the flexible rubber seal only at the verge of closure with a view to avoid seal wear and achieve drop tight shut off. The surface of the gate coming in contact with the seal should be polished & buffed.

The bonneted valves up to 600 mm size shall have glandless design to avoid repeated tightening / replacement of gland packing. The stuffing "O" ring seal should be pressurized by thrust washer from both the sides and should be pressurized / tighten by thrust retainer nut.

The bonnet-less valve above 600 mm size shall be provided with sufficient ply of gland packings in the in-built stuffing box to seal the rear opening. The packings should be of graphited synthetic yarn to reduce the friction and offer higher life. Provision shall be made to enable tighten the gland packing by means of a pusher arrangement to minimize the leakage through the back of the valve. Replacement of gland packings should be possible in installed condition of the valve without there being line pressure.

The spindle should be double start / single start and non-rising type for compact & safe operation. Gate opening indicating arrangement should be provided to find out the extent of gate opening /closing.

The operation of the valves shall be manual / motorized as specified elsewhere in the tender specification.

In case the valve is to be operated from a far then it shall be provided with joining couplings, extension spindle, spindle guides and mounting pedestal with suitable anchor bolts / anchor fasteners on the platform.

MATERIALS OF CONSTRUCTION:

The material of construction for various components of valves shall be as under.	
Body	: Ductile iron to BS 2789 Grade 420/12
Seal Retainer ring	: Stainless steel to ASTM A351 Gr CF: 8
Inlet Seal / Rubber Seals / O rings	: EPDM Rubber
Knife gate	: Stainless Steel ASTM A 240 type 304
Spindle	: Stainless Steel ASTM A 276 type 304
Assembly bolts, nuts and fastener	: Stainless Steel ASTM A 276 type 304
Spindle nut	: Brass/DI
Bracket / Adapter plate	: Mild Steel to IS: 2062 grade A, Epoxy Painted
Packing	: Synthetic yarn with PTFE

PAINTING : Following painting procedure shall be adopted for the valves :

Surface Preparation: Blast clean to near white metal finish.

Finish Painting: Suitable coats of epoxy paint to achieve minimum DFT 100 microns inclusive of priming. Primer painting / pre-painting before leakage testing shall be allowed.

AIR VALVES

A SCOPE AND GENERAL DESIGN FEATURE

This section covers the requirements of double orifice type air valves with tamper proof cover to be used for evacuation of accumulation of air in water mains under pressure, for the exhaust of air when such mains are being charged with water and for inlet of air when they are emptied of water.

The working pressure of the air valves shall be 10 kg/cm^2 (PN 1).

B FUNCTION

Automatic air valves generally conforming to IS 14845 / relevant ISO with latest amendments are to be used for evacuation of accumulated air in water mains under pressure, for the exhaust of air when such mains are being charged with water and for ventilating the mains when they are being emptied of water.

C DESIGN FEATURES

a) Air valves shall be double orifice type and tamper proof unless otherwise directed by Engineer. A buoyant rigid float shall seal the large orifice and the chamber housing shall be designed to avoid premature closing of the valve by the air whilst being discharged. Small orifice shall discharge small air volume during operation under full internal pressures. All air valves shall be provided with isolating sluice valves and flanged end connection.

b) The valve shall be capable of exhausting air from pipe work automatically when being filled, the air being released at a sufficiently high rate to prevent the restriction of the inflow rate. Similarly the valve shall be capable of ventilating pipe work automatically when being emptied or under water hammer condition, the air inflow rate being sufficiently high to prevent the development of a vacuum in the pipelines. The valve shall also automatically release air accumulating in pipe work during normal working conditions.

c) The valves shall be designed to prevent premature closure prior to all air having been discharges from the line. The orifice shall be positively sealed in the closed position with the float only raised by the liquid and not by a mixture of air and liquid spray. The seating shall be so designed to prevent the float sticking after a long period in the closed position.

d) Air valves shall thus be designed to automatically operate so that they will;

- Positively open under internal pressure less than atmospheric pressure to admit air in bulk during pipeline draining operation;
- Exhaust air in bulk and positively close as water, under low head, fills the body of the valve during filling operation;
- Not blow shut under high velocity air discharge; and
- Exhaust accumulated air under pressure while the pipe is flowing full of water.

D CONSTRUCTION FEATURES

Material of construction of air valves shall comply with following requirements:

a) All air valves shall be constructed so that internal working parts which may become necessary for repairs shall be readily accessible, removable, and replaceable without used special tools and removing the valve from the line.

b) Valves with air intake or exhaust facilities shall have an integral protecting cover top shall be supplied to prevent dirt and debris from entering the outlet of the valve.

c) The contractor shall verify with the supplier of the valves that the valves have the capacity to sustain the pipeline test pressure prior to testing. In the event that the valves do not sustain the pressure they shall be removed and the stub pipes from the main pipeline blanked off before pressure testing the pipeline.

E DATA

a)	Valve size	:	300 to 1000 mm dia
b)	Suitable for max. differential pressure (kg/cm^2)	:	10
c)	Material of construction		
	Body and cover	:	CI IS 210 Gr FG 200 **or** SG iron 1865 Gr 400/12 or grade GGG40
	Float	:	Rubber coated timber **or** Polycarbonate up to 50 NB/ SS 304 above 50 NB
	Internal Linkages	:	SS 304
	Seat Ring	:	Dexine (Nitrile Rubber) or bronze seat
	Isolating Sluice Valve	:	Generally conforming to IS 14846/relevan ISO with latest amendments
	Spindle for Sluice Valve	:	St. St. AISI 410
	Bolts & Nuts	:	M.S.

TESTING AND PERFORMANCE

a) When tested as per clauses 11.6.d.1, the air passage and the function of ball floats in a valve shall be satisfactory, and the valve shall work smoothly.

b) Hydrostatic test of valve body, when tested in accordance with 11.6.d.4 there shall be no leakage through pressure sustaining components and joints. There shall be no permanent deformation of any part.

c) Valve seat and cock, when tested in accordance with 11.6.d.2 and 11.6.d.3 shall not show any leakage.

d) Function and Performance Test

d.1 The valve shall be fitted on a test bench. The pressure of the water in pipe shall be developed to working pressure, and the main valve shall be gradually opened to check the air release and float function. Compressed air shall then be slowly put into the valve through underside of the valve, and check the function of floats.

d.2 High Pressure Orifice Seat Test

Subsequent to high pressure orifice performance test, hydraulic pressure shall be reduced upto half of the working pressure to check leakage of orifice seat for a duration of three minutes.

d.3 Low Pressure Orifice Seat Test

Subsequent to high pressure orifice performance test, hydraulic pressure shall be reduced upto half of the working pressure to check leakage of orifice seat for a duration of three minutes.

d.4 Body Test

The valve body (without cover and ball floats) shall be covered by a blank flange, keeping isolating valve open. Hydrostatic pressure of 1.5 times the pressure class of the valve shall be applied for duration of 5 minutes to check the water tightness of the body.

Kinetic Double Air Valve

The valve shall be capable of exhausting air from pipe work automatically when been filled. Air being released at a sufficiently higher rate to prevent the restriction of the Inflow rate. Similarly, the valve shall be capable of ventilating pipe work automatically when being emptied. The air inflow rate being sufficiently high to prevent the development of a vacuum in pipeline. The valve shall automatically release air accumulating in pipeline work during normal working condition. Air valve shall be of double orifice type with a large orifice for ventilation for exhaust of the pipeline and small orifice for release of air under working pressure. The valve shall be suitable for maximum working pressure in the system. All air valves shall be provided with isolating sluice valve and flanged end connection. Air valve shall be designed to prevent premature closure prior to all air having been discharge from the line. The orifice shall be positively sealed in the close position, but float (Ball) shall only be raised by the liquid and not by mixer of air and liquid. The sealing shall be designed to prevent the floats striking after long period in the close position. All branched outlets including outlets for Air valves will be with compensation pads (Dia of Main / For branch Dia ratio greater than 3). Diameter of compensation pad will not be less than 1.75 times the O.D. of the branched outlet. Plate thickness for pads will be same a that of the main. For outlets with above ratio less than three, then the joints will be of plate reinforcement type. The aperture of valves must be properly designed for which the contractor shall submit design calculations for necessary approvals before the procurement of valves. The air valve should be as per IS: 14845 of minimum PN 1.0 rating.

All branched outlets including air valve tee's will be provided with one 15mm BSP coupling duly plugged for measurement of pressure in due course. The closing plug will be in Stainless Steel (AISI 304 or equivalent) with Hex. Head. and will be provided with copper washer for sealing. All flanges will be drilled as per I.S. 1538.

The gaskets shall be of nitrile rubber.

DI Air Valve

Single chamber, double orifice DI Air Valve with double function (Venting and admitting), Tamper proof in one piece construction (Both Large and small orifice housed in the housing itself), with capacity to handle air up to sonic velocity (300 m/s), with flange dimension acc. To EN 1092-2/ IS 1538. Body and cover in ductile cast iron of grade GGG 40. All internal parts such as float, shell etc & all cover bolts of austenitic alloy steel and DN 50 float of HOSTAFLON and gaskets and seals of EPDM approved for anti-bacterial which is

mandatory for drinking water, with Electrostatic epoxy powder coating (EP-P) inside and outside color blue RAL 5005 with minimum coating thickness of 250 microns. The EPDM rubber & Epoxy Powder should be approved by W 270. it is a resicoat powder approved for drinking water application, applied through fusion bonding technology process by dipping the shot-blasted casted components heated up to 200 deg C).

Material of Construction

Body: Ductile iron to EN-JS 1030 (GGG-40)

Bonnet/Cover : Ductile iron to EN-JS 1030 (GGG-40)

Float: Stainless steel (ASTM A240 Grade 316 Ti/AISI 316 Ti); DN 50 float of Hostaflon- Polypropylen

Shell Body : Stainless Steel(ASTM A240 Grade 321/AISI 321)

Shut off Device & Ring : Stainless Steel(ASTM A240 Grade 321/AISI 321)

Gasket & Seal : EPDM Rubber [Grade- W 270]

Lead Screws : Stainless Steel (ASTM A194 Grade 303/AISI 303)/ (ASTM A194 Grade 304/AISI 304)

Cylindrical Screw: Stainless Steel(AISI 304/A2-70)

Surface Protection : Electrostatic epoxy powder coating min. 250 microns thickness, color RAL 5005 Blue

The Air valve should be able to seal at as low as at 0.3 bar which should be demonstrated at test bed.

14 VALVE CHAMBERS

Valve chambers shall be constructed according to the typical drawings suitable for the respective valve and special arrangement if any shall be approved by Engineer. They shall be constructed in brick masonry as shown in the drawing. The chambers shall be constructed after the laying of the pipes and the assembly of specials and valves. The size of the chambers shall be according to the following criteria/ as per direction of Engineer.

- Minimum distance of flanges from walls : 45 cm
- Minimum distance of sockets from walls : 45 cm
- Minimum distance between highest point of equipment and roof slab : 30 cm
- Maximum distance between highest point of equipment and roof slab : 50 cm

Pipes passing through walls should be coated by two layer of soft material (Hessian felt) to allow for differential settling and longitudinal expansion if directed by Engineer. Only metallic pipes may be cast into the walls for anchoring purposes.

The work shall include excavation, consolidation, leveling, lean concrete as per drawing in foundations, finishing, refilling. It shall include all labour and material required for the complete chamber.

15 DISMANTLING JOINTS

Double flanged Dismantling joints shall be of Cast Iron in such a manner that valves (300 mm and above dia) can be dismantled without stress to the joints. These shall be for working pressures of 10 kg/cm2 (1 Mpa) and shall be completely leak proof with proper gasket arrangement. Flange dimensions shall conform to IS 1538 (part I to XXII). Flanged specials shall be supplied with required nuts, bolts and rubber gaskets. The nuts and bolts shall be of best quality carbon steel, machined on the shank and electro-galvanized. Rubber gasket shall be as per IS 5382. Dimensions and drilling of flat gasket will be as per IS 1538 : 1993, suitable for making flanged joint. The dismantling pieces shall provide minimum clearance of + 25 mm (total distance 50 mm. The dismantling joint shall be internally and externally coated with hot applied (dip) bituminous paint.

16 THRUST BLOCKS

The thrust blocks shall be of plain/reinforced cement concrete on site as per design and drawings to be given by the Contractor and approved by the Engineer In Charge. The thrust blocks shall be cast directly against the undisturbed soil.

17 BALL VALVES

End connection for ball valve shall be screwed / flanged end based on valve size.

Material of construction for Cast Steel Valves

Body	ASTM A 216 Gr WCB
Ball	ASTM A 276 Type 304

Stem	AISI-410
Seat Ring	PTFE
Seat	PTFE
Lever	Steel with PVC sleeve
Studs	A 193 Gr.B7

Material of construction for Stainless Steel Valves

Body	ASTM A 351 Gr CF8
Ball	ASTM A 276 Type 304
Stem	ASTM A 276 Type 304
Seat Ring	PTFE
Seat	PTFE
Lever	Steel with PVC sleeve
Studs	A 193 Gr.B7

Actuator

Type	Motorized type
Power Supply	415 +/- 10% / 3 / 50 +/- 5%
Actuator stator	Non Integral type
Motor type	AC electric motor with engage/ disengage clutch mechanism of the dry type, anti-condensation heater & weather proof.
Motor rating	As per design
Limit switch mechanism	2 Nos. for valve open & close position, 2 Nos additional contacts, cable entry (3/4" electrical treading), 2 NO + 2 NC of 3A, 230 V AC with mounting bracket
Torque switch mechanism	2 Nos. - One for closing direction and one for opening direction
Torque rating	1.5 times of Max valve torque
Accessories	Local OFF remote switch with pad locking facility 3 set of auxiliary limit switch for each direction
Contact Ratings	Continuous
Position indicator	Required
Manual Over ride	Lever up to 150 NB/ Gear for 200 NB & above.
Lockable cover	For local controls
Make	As per approved vendor list
Opening Time / Closing Time (Gate)	Max. 1.5 to 2.0 min.

Opening Time / Closing Time (Valves)	100 NB to 400 NB = 30 sec. 500 NB to 600 NB = 60 sec More than 600 NB = 90 sec.

Interception & Diversion Works

a. General

i. Design and Engineering

The Contractor shall execute the basic and detailed design of Sewerage Network and/or I&D Works and allied structures and its execution in compliance with the technical specifications and requirements contained in the contract, codes of practices as published by the Bureau of Indian Standard (BIS) or its equivalent standard as well as the latest version of "Manual on Sewerage and Sewage Treatment" as published by the Central Public Health Engineering Organization (CPHEEO) of the Ministry of Urban Development, Government of India, New Delhi (draft or approved but whichever is latest). Wherever, the codes, standards and manual do not provide for the design and execution of some component i.e. required to be designed and executed, the contractor shall follow the standard engineering practices as approved by Competent Authority.

The Engineer in charge shall review the designs of the Sewerage Network and/or I&D Works based on the alignment suggested by the concerned ULB. The changes in the suggested that include technical; allowed alignments etc shall be considered only due to compelling site conditions or unforeseen technical reasons, subject to the approval of the competent authority.

ii. Codes and Standards

Wherever references are made in the Contract to codes and standards, in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards 30 days prior to the Submission Deadline shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied after approval by the competent authority or its representative.

iii. Design Responsibilities

The contractor's design and design-related services shall include, but not limited to the following:

1. A confirmatory topographical study covering the proposed sites and the network alignment. Survey drawings are to be submitted in hard and soft copy to the Competent authority and Engineer in Charge;
2. [Investigation and assessment of the design requirements taking into cognizance of the indicative results of the Asset Condition Assessment Study]
3. Site investigation and data collection including geotechnical assessment and soil analysis for the design and construction of the structures required for the Sewerage Network and/or I&D Works;
4. Contractor uses the population data/ projections for future supplied; and per capita wastewater production assumptions by the engineer in charge. Selection, adoption and detailed engineering designs for the most appropriate techno economically feasible cost effective pumping configuration, network alignment and network installation process ensuring that the sewerage system meets with the standards prescribed by the NGT/ MOEF / CPHEEO / CPCB as may be applicable. The hydraulic designs use computer based approved/ proven software.
5. Selection, adoption and detailed engineering design for the sections of the Existing Sewerage Network and/or I&D Works, wherever required, to integrate with the new network

system and/or I&D Works. Usefulness of existing network will be conducted through a conditional assessment where engineer in charge will also participate. Decision regarding the condition assessment shall be communicated by ULB within 15 days after submitting complete condition assessment report by the contractor.

6. The preparation of Hydraulic Flow Diagram (HFD) / schematic / preliminary design documents to illustrate the scale and character of the Design-Build Services and how the units of the process-adopted functionally relate to each other;

7. Preparation of design development documents, based on the approved HFD /schematic design documents accepted by the engineer in charge, consisting of drawings and other documents appropriate to the size of the Pumping Stations to describe the units and character of the entire proposed plant including architectural, mechanical, civil works, and electrical systems, materials, operations, landscaping, and such other elements as may be appropriate;

8. The preparation of Design-Build Documents setting forth in detail the requirements for construction based on the design development documents accepted by the Engineer in Charge;

9. The Contractor shall provide support to the ULB in preparing the required documents as well liaise with the concerned issuance authority/Department/officials, towards obtaining all approvals, permits, including building permits, and licenses for the Design-Build Services, necessary compliances with occupational health and safety requirements etc. which are explicitly required to be obtained under the Applicable Law.

10. The Contractor shall provide the “As-built” drawings for all the components of I&D in detail to the Engineer In charge.

11. The contractor must considering all the environmental aspects, flood condition of the town, type of soil in Nallah / Drain embankment and Bed, while designing the interception & diversion and other allied works.

Chapter 3

SPECIFICATION FOR CONSTRUCTION OF R.C.C. SUMP

1. PREAMBLE:

The work comprises of construction of Sump well at various locations and at Sewage treatment plant

2. Scope of work:

Seven RCC sumpwell as mentioned in Description of work is to be designed and tested on Lump sum contract.

The work includes the following sub work:

i. Investigation and testing for foundation.

ii. Design and drawing of the structure.

iii. Construction as per approved designed and drawing.

iv. Providing and fixing of pipes, valves and other appurtenances.

v. Testing of the structure for the water tightness and stability.

All materials required for satisfactory completion of the work such as cement, steel, pipes, specials and valves shall be procured by the contractor himself. The water required for construction shall be arranged by the contractor but that required for testing and handed over to the department within the time period specified in the Notice inviting TENDER.

3. LOCATION OF WORK:

Sump well site: ……..

4. GENERAL REQUIREMENT:

4.1 The foundation of the structure should be taken down sufficiently below the average ground level for safe transfer of load to undisturbed formation. The strata chart of test pit, taken at this site is enclosed as Drawing. No.3 for general information only Suitable Soil test should be carried out by the contractor through Govt. Engineering college or any other recognized laboratory to ascertain safe bearing capacity of the soil for design purpose.

4.2 The specification laid down in the letter TC No. 236 dated 21.05.97 issued by Engineer-in-Chief PHED M.P. Bhopal be strictly followed.

4.3 The type of foundation should be suiting to the determined safe bearing capacity of the soil and shall be designed accordingly. The excavation shall be done in all sort of strata and if blasting is required, the contractor shall obtain permission from the competent authority and all rules regarding safety shall be followed.

4.4 The tanks can either be rectangular or circular is shaped supported over column staging but the location plan of the columns should permit utilization of spacing underneath fully for construction of office/staff building.

4.5 The capacity of the tanks specified in para 2.0 above shall be between the outlet level and the full tank level. The maximum depth of water in the tanks should not be more than 4.0 m. The outlet level should be kept minimum 0.15m above the tank floor level. A free board of 0,5m should be provided below the lowest surface of the roof slab or beam. The inlet level should be 0.10m above the full tank level. The scour level should be kept flush with the floor slab.

4.6 A RCC doglegged staircase 1.2m wide shall be provided from ground level to upto the top of the tank. The staircase should have straight flights with intermediate landing at bracing levels. The rise of the stairs shall not be more than 25cm. The staircase should have railing on both sides comprising of 1.2m high GI medium class pipe of 80 mm dia posts, 1.5 to 1.6m apart and medium class 20mm dia I pipes in three rows. The GI pipes posts and the railing pipes (class medium) should be secured adequately.

4.7 A RCC gallery 1.2m wide all around the tank at vertical wall ring beam level should be provided to facilitate inspection, cleaning and painting of the tank. A railing comprising of medium class 80m dia GI pipes posts 1.2m high rigidly fixed in the gallery slab at 1.5m maximum spacing with 3 rows of 20mm GI pipes (Class medium) should be provided. The gallery should have access from the staircase, A steel door shall be provided at the entrance to the gallery or at the far end of the RCC staircase to prevent unauthorized entry.

4.8 RCC ladder properly supported from tank wall with hand rails 0.45m in width should be provided outside of the tank from gallery of top of roof slab. The RCC ladder shall have at least one landing in between gallery and roof top and. Mild steel ladder, from the manhole in the roof slab to floor slab, inside of the tank to facilitate inspection and cleaning. These ladders should be of MS plates 65mmx10mm size with 20mm dia round bars fixed at 0.25 centers by holding and welding to MS plates. The insides ladder should be properly supported in the mid span for rigidity.

4.9 An apron of cement concrete 1:2:4 i.e. M-15 mix should be provided for an area which is 1.5 meter more the dimension of the tank of all sides having 100x100 mm drain in cement concrete 1:2:4 all around shall be constructed and water will be led to the proper disposal point through the drain to be constructed for the purpose. The top of the drain around the apron shall be 100mm above the ground level. Outer edge will be covered with sloping earth the apron will have a slope of 1.60 from centre towards the drawl. The edge of the drain will be flush with the top surface of the apron. The apron will be 100mm thick in cement concrete 1:2:4 laid on sub base of 100mm thick 1:4:8 cement concrete in case of black cotton/cohesive soil the soil will be removed up to 500mm below the ground level and refilled with rammed moorum up to 400mm incase of hard strata like moorum, kopra etc. moorum filling will not be required. The sump well shall be in R.C.C in SRC cement of min Grade M-30. It will house submersible pumps, which will always be submerged in sewage. The bottom floor will slope towards pump channel side. Pump channel will be of adequate height and width to house pumps, which will be always in submerged condition. The norms for arrangements spacing etc. of pumps shall be as per CPHEEO manual guidelines and min. submergence as per pump manufacturer's requirements. There will be high level and low-level alarm and tripping system installed.

5. PIPES AND FITTINGS:

The inlet, outlet, over flow and scour pipes for the tanks shall be cast iron double flanged class A as per IS : 7181-186 all these pipes shall be independent of each other and shall be fixed in vertical position rigidly by bolting and clamping properly.

The size of these pipes in SUMPWELL shall be as given below

inletdia of pipe	250 mm
Outlet dia of pipe	300 mm
Overflow dia of pipe	350 mm
Scour dia of pipe	200 mm

Cast iron bell mouths as per Appendix 10.2 of CPHEEO manual conforming to IS 1538-1976 shall be provide on the top end of all pipes. These pipes shall have CI puddle collars properly embedded in the floor slab at the time of concerting to provide monolithic joint. Cast iron strainer shall be provided don the top of outlet and scour pipes,. Cast iron duck foot bends shall be fixed over cement concrete bed block, to support vertical pipes. The bed blocks shall be designed to take the load of pipes and the water column indecently. The double flanged Duck foot shall be provided. 1.2m below average ground level at site.

Cast Iron Double flanged sluice valves with spur gear and hand wheel class PN 1.0 confirming to IS : 14846 with all revision up to date issued of NIT shall be provided and fixed minimum 3.0 m away from the ground level bracing, along with necessary C.I.D.F. pipes. The size of the valves shall be as given below:

Inlet valve	Dia	(150 mm)
Outlet valve	Dia	(150 mm)
Scour valve	Dia	(80 mm)

The overflow pipe shall be left open at minimum 3.00 m distance from bracing CIDF pipes shall be provided between Duck foot bends and D.F. sluice. The contract will limit up to fixing of DF values.

6 APPURTENANCES:

6.1 Water level indicator:

A float operated level indicator comprising of stainless steel float pulleys, steel wire rope and enameled indicator plate calibrated to read depth of water in metre, shall be provided.

The pulleys should provide free movement of rope and they should be easily accessible for repair and maintenance. The indicate plate should be fixed at about 5m. Above ground level on the front side of tank.

Additionally the following arrangement may be provided as optional

(a) Water level indicator, working on physical characteristics.

(b) Pressure gauge, calibrated, to read water depth directly.

6.2 Ventilators :

Mosquito proof ventilators, of suitable design shall be provide on the roof slab of tank to facilitate discharge of dissolved gases of water and to keep the inside of tank odour free.

6.3 Man hole:

An opening of 0.75x0.75m or 0.9m dia size shall be provided in the roof slab fo tank for access inside the tank for inspection and cleaning. The opening shall have CI/MS cover with locking arrangement.

Lightening Arrestor:

Aluminum lightening arrester as per relevant B.I.S. shall be above highest point and 30 mmx4mm size strip connected to earth electrode shall be provided. The earth strip shall be secured rigidly to concrete surface.

7 Finishing and painting

7.1 Form finish:

All external surfaces on the structure shall have form finish. However all uneven surface and small defects shall be made even immediately after removal of forms with 1:1 cement mortar. The inside surface of the tank shall be rendered even and water proof by cement plaster in 1:2 portion.

7.2 Painting of Concrete:

The outside surface of the Sump shall be painting with 2 coats of IS marked cement colour of approved make. The colour shade shall be decided by the Engineer-in-Charge.

7.3 Painting of pipes etc.

Cast iron pipes, valves and fittings, shall be painted with 2 coats of black bituminous paint.

7.4 Painting of MS Ladders and MH Cover:

As the MS ladder inside of the tank and manhole cover shall be subjected to corrosive action of chlorinates water they shall be coated with epoxy paint

8. TESTING OF SUMPWELL:-

In addition to the structural test as given in IS 456-1978 revised and amended up to date the Sumpwell shall also be tested for water tightness at maximum water level in accordance with clause 10.1.1 of IS 3370 (part-I0 1965. The tanks shall be filled more than 0.25m per day and the settlement of foundation of foundation shall be measured accurately before each filling. Any defect of any sort affecting the strength, durability, appearance of usefulness of the structure noticed during testing shall be completely removed to the satisfaction of executive Engineer with in the specified time for completion of work.

9. COMMISSOINING & HANDING OVER:-

On completion of all works and the successful of the Sumpwell, it shall be handed over to the department for commissioning as required on completion of work and testing. The contractor shall submit completion drawing in six sets along with foundation investigation, concrete strength water tightness test reports at the time of handing over of work.

Additional Specifications

01 The work of construction of RCC reservoir involves workman ship; hence requirement of higher standard than general concrete work is essential.

02 The TENDERs submitting their officer in form F (lump-sum TENDER) submit the drawing and calculation within one month from the date of acceptance of their TENDER for scrutiny and approval of competent authority of Public Health Engg. Department Madhya Pradesh. The responsibility for design, construction, structural stability and water tightness for all water tight structures will however, rest solely with the contractor and the will have to make good at their own const any damage or loss to Government due to defect, if any in the above mentioned work.

03 The TENDER submitting their offer in form "F" (lump-sum TENDER) shall indicate the approximate quantities of various items involved in the work e.g. cement, concrete and steel etc. This information shall be attached with the TENDER itself. The lump sum offer shall include provision for balcony railing, lightening arrestor, water level indicator and staircase also.

04 The contractor shall have to arrange his own steel whatever the quantity of steel is required to complete the whole structure in all respect. The department shall not supply any quantity of steel under any circumstances. No extension of time will be granted for late supplies of steel of escalation, if any in future. The steel for reinforcement shall conform IS2266-1962 OR IS 1977-92 (st. 44) only and a certificate shall be required to be produced to the department in support

in addition to random sample at site duty got checked at contractor cost to see whether it confirm to above specification.

05 The department shall not be responsible for providing water required for construction and other purpose. The contractor shall make his own arrangement for the same at his own cost.

06 Not extra charges for the plastering if required for the finishing of the surface of structure shall be paid under any circumstances.

07 Whenever bailing out of water or dewatering of foundation is required to be done, nothing extra will be paid for it the contractor/firm should quote his rate after taking this factor into consideration.

08 The contractor/firm shall be required to submit the complete drawing in six copies on completion of the work in A3 size only.

09. The contractor shall have to make his own arrangement of electric or telephone connection, if required at his own cost.

10. For blasting if required, in foundation the contractor /firm will make his own arrangement for license/permit and materials from the competent authority.

11. The work shall be treated as complete when the same is completely tested and handed over to the department including site clearance.

DESIGN REQUIREMENT

01. A separate drawing showing only dimension must be given.

02. Details of reinforcement in different components like footing, columns bottom dome, vertical wall rings beams, roof dome and stair case etc.

03. Orientation and shape of each type of bar must be shown against sketch for the component length and total number of bar of each type must be mentioned to avoid confusion.

04,. Location of pipes and other fittings and extra reinforcement at opening should be shown separately.

05,. Bar bending schedule and location of construction joints also be made clear in the drawings.

06. Contractor shall consider the earthquake zone for design purpose.

REINFROCED CONCRETE WORK

It shall be strictly as per IS 456 & IS 3370 (part (i) to (iv), IS 11682 and other relevant specification revised up to date for RCC structure s.

01. Minimum strength of concrete:

Minimum strength of concrete for components of elevated tank shall be as below:

Columns, staging	-	M25 (250kg/sqm.cm)
Tank including roof	-	M-30 (300kg/sqmc.m)

02 Minimum cement content:

From durability considerations minimum content shall be as below:

Concrete M-25	-	350mg/cum
Concrete M-30	-	400kg/cum

03 The cover of concrete:

The minimum cover shall be 40mm all the reinforcement & for foundation this cover shall be 60mm.

04. Cement Grade:

Grade 43of cement should be used for columns and grade 53 for the tank portion, including the top dome cover only fresh cement should be used in the tank. It is advisable to use cement, manufactured by major plant and reputed firms OPC or blast furnace slag cement should be used.

05 Water cement ratio

Water cement ratio shall not be more than 0.45. This means 22.5 litres of water per 50kgt beg of cement.

06. Use of Chemicals

When the water cement ratio is less he strength and durability of concrete of concrete is good. It is advisable to use plasticizers in concrete and reduce water cement ratio up to 0.4

plasticizers manufactured by reputed combines are recommended. Proportion of plasticiser to be used shall be as per the instruction manual supplied by the manufactures.

07 MEASUREING:

The quantity of cement shall be determined by weight. The quantities of fine and coarse aggregates shall be determined either by volume or by weight.

08 Aggregates

It is advisable to use metal derived form igneous rock preferable of basaltic or granitic origin. The coarse sand should be free soil. All aggregates shall conform to all provision and test methods of I.S. specification 388-1963.

01 Fine aggregates when tested by the colorimetric method the color shall of be darker than light amber, fine aggregates shall be capable of developing 30% o the compressive strength.

02 Maximum aggregate size shall not be more than 20mm when the spacing of reinforcement bar is 20mm.

03 Fineness modulus shall be more ten plus or minus 0.20 from that of the approved sample.

04 Water shall be clean & free from oil acids of injurious substances.

09. Storage of material

Cement shall be stored off the ground in a dry ventilated building. Aggregate shall be stored in 0.6 meters layers on planning. reinforced steel shall be stored under cover & protected from rusting oil grease or distortion only steel needed for immediate use shall be removed from storage.

10 Minimum Dimension And shapes:

Minimum Dimension shall be as below:

Circular	400mm
Tank wall	200mm
Bottom slab	150mm
Top slab	125mm

Note: If a dome is provided at the top, the thickness can be limited to 100mm rectangular square columns are not allowed circular shafts are also not allowed. In respect of horizontal braces corners shall be chamfered by 40x40mm

Form

01 The contractor shall provide form that will produce correctly aligned concrete.

02 The centering shall be true and rigid and thoroughly based both horizon tally and diagonally. The forms shall b sufficiently strong to carry the dead weight of the concrete without defection and tight enough to prevent leakage of mortar.

03 For exposed interior or exterior concrete surface of columns and walls, steel or other approved corrosion resistance devices shall be used.

04 Rigid care shall be exercised that all columns are in plum and true & thoroughly cross braced to keep them so.

05 All floor and beam concreting shall be crowned not less than 6mm in all direction for every 4.8 meter span.

06 Beveled strains shall be provided in form, angles and in corners of column and beam boxes for chamfering of corners where shown in drawings or as directed.

07 The inside of forms shall be coated with approved oil thoroughly wetted oil shall be applied before reinforcement is placed.

08. Temporary openings for cleaning and inspections shall be provided at the base of vertical forms and at other places when they are necessary.

11. FORM WORK:

Wherever intz type of tanks are adopted or where then is an inclined slab having inclination steeper than one vertical to three horizontals, inside form work must be provided, the procedure for such a form work be

a) Place outer form work.

b) Place inner form work 300 to 450mm wide Then concrete that portion then fix next strip and concrete.

c) In respect of top of bottom domes, place upper form work for lowest circular strip of width equal to 1/4th dia of dome and concrete as stated above, then concrete central half for which top form may not be provided.

12. REINFORCEMENT STEEL

01. Bars and rods shall be free from scale oil structural defects and shall be maintained so on the job.

02. Fabrication shall be accurately done to the dimensions shown on the drawings, stirrups and ties shall be bent around a pin having diameter at least twice the bar thickness, other bars shall be bent around a pin having a diameter at least 6 times the bar thickness. All bars shall be bent cold.

03. All steel will be rigidly held in place with approved galvanized wire devices in such a manner that all steel will support the weight of the workman without displacement.

04. On exterior exposed concrete no metal ties charts or spacer shall remain within 40mm of the finished surface.

05. Reinforcement Steel shall confirm to BIS Specification 432-1966 (with up to date revision) and B.I.S. Specification 1786-1985 (with up to date revision). All reinforcement steel shall be Fe 415 TMT grade with preferable make.

13. Minimum Steel:

Design requirements as set out in relevant codes in respect of steel shall be full satisfied. However, following minimum steel should be provided

a)	Vertical steel in column	0.8% of cross-sectional area actually required & 0.3% when larger section than actually required is provided.
b)	Horizontal links in columns	not less than 8mm dia at 200mm c/c or 10mm dia not more than 300mm c/c.
c)	Exposed RCC Surface	On both faces when thickness is 150mm or more. 2 kg/sqm in one direction. 2 kg/sqm in perpendicular direction. The above requirement is satisfied if. 8mm bars @ 200mm c/c OR 10mm bars @ 300mm c/c are provided. Even if design steel is less than above, the above minimum shall be provided.
d)	Steel in tanks	As per provision of IS 3370 subject to minimum as set out in (c) above.

13. Minimum Spacing of Reinforcement:

Maximum spacing of main reinforcement in slab or walls shall not be more than 150mm center to center. The spacing of secondary bars, such as distribution steel of vertical bars in columns shall not be more than 300mm center to center.

14. Type of Steel:

It is advisable to use corrosion resistant CR steel such steel is now available.

15. Detailing of Steel:

Before commencing the work the drawing should be studied. It must be insisted that the designer provides details of the shape of each bar, its diameter, length and numbers of each category in a schedule of reinforcement. This must be incorporated in every working drawing.

16. Mixing Concretes:

01 It is extremely essential that the contractors undertaking the work should have concrete mixer with them. No hand mixing shall be allowed.

02. Concrete shall be mixed in the standard batch mixer with a drum speed of 200 to 250 peripheral feet per minute mixing time shall be two minutes for batches of 1 cu. yd or 0.39 cum or under and shall be increased 15 seconds for each additional 1/2 cu. yd or 0.39 cum of fraction there of.

03. Tempered concrete shall not be allowed Air standard or lean concrete shall not be used; the contents of the mixer shall be completely discharged before each new batch is loaded.

04. The concrete shall be, uniform in ingredients, colour and consistency.

17. Transportation

Concrete shall be handled from the places of mixing to the place of original deposit as rapidly as practicable by methods which will prevent segregation or loss o any ingredients. If segregation does occur during transport the concrete shall be remixed before begin placed.

18. PLACING OF CONCRETE

01. Concrete shall be deposited in its final position with out segregation remanding or flowing.
02. When possible concreting shall be continues unit the section in completed.
03. Form shall be clean before concrete is placed.
04. In no case the concrete shall be laid without vibration, it is desirable to keep two concrete vibrators at the construction site so that in case of break down the other vibrator can be used.
05. Concrete shall be shaped & vibrated with approved mechanical vibrator to maximum subsidence without segregation and adjacent to form and joints over vibrating or vibrations of very wet mixes will not be permitted and should be avoided Reinforcement bars shall be shaken to ensure bond with concrete.
06. Slabs and beams stems shall be placed in one operation.
07. Concrete columns & walls settle at least 2 hours before the floor system supported on is poured.
08. Construction joints be treated in accordance with is 456. The surface of already laid concrete be cleaned by water jet and cement slurry be applied, Cement mortar 10mm thick of the same proportion as in concrete by applied and then fresh concrete of the lift be laid. The form work must overlay 100m on the already laid concrete.
09. Conveying & chatting of concrete shall be done only by approval of the Engineer-in-charge & with equipment to insure a continuous flow with out segregation.
10. Water accumulation during placing shall be removed concrete shall not be deposited in such accumulation.
11. The concrete shall be placed and compacted before setting commences and should not be subsequently disturbed.
12. Converting shall be placed and compacted before setting commences and should not be subsequently disturbed.

19 EXPOSED SURFACE

01 Imperfect surfaces where strength is not impaired may be patched and rubbed smooth with carborundum brick.
02. Fins and projection shall be removed and the concrete surface affected there by shall be rubbed smooth.
03. Small voids shall be filled with 1:3 mortar pressed into holes and floated smooth.
04. Plastering and steel trawling of surface shall not be allowed.
05 Honey comb concrete shall be repaired by removal and replacement of member.
06. Forms shall be filled tightly so as to minimize fins joints shall be finished with bevels strips as directed by the Engineer-in-charge.

20. CURING CONCRETE

01. It is extremely important to make arrangement for supply of sufficient water at the construction site for curing of the concrete. Continuous and efficient curing is extremely important for development of good compressive strength in any concrete structure.
02. After finishing concreting, curing shall be done by damping concrete at least for one week after placing. Floor & vertical surfaces shall be covered with a layer of old gunny bags or similar absorbent material and kept constantly wet. Curing operations shall begin as soon as the concrete has attained initial set. All materials and facilities for curing concrete shall be on hand and ready for use before concrete is placed.
03. Curing of concrete shall be as per IS 456-2000 with up-to-date revision.
04 Concrete shall be kept wet and moist for at least two weeks.

21. FLOOR FINISH

Tank wall and floor finish shall be monolithic bonded.

22. REMOVAL OF FORM

01 In no circumstances forms shall be struck until the concrete reaches strength of at least twice the stress to which the concrete may be subjected at the time of striking.

02. In normal circumstances i.e. at temperature 21 C forms may be removed at the following minimum times which will be subject to the Engineer's requirement.

Wall	02 days
Columns	03 days
Beams soffits (sides)	05 days
Bottom of beams up to 6m span	14 days
Bottom of beams above 6m span	21 days
Slabs 125mm thick or less, up to 4.6m span	07 days
Slabs 125mm thick or less, above 4.6m span	14 days
Slabs over 125mm thick or, up to 4.6m span	18 days
Slabs over 125mm thick or above 4.6m span	14 days

04 All concrete shall be inspected for quality before forms are removed.

05. When struck by a carpenter's hammer it shall ring like stone.

06. Upon removal of forms the contractor shall place adequate precautions to prevent injury to the concrete by construction loads.

07. The contractor shall be responsible for safe removal of forms and for placing adequate precaution.

23. APPROVAL OF MATERIAL

Before use, samples of all materials shall be got tested from recognized laboratory by the contractor at his own cost and the test certificate shall be furnished to the Engineer-in-charge & no material shall be used until it has been approved.

25. LABORATORY TEST

Following laboratory test shall be made by the contractor at his own cost and reports furnished to the Engineer-in-charge.

Sn	Material	Lab test	Test method
01	Cement	Physical & Chemical test	IS 269-445
02	Coarse & Fine Aggregate	i) Gradation ii) Deleterious constituents iii) Moisture Content iv) Bulking of fine aggregate (for volume batching)	IS 2386 (part-I) IS 2386(part-I) IS 2386(part-III) IS 2386(Part-III)
03	Coarse aggregate	i) Los Angles abrasive values (aggregate impact valve) ii) Soundness iii)Alkali aggregate reactivity	IS 2386(part-IV) IS 2386(part-V) IS 2386(part-VII
04	Water	Chemical test	IS 456
05	Concrete	i) Workability (Slump or compacting factor test) ii) Concrete strength	IS 1199 IS 516
06	Bars and Rolls	i) Tensile Strength	IS 432 (Part-I)

26 FIELD TEST

01 The contractor shall provide all equipments and make all arrangements for fields tests to exercise proper quality control over work specially for test mentions as S.No.2(ii) and S.No. 5 mentioned under para 28.0.

02 Test for compressive strength of concrete.

03. Test specimens cubical in shape shall be 15x15x15cm.If the largest nominal size of the aggregates does not exceed 20mm; 10cm cubes may be used as an alternative. Cylindrical test specimen shall be 15cm in diameter and 30cm long. Smaller test specimen shall have ratio of diameter of specimen to maximum size of aggregate of not less than 3 to 1 except that the diameter of the specimen shall be not less than 7.5 cm for mixtures containing aggregate more than 5% of which retained on is sieve 480.

04 The mould shall be of metal preferable steel or cast iron and should be strong enough to prevent distortion. It shall be constructed in such a manner as to falcate the removal of the moulded specimen without damage and shall be so machined that when it is assembled ready for use. The dimensions and internal faces shall be accurate within the permissible limits the mould and base plate shall be coated with a thin film of oil before use in order to prevent adhesion of the concrete.

05. The tamping bar shall be of steel bar 16mm in diameter 0.6 meter long and bullet pointer at the lower end.

06. The test specimen shall be made as soon as practicable after mixing and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance. The concrete shall be filled into the mould in layers approximately 5cm deep in placing each scoop full of concrete. The scoop shall be moved around the top edge of the mould as the concrete slides from it in order to ensure a symmetrical distribution of the concrete within the mould each layer shall be compacted by vibration. After the top layer has been compacted the surface of the concrete shall be finished level with the top of the mould using a travel & covered with a glass or metal plate to prevent evaporation.

07 When compacting by vibration, each layer shall be vibrated by means of an electric or pneumatic hammer or vibrator or by means of a suitable vibrating table until the specific condition is attained.

08. The mode and quantum of vibration of the laboratory specimen shall be as nearly same as those adopted in actual concreting operations.

09. The test specimen shall stored in a place free from vibration it should be kept in molest air of at least 90% relative humidity & at a temperature of 2702 C for 24 hours + - 1/2 hours from the time of addition of water to the dry ingredients in the fields, it should be kept under matting racks or other similar material for 24 hours + 1/2 hour from the time of adding water to the other ingredients at a temperature at a temperature range of 22 to 32 C, after this period, the specimen shall be marked and remove from the mould and unless required for test within 24 hours immediately submerged in clean, fresh water or saturated lime solution and kept there until taken out just prior to test. The temperature of water or solution shall be maintained at 27 + - C, the specimen shall not be allowed to become dry at any time until they have been tested.

10. At least 06 test samples on each day concreting should be collected and date mentioned on it subject to minimum samples as described in para 25 (05) above.

11. The contractor shall also provide all equipments and make all arrangements for field test and conduct all test as under and submit the test result to the Engineer-in-charge.

Chapter 4

SPECIFICATIONS FOR SEWAGE TREATMENT PLANT

All the work shall be carried out as per relevant clause of CPHEEO Manual

(1) Construction of Sewage Treatment Plant. The Job includes the construction of STP each of capacity …….. MLD. The proposed STP is based on proven technology to achieve the desired outlet quality.

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

- Raw Sewage Pumping Stations comprising connection of incoming sewer to receiving chamber, receiving chamber, coarse screen channels.
- Primary Treatment Units comprising Inlet Chamber, Fine Screen Channels and Grit Chambers, Outlet Channel from grit chamber to biological units.
- Biological Treatment Units.
- Disinfection system.
- Disposal of treated sewage into nearby water body.
- Sludge Dewatering Units comprising Sludge Sump and Pump House, Sludge Dewatering House and Dewatering Polymer Dosing System.
- Buildings including Air Blower cum Admin cum MCC & Control Building, HT Substation, DG House, Security Cabin etc.
- Other Ancillary Structures including Roads & Pathways, Plant Drains & Storm Water Drains, Boundary Wall for STP site etc.
- Landscaping.
- O & M of …… month for entire facility.
- All the process design, structural designs and drawings shall be vetted by a reputed and specialist institution like NIT Bhopal / IIT and cost for the same shall be borne by the contractor. No other institutional approvals shall be acceptable.
- Apart from the designs given by the technology provider, all other STP related designs and electro-mechanical details should also be vetted by the Technology provider. Also, After commissioning of sewage treatment plant (after operation of the plant for three months), technology provider should inspect the plant once again and should submit his observation/finding report to the end user (client).
- Providing Internal Acrylic Washable Paint and External Acrylic Smooth Exterior Paint to all Buildings.
- Providing Rolling Shutters, Doors, Windows and Ventilators in all Buildings.
- Providing External Epoxy Paint to all Steels Works made of MS or GI.
- All hand railings shall be in GI.
- Supply, Erection, Testing & Commissioning of all the Mechanical Equipment as detailed in Mechanical Specifications.
- Obtaining incoming HT Power Supply from nearby Source to the STP Site and necessary Deposits and Documents shall be arranged by the Employer. However, contract shall provide maximum demand for STP.
- Supply, erection, testing & commissioning of all the Piping, Gates & Valves as detailed in Mechanical Specifications.
- Supply, Erection, Testing & Commissioning of all the Electrical Equipment's including LT Equipment's as detailed in Electrical Specifications.
- Supply, Erection, Testing & Commissioning of all the Instrumentation Equipment's as detailed in Electrical & Instrumentation Specifications.
- PLC/ SCADA based Automation System for the entire Plant as detailed in Specifications.

- Supply, Erection, Testing & Commissioning of Safety Equipment's at required locations including Safety Showers, Sand Buckets, Fire Extinguishers, Fire Alarms etc.
- Providing Laboratory with required Laboratory Equipment's, Instruments, Chemicals & Reagents and Furniture.
- Planting of Trees and Plants / Landscaping.
- Performance Run of the constructed & hydraulically tested Plant along for a period of three (3) month and Operation & Maintenance (O&M) of STP for …… years after Trial Run as per Tender specifications.
- Supply of all Spares, Tools & Tackles required during Performance Run and O & M Period.
- Repairing & reconditioning of all the Equipment in the concluding year of the Operation & Maintenance Period to such a condition that they are in running condition with regular preventive and recommended maintenance.
- Providing "on the job" training to the Employer's personnel.
- Equipment with poor performance history will be summarily rejected.
- Preparation and submission of As-Built Drawings and Operation & Maintenance Manuals for Mechanical, Electrical & Instrumentation Items.

The Bidders are advised to visit the STP site before quoting for the proposed STP.

The above works shall be completed within --------calendar months (including monsoon period) from the date of issue of work order.

Minimum Number of Units or Modules to be Provided for Unit Processes						
Unit Process	STP Design Average Capacity (MLD)					
	≤25		>25		> 65	
	Number of Units (W=Working S=Standby)					
	W	S	W	S	W	S
Mechanical Screens channels	1	0	2	0	2	0
Manual Screens channels	0	1	0	1	0	1
Grit Removal (Mechanical) unit	2	0	2	1	2	1
SBR Basins	2	0	4	0	6	0
Chlorination tank with baffle	1	0	1	0	1	0
Sludge Dewatering building	1	0	1	0	1	0

Note: Above no. of units are minimum requirement of tender. Bidder may provide additional no. of units based on the process requirement.

(2) TREATMENT:

Specifications of all the treatment units shall be as per CPHEEO Manual and relevant IS standards. Bidder shall require to submit a brief write up on the Sewage treatment plant along with the TENDER. On acceptance of TENDER the successful Bidder shall

submit a detailed design and drawings of the Sewage treatment plant based on CPHEEO Manual and relevant IS specifications for the approval of competent authority.

Sr. No.	Design Parameters	Capacity
1	Average Flow for STP	…. MLD
2	Peak Factor for STP	As per CPHEEO
3	Peak Flow for STP	…… MLD
4	Average Ground Level (AGL) at Site	…… m
5	Finished Ground Level (FGL) at Site	……. m
6	HFL of nearby river	…… m
7	Top of units	m above 0.50FGL
8	Plinth Level of buildings	0.50m above FGL
9	Approximate length of Disposal Pipe (outfall sewer)	…… m
10	Ground Water Table	As per site conditions

The Sewage treatment plants shall be for Primary and Secondary treatment of MUNICIPAL SEWAGE. Typical composition of untreated domestic wastewater,

		Concentration		
Contaminants	unit	Weak	Medium	Strong
Suspended Solids	mg/l	100	220	350
BOD_5	mg/l	110	220	400
COD	mg/l	250	500	1000
Total Nitrogen	mg/l	20	40	85
Free Ammonia	mg/l	12	25	50
Nitrates	mg/l	0	0	0
Total Phosphorous	mg/l	4	8	15
Chlorides	mg/l	30	50	100
Sulfate	mg/l	20	30	50
Grease	mg/l	50	100	150

The Effluent Characteristics should meet the MP Pollution Control Board norms for discharging water in inland water ways or to be used for community purpose as per Pollution Control Authorities with up to date amendments. The effluent discharge limits are described below.

Sr. No.	Parameters / Pollutants		Values after treatment
1	pH	:	6.5 to 9.0
2	Biochemical Oxygen Demand (BOD_5)	:	≤ 10 mg/l
3	Chemical Oxygen Demand (COD)	:	≤ 50 mg/l
4	Total Suspended Solids (TSS)	:	≤10 mg/l
5	Total Phosphorous (TP)	:	≤ 1 mg/l
6	Total Nitrogen (TN)	:	≤ 10 mg/l
7	Ammonical Nitrogen (NH3-N)	:	≤ 5 mg/l
8	Fecal Coliform	:	Desirable ≤ 100 MPN/100 ml Permissible ≤ 230 MPN/100 ml

All the treatment units shall be as per CPHEEO Manual and relevant IS standards. Bidder shall require to submit a brief write up on the Sewage treatment plant along with the TENDER. On acceptance of TENDER the successful Bidder shall submit a detailed design and drawings of the Sewage treatment plant for the approval of competent authority. The general specifications and guidelines for STP are as below,

1.0 General Guidelines for level of STP and proposed Trunk Main Sewer.

The contractor is advised to have a site visit and verify the site levels. The STP should be designed, such that the complete process is completed with least of power consumption, also STP should be at sufficient height to avoid flooding during monsoon. It is the responsibility of contractor to match the outfall chamber level with proposed by pass channel meant for excess flow and discharge of treated sewage Sewerage.

2.0 Raw Sewage Intake System & Raw Sewage Sump & Pump

The raw sewage shall be intercepted from the last manhole and shall be taken to the raw sewage intake and pump sump via gravity. A minimum self-cleaning velocity shall be maintained throughout the sewer line in order to avoid the settling of the particles. The raw water sewage pumping station shall comprise of the following system: Inlet chamber, Mechanically cleaned coarse bar screen, pump sump and raw sewage pumps.

A bypass line to the Pumping station shall be provided which shall discharge Sewage to the drain, in case of overflow or raw sewage pump failure. This Pipe line shall be designed to maximum hydraulic capacity.

Receiving chamber

the deep gravity outfall sewers will discharge the raw sewage into a receiving chamber. the function of the receiving chamber is to distribute the flow for process units. the receiving chamber shall be designed for peak flow. the receiving chamber shall consist of sluice gates on upstream for flow regulation. in the sidewall of the receiving chamber, sluice gates shall be installed such that it is possible to operate them manually, inspection as well as operation by standing on a platform constructed at a suitable elevation adjoining and circumventing the receiving chamber. the receiving chamber shall be of adequate size to meet the requirements of workability inside it. the receiving chamber shall be open to sky and shall be water tight to prevent seepage of the sewage out of the receiving chamber. the entire construction is in m30 grade concrete and as per is 3370. rcc access platform minimum 1000 mm wide with railing as per specifications shall be provided on one side of the chamber:

number of units	:	1 (one)
detention period	:	30 sec
min free board	:	0.50 m above fgl

there shall be a provision of one plant bypass before pumping station.

coarse screen channels

min. one mechanical screen working and one manual screen standby of 20 mm clear spacing and screen shall be provided for peak flow capacity.

the bar screens shall be made of 10 mm thick stainless steel (ss 304) flats respectively. the coarse screens shall be of 20 mm opening as per the specifications detailed elsewhere in the tender. conveyor belt and chute arrangement shall be provided to take the screenings. screenings dropped from chute shall be collected in a wheel burrow. manually operated ci gates are provided at the upstream end to regulate the flow.

adequate rcc platforms shall be provided at the upper level to enable operation. railings shall be provided around the entire periphery of the platform. the entire structure is to be m30 concrete and as per is 3370 including the platform. rcc staircase 1000 mm wide shall be provided for access from the ground level to the top of the unit & to the operating platform.

number of units	:	Min. 1 (working) mechanical + 1 (stand by) manual
approach velocity at average flow (m/sec)	:	0.3
velocity through screen at average flow (m/sec)	:	0.6 maximum
velocity through screen at peak flow (m/sec)	:	1.2 maximum
min free board	:	0.50 m above FGL
wheeled trolley	:	1 no.

all other accessories, whether specified or not, but required for completeness of contract shall be in contractor's scope.

Raw sewage pumping station

sump and pumps

sewage enters into wet well of the pumping station after screening. the wet well shall be circular/rectangular in shape and shall be designed for an average flow. the capacity of the wet well should be kept such that the detention time in the wet well shall be minimum 5 minutes of peak flow and the maximum detention time shall not exceed 30 minutes at average flow. the entire structure is to be m30 concrete and as per is 3370 including the platform. following criteria shall be considered to size the sump:

1. that the pump of the minimum duty/ capacity would run for at least 5 minutes considering no inflow or
2. the capacity of the sump is to be so kept that with any combination of inflow and pumping the operating cycle for any pump will not be less than 5 minutes and
3. the arrangement of the submersible pumps as per pump manufacturer's data i.e. spacing between pumps, minimum space between pump and wall etc.
4. the side water depth (live liquid depth) shall be minimum 1.5 meter. in addition to the above liquid depth an additional depression shall be provided to ensure adequate submergence of the pump as per the manufactures recommendations pumping station should have a room adequate for installing electrical panels. suitable arrangement should be provided for lifting of pumps.
5. the effective liquid volume shall be provided below the invert level of the screen chamber after leaving provision for a minimum of 0.3 m. IS: 3370 and IS: 4111 (part 4) shall be followed for the design and construction of wet well.
   pumping machinery shall be designed for average flow and a peak factor. The pumps shall be submersible raw sewage pumps with centrifugal, non-clog type design. the speed of pump shall not be more than 1000 rpm. the impeller should be of a non-clog design with smooth passage and solid handling capability of 100 mm size.

the pumps will have automatic coupling arrangement at discharge end for removal and a guide pipe and chain in ss 304 will be provided for removal and lowering of pumps. pump shall run smooth without undue noise and vibration. vibration shall be limited as per bs 4675 part i. the motor shall be squirrel cage type, suitable for three phase supply continuous duty with class 'f' insulation. motor shall have integral cable parts and the cable entries shall be sealed. complete rotor shall be balanced dynamically.

design flow	:	peak flow
minimum retention time	:	5 minutes minimum at peak flow.
no. of pumps	:	as per CPHEEO manual
type of pumps	:	submersible type non-clog design
solid passage size through pumps	:	100 mm max.
insulation	:	class f
protection	:	ip-68

wet well specific requirement, material of construction and accessories:

number of units	:	(1) one designed for peak flow
pumping station material of construction wet well / sump	:	rcc

the size of the sump shall be suitable to accommodate the number of pumps required for operation with easy manoeuvrability.
electrical panel of the pump house shall be placed in such a manner to avoid corrosion from gases. either, it can be clubbed with mcc panel or necessary protection can be given.
the pump house shall be suitably sized to house the electrical cum control panel if required, space for spare parts and a maintenance area, etc. and be complete with the following accessories:

i. hoist - comprising of i-girder and a 1½ ton or more chain pulley (the chain pulley block capacity to be 1½ ton or 1.5 times the maximum single unit/ weight that may be required to be removed for maintenance) with horizontal travel on the i-beam.
ii. the room shall be so covered from sides to protect it from the elements and be suitable for protection from the natural elements. ventilation in the sheds shall be as per nbc norms specified in the civil construction manual.
iii. the room shall be suitably designed to avail of natural lighting and ventilation.
iv. internal illumination at levels suitable for proper lighting.

pumps configuration	:	As per CPHEEP
pump head	:	suitable
liquid	:	raw sewage
specific gravity	:	1.05
temperature	:	min. 20° c
efficiency	:	more than 70%
installation	:	fixed.
casing	:	cast iron is 210 gr. fg 260
impeller	:	CF8M
shaft	:	aisi 410
cable gland	:	cast iron is 210 gr. fg 260
motor body	:	cast iron is 210 gr. fg 260
sealed cover	:	cast iron is 210 gr. fg 260
automatic coupling	:	ci
duck foot bend	:	ci
guide pipe	:	ss 304
lifting chain	:	ss 304
fasteners	:	ms with gi coating

testing of pumps at manufacturers premises:

a) hydrostatic testing : all pressure parts of pumps prior to assembly, shall be subjected to hydrostatic tests to the satisfaction of executive engineer at 1.5 times the maximum pressure obtained with the delivery valve closed and suction pressure at maximum, or twice the working pressure whichever is higher for a duration of 10 minutes.
b) balancing test: impeller and pump rotating assembly shall be dynamically balanced.
c) performance test: each pump shall be tested for full operating range individually to bs: 5316: part 2. test shall be carried out for performance at rated speed with minimum npsh as available at site.
d) pump performance shall be within the tolerance limits specified in bs: 5316: part 2.

Pumped wastewater conveyance

the pumped flow from the pumping station to the elevated head works inlet chamber of the plant shall be taken through a ci class "la"/ di – k-9 pipeline. the rising main shall be designed average flow with a peak factor.

(a) the pipeline shall be adequately sized to have a minimum velocity of at least 1.2 m/s at minimum flow conditions and not more than 2.5 m/sec at pumped peak flow.
(b) the pump head shall be adequately sized to give a residual discharge head as per CPHEEO manual.

a suitable plant bypass shall be provided from the pumping station to divert sewage in case of emergency.

3.0 Sewage Treatment Plant

3.01 Inlet chamber

Inlet Chamber of STP shall receive the flow from Raw Sewage Pumping Station. Inlet Chamber shall be designed for Peak Flow. The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370. RCC Platform/Walkway, minimum 1.20 m wide with Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.20 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway.

Number of Units	:	1 No.
Hydraulic Retention Time	:	30 Sec at peak flow
Free Board	:	0.50 m min.

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

3.02 Fine Screen Chamber.

Min. One Mechanical Fine Screens (Working) and one Manual Fine Screen (Standby) shall be provided in Fine Screen Channels. Fine Screen Channels shall be designed for Peak Flow. The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370. RCC Platform/Walkway, minimum 1.20 m wide with Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.20 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway.

The clear opening shall be 6 mm for Mechanical Fine Screen and 10 mm for Manual Fine Screen. The Screens shall be made of SS 304 flats (2-3 mm for mechanical screen and 10 mm for Manual Screen). Conveyor Belt and Chute arrangement shall be provided to take the screenings. Screenings dropped from Chute shall be collected in a wheel Burrow. Manually operated CI Sluice Gates shall be provided at the upstream and downstream ends to regulate the flow.

Number of Units	:	Min. 1 (Working) Mechanical + 1 (Stand by)

Manual each of 100% of Peak Flow capacity.

Approach Velocity at Average Flow	:	0.30 m/s
Velocity through Screen at Average Flow	:	0.60 m/s max.
Velocity through Screen at Peak Flow	:	1.20 m/s max.
Free Board	:	0.50 m min..
Wheel Barrow	:	1 No. min.

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

3.04 Grit Separator Units

Min. One Mechanical Grit Chamber (Working) along with one Manual Bypass Channel (Standby) shall be provided after Fine Screen Channels. Grit Chamber shall be designed for Peak Flow whereas Bypass Channel shall be also designed for Peak Flow. The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370. RCC Platform/Walkway, minimum 1.20 m wide with GI Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.20 m wide with GI Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway.

Each Grit Chamber shall have the following features::

- One tapered Inlet Channel running along one side with adjustable Influent Deflectors for entry of sewage into the Grit Chamber.
- One tapered Outlet Channel for collecting the de-gritted sewage, which overflow over a adjustable Weir into the Outlet Channel. It shall be designed in such a way that no settling takes place in it.
- One sloping Grit Classifying Channel in to which the collected grit shall be classified.
- The grit from Classifier shall be collected in a Wheeled Trolley .
- A Grit Scraping Mechanism.
- Screw Classifier or Reciprocating Rake Mechanism to remove the grit.

Manually Operated C.I. Sluice Gates shall be provided at entrance of the Inlet Channel of the Grit Chambers as well as Bypass Channel to regulate the flow.

No. of Units	:	Min. One mechanical working
Type	:	Mechanical
Size of grit particle	:	0.15 mm
Specific gravity of grit	:	2.65
Maximum Surface Overflow Rate	:	960 m3/m2/day
Free Board	:	0.50 m min..
Side Water Depth	:	0.90 m min.
Wheel Barrow	:	1 No. minimum

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

Flow Measurement

Flow measurement shall be done online using an ultrasonic flow meter on the rising main of raw sewage transfer pumps or

Flow measurement in the common outlet channel after screening and grit removal shall be in the form of a Parshall flume housed in the RCC channel. There shall be a straight length of at least 10 times the throat width of the channel housing the flume in both upstream and downstream of the flume. The flume shall be constructed in RCC and finished in cement mortar. An ultrasonic

level measurement device shall measure sewage depth in the flume and the flow computation shall be through the dedicated digital display with integrator near the flume. The readings of this meter shall be transmitted to the control room. Parshall flume channel shall lead to the distribution chamber of biological treatment.

3.05 Biological Treatment of Sewage

- **Process Design**

Sewerage from the primary treatment shall enter biological process basins. Screened and De-gritted sewage shall be fed for biological treatment to remove BOD, COD, Suspended Solids, Nitrogen and Phosphorous.

It shall perform biological organic removal, Nitrification, De-nitrification and Biological Phosphorous removal. It shall be capable of simultaneous sludge stabilization. Complete operation including decanting rate, sludge recirculation and wasting of excess sludge shall be controlled by PLC. Treated Sewage shall be disposed in the adjacent drain through Sewerage Pipe after chlorination.

The treatment technologies which are not giving the desired outlet quality are not acceptable. Only those technologies which are capable to achieve the desired outlet quality and for those design guidelines are given in CPHEEO manual are only acceptable.

A) Biological processes (For SBR process if proposed by bidder):

a) SBR Division Box (If required):

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

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

- Sewage shall flow by gravity into Anoxic Tank via appropriate isolation gates. Anoxic Tank shall be designed for biological nitrogen removal as per the tender specifications.

- The system shall have a sludge volume index (SVI) <120 for higher settling rates and should be designed in such a way that growth of filamentous bacteria is restricted. The complete operation including Filling of Sewage, Aeration, Sludge Recirculation, Decanting and Wasting of Excess Sludge shall be controlled by PLC. Treated sewage from Sequencing Batch Reactor (SBR) Units shall be discharged in Chlorination Tank for its disinfection.

c) SBR basins:

1. Sequencing Batch Reactor (SBR) shall be either continuous flows and intermittent decant or intermittent flows and intermittent decant type. It shall perform biological Organic Removal, Nitrification, De-nitrification and Biological Phosphorous Removal and shall be capable of simultaneous sludge stabilization. SBR designs shall strictly comply with process requirement set out in this bidding document and all other requirements specified in the bid documents.

2. If the SBR cycle includes fill during settle, the contractor shall fully describe the internal configuration of each basin which ensures that mixed liquor settlement is not adversely affected, and that short circuiting of influent wastewater does not occur.

3. The decanters shall be designed to prevent solids entering the decanting device during the aeration phase. Each decanter shall be fitted with scum retention mechanism/ baffles to prevent surface scum and floatables from exiting with the treated sewage. Any shortfall in meeting the performance standards due to decanting depth observed during commissioning and operation of the plant shall be corrected by contractor at his own risk and cost.

4. Each SBR tank shall be fitted with separate scum collection & removal system. The system shall be designed to minimize the volume of liquid discharged with the scum whilst providing efficient removal of the scum and shall be capable of collecting the scum with varied water levels of tank. All the scum shall be properly screened separately in accordance with screening requirements specified in tender document and liquid stream shall be sent directly to the Thickened Sludge Sump using an automated pumped system.

5. SBR basins may or may not have internal partitions. Regardless of such internal partitioning, all SBR designs shall strictly comply with the minimum requirements specified in the bid documents.

6. Designing, providing and constructing in RCC (M 30), SBR basins for biological removal of BOD along with built-in nitrification-de-nitrification, Bio-P removal in compartments to handle design flow including recirculation flow and construction ofselector compartments and providing 1.2 m wide clear approach walkways, expansion joints wherever necessary, including foundations etc as per specifications, aeration system complete with air blowers, fine diffused aeration grid and FB 0.5 m and SWD as required. DO level in basin to be minimum 2 mg/l and all related instruments, Stainless steel decanters and automation works. MLSS concentrations & F/M shall be as specified below to arrive at the specified HRT range and SRT suitable for fully digested sludge. SBR process shall have steps like Fill & aeration, Settling (Sedimentation/clarification), Decanting. The system should work on a gravity influent condition. It should have all other related works.

Division Box for SBR		
Design Flow	-	Peak Flow
Minimum Freeboard	M	0.5
MOC	-	RCC M30

Anoxic Basin/ Bio-Selector Zone

Design Flow	-	Average Flow
MOC – Structure		RCC M30
Side Water Depth (SWD)	M	Min. 5
Minimum Freeboard	M	0.5

Minimum HRT at Average flow	Hrs	For STP based on SBR process as per technology provider's design;
Mixing in Selector zone/ Pre-react zone	-	Submersible mixers or mixing as per bidder's design
SBR Submersible Mixers (if required)		
Direct pumping turnover frequency	per hr	1
Minimum number of Mixers per basin - Working	Number	1
Maximum number of Mixers per basin - Working	Number	4
Mixer type	-	Submersible or floating mechanical
Minimum number of mixers - Uninstalled Spares as percent of Working	%	25
Minimum number of mixers - Uninstalled Spares	Number	1
Required Minimum unit power input	w/cum	5
MOC	-	SS316

SBR Biological Processes – Design Requirements				
Sr. No.	**Parameters**	**Units**	**Continuous Flow and Intermittent Decant**	**Intermittent Flow and Intermittent Decant**
1	Minimum number of basins	Nos.	2	
2	MOC – Structure	-	RCC M30	
3	SWD	m	Min. 5	
4	Minimum Freeboard	m	0.5	
5	Food applied t oMicroorganism ratio (F/M)	d^{-1}	0.05-0.08	0.05-0.3
6	Sludge Age	d	15-20	4-20
7	Sludge Yield	Kg dry solids/ Kg BOD	0.75 to 0.85	0.75 to 1.0
8	Mixed Liquor Suspended Solids (MLSS)	mg/l	3,000-4,000	3,500-5,000
9	Cycle Time	h	4-8	2.5 -6
10	Settling Time	h	>0.5	>0.5
11	Decant Depth	m	1.5	2.5

12	Fill Volume Base	-	Peak Flow	Peak Flow
13	HRT	h	As per technology provider's design;	
14	Minimum RAS (% of influent)	%	25	25

Note: The design SBR system shall be as per Table 5.57 Typical process parameters for SBR configurations of page no. 5-198 of CPHEEO manual.

Decanting Device

- The Decanting Device shall be Moving Weir Arm Device of SS 304 or higher grade with top mounted Gear Box, Electric Drive, Scum Guard, Down comers, Collection Pipe, Bearings. The following type of decanter assemblies are not acceptable:

  - Rope Driven Decanters.
  - Floating Decanters.
  - GRP Products.
  - Valve Arrangement.

- Maximum weir loading rate for SBR decanters shall not exceed 140-180 m3/hr/m. Technology provider.
- Bidder shall be provide the evidence along with his bid that the technology provider has provided decanter in at least 01 number of STPs in India, and successful operation for last 5 years.

Aeration System

- The aeration facility shall be installed for average flow.
- Only Fine Bubble Type, EPDM / PU Membrane Diffusers shall be acceptable with minimum Membrane Diffusers to Floor Coverage Area of 5%. Combination of aeration techniques using Aerators/Submersible Mixers etc. is not acceptable. Diffusers shall be submerged, fine bubble / fine pore, high transfer efficiency, low maintenance and non-buoyant type. Diffusers shall be panel / tubular type. In case tubular type Diffusers are used, only top half surface area of the Diffuser shall be considered for supply of air. Material of construction for entire under water system including accessories shall be of non-corrosive. Complete Diffuser as a unit shall be assembled at the manufacturing factory level. The grid supports shall of adjustable type made of SS 304.
- The Air Blower Arrangement shall be capable of handling Total Water Level and Bottom Water Level operation conditions controlled by process sensors such as DO, Temperature and Level.
- Each set of blower shall have at least one dedicated standby. Minimum One working air blower in each set shall operate via VFD while others may be operating at a fixed constant speed on soft starter configuration.
- The blowers for air diffuser system shall be positive displacement (roots) type, and head for blowers shall be decided on the basis of efficiency of diffusers and maximum liquid depth in tank duly considering the losses governing point of delivery (diffusers) and the blowers. Blowers shall be complete with motor and accessories like base frame, anti vibratory pad, silencer, non return valve, air filter etc. as per requirements. Vibration due to operation of blowers shall be to avoid damage to structures. Further, blowers shall have acoustics to ensure that the noise level at 3 m from blowers is below 50-db. The blower room shall have sufficient ventilation, lighting and working space. The room will be equipped with sufficient capacity EOT (Min 2 T or 1.5 times the weight of blower, whichever is more) to facilitate removal of blower/ motor etc. for repairs. The room will also have rolling shutter.

- The blower and air diffuser system shall include PLC based control for diffuser operation. The
- operation and speed of blowers shall be automatically adjusted using parameters like Oxygen Uptake Rate, Dissolved Oxygen and Temperature, Incoming flow and liquid level in the basin such that the DO is supplied as per demand and power utilisation for operation of blowers is optimised.
- The main air header/ring main shall be in MS as per relevant IS painted both outside and inside with corrosion resistant paint as per manufacture's recommendations. The header / ring main shall be supported on saddles at suitable intervals or will be protected against external corrosion in case they are laid below ground. The header shall have auto valves to facilitate switch over aeration cycle from one basin to other by PLC operation. The header shall supply air to fixed type diffuser grids at various locations through air supply pipes. Air supply pipe above water level shall be in GI and below water level it shall be in uPVC as per relevant standards. All under water lateral pipes shall be of uPVC. Junction between air header and air supply pipe shall be suitably protected against corrosion due to dissimilar materials.
- All other accessories, whether specified or not, but required for completeness shall form part of contractors scope. An Air cooler shall be provided, if required at the common discharge blowers to ensure that the air temperature at the inlet of diffusers is less than 80 deg. C

Blower Capacity	:	As per process requirement
Minimum Blower Head	:	As per process requirement
Number of Blowers	:	Min. 3 nos. (2W + 1S) in each set
Type of Blower	:	Twin Lobe

Return Sludge and Excess Sludge Pumps

Dedicated Return Sludge, if required and Excess Sludge Pumps shall be provided in each SBR Basin. The Pumps shall be of submersible / horizontal centrifugal type suitable for handling biological sludge of 0.8 – 1% solids consistency. Capacity and Heads shall be decided based on process requirements. Each Basin shall be provided with suitable lifting arrangements to facilitate lifting of these Pumps if required for maintenance.

A. RETURN SLUDGE PUMPS (IF PROVIDED)

Capacity and Head	:	As per requirements
Type	:	Submersible / Horizontal Centrifugal
Liquid consistency	:	Biological Sludge of 0.8 – 1% solids
Specific gravity	:	1.05
Solid size	:	40 mm (Maximum)
Temperature	:	Min. 25° C
Efficiency	:	more than 50%
Quantity	:	1 No. per Basin + 1 No. Store Standby

B. EXCESS SLUDGE PUMPS

Capacity and Head	:	As per requirements
Type	:	Submersible / Horizontal Centrifugal
Liquid consistency	:	Biological Sludge of 0.8 – 1% solids
Specific gravity	:	1.05
Solid size	:	40 mm (Maximum)
Temperature	:	Min. 25° C
Efficiency	:	more than 50%
Quantity	:	1 No. per Basin + 1 No. Store Standby

Automation and Control

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

- HMI Panel shall comprise latest Personal Computer with 22" LCD Monitor, Multi Media Kit, Printer, Internet Connection, RS-View, RS-Links (Gateway Version), Process and Operator Software with dynamic Flow Charts, Pictures, Screens, Alarms, Historical Trends, Reports etc.
- SCADA based Automation System to monitor the following parameters continuously in each SBR Basins:
  - Fill Volume
  - Discharge Volume
  - Temperature
  - DO Level
  - Oxygen Uptake Rate
- Air Blower Speed
- Decanter Speed

The basic continuous signal instrumentation system

It shall include flow measurement and the necessary water level readings from a pressure transducer device installed in each reactor. The measuring elements for all instruments including floats shall be located together on the side of the reactor in a well-mixed area easily accessible for maintenance.

- **Level transducers**

  One level transducer shall be used in each reactor and in any other basin where water level is to be monitored to assure the automation of the operation. One spare pressure transducer shall be supplied to enable a quick replacement of a faulty part. The pressure transducers shall be maintenance-free with a maximum deviation of less than 2% over a period of 6-month operation.

- **Dissolved oxygen (DO) transducer**

  One DO transducer shall be supplied for each reactor. This instrument is meant to control the aerobic environment in the reactor by controlling the blower operation (start/stop). Proper logic control is to be established by the bidder. One spare sensor shall be supplied to enable a quick replacement of a faulty part.

- **Sequence control strategy**

  The TECHNOLOGY PROVIDER shall be responsible of providing all the logic control programming and related hardware into an enclosure panel described further complete with all the equipment specified herein.

  The contractor shall be responsible to install the logic control panel and to provide and install separate MCC and power distribution panels as specified in the electrical section of this specification. The contractor shall also be responsible to interconnect electrically all the instrumentation and float signals specified herein with the logic control and the MCC panels as needed for a complete automated operation.

- **Logic control hardware and panel**

  The program controller shall be provided with key pad and display to enable the operator to easily re-adjust all cycle time and sequence. The programmable logic controller (PLC) shall have sufficient memory to perform automatic control of the process described herein and shall be sized to provide an additional number of input/output capacity of 10%.

  All control equipment installed in the control panel shall be accessible for operation or mounted on the front face of the panel. This panel shall control the operation of the various process equipment including:

  - influent valves or gate weirs
  - air blowers
  - decant equipment
  - waste sludge pumps (or valves)
  - any additional process equipment specified herein

The PLC shall receive all input signals or described and take the necessary decisional action in regards to the operation of the above process equipment.

The panel for the logic control shall be NEMA enclosure and shall be provided with necessary control breaker transformers and supplementary contacts as noted herein.

The panel wiring shall be sized per applicable codes using AWG 16 gauge minimum wire size. Wiring terminal blocks shall be rail mount control terminal type thermoplastic rated at 600 Volts. No more than two wires shall be allowed to terminate in anyone terminal.

The panel face shall be provided with an individual 3-position selector switch (HOR) for each automated valve, blower (4-position selector if dual-speed blower), pump, decanter or auxiliary equipment and instrumentation specified herein. It shall be equipped with one pilot light dedicated to each equipment.

The pilot light shall be wired in parallel with the related motor starter auxiliary contact or relay other limit Switch contact to indicate that the equipment is activated or deactivated. Pilot lights shall be 415 VAC direct types or led type.

All internal devices shall be clearly marked and identified as to its application, including selector switches, pilot lights, pushbuttons and other devices exposed in front of the panel. Identification nameplates shall be black with letters or numbers in white, carved in plastic.

For all automated valves and decanter operation, feedback signal shall be also provided and connected to the logic controls to acknowledge and confirm the good operation. In the event of one equipment failure, the reactor shall be temporarily bypassed and an alarm shall be activated to notify the operator. In the meantime, the flow shall be managed by the other reactor(s) in accordance with the programming.

The control panel shall be equipped with circuitry to shutdown automatically the pump motor when required, to protect this equipment from damages caused by excessive humidity, temperature, or current overload. The contractor shall be responsible for connecting these pumps and motor sensors to the appropriate circuit in the control panel to protect the pumps in accordance with the pump manufacturer instructions. One pilot light shall be mounted on the control panel surface to indicate an alarm condition; all alarms shall appear on the operator interface. In both cases, these alarm conditions shall open the circuit of the pump starter to prevent it from starting.

The control panel shall be shipped completely factory wired, assembled and factory tested.

- **Programmable Logic Controller**

  The programmable logic controller (PLC) shall be Allen-Bradley or approved equal.

- **Operator Interface Unit**

  The operator Interface Unit shall be ABB Panel View or approved equal.

3.05 Disinfection System

Chlorine Contact Tank

For Chlorination of final treated sewage a provision shall be made so that no harm is caused to the receiving water body. Decanted treated water from Biological treatment Process shall be taken to chlorine contact tank by RCC channel/pipe.

Tank shall be provided for dosing of chlorine from the chlorination system to the sewage from Biologocal Process. The tank shall be constructed as per the relevant IS code. RCC platform 1000 mm wide as per specifications shall be provided. RCC staircase 900 mm wide shall be provided for access from the ground level to the top of the unit and to the operating platforms. Baffle walls shall be provided to achieve proper disinfection. The baffle walls shall be constructed in concrete and 20 cm thick plaster in CM 1:3 on either side.

The inlet and outlet pipe shall be designed for peak flow.

No. of Units	: 1 no.
Detention Time whichever is more	: min. 30 minutes of average flow or decant flow

Freeboard	: 0.5 m

Chlorination System:

Number of Units	: 2 nos. (1W + 1S)
Type	: Vaccum Chlorination system
Chlorine Dosing	: 5 mg/l
Residual chlorine	: 0.2 mg/l
Capacity of system	: Rounded to the upper Kg./hr.

Chlorine house of adequate plinth area shall be provided. It shall have sufficient ventilation as per the latest norms for safety purpose with necessary lifting arrangement and EOT etc. complete. All other accessories, whether specified or not, but required for Chlorination shall form part of contractors scope.

UV, if proposed by the contractor for disinfection should have valid USEPA certification or relevant Indian certification issued by Government of India (ISI) . UV should be designed for maximum 60-65% UV transmittance.

3.06 Outlet Pipe

Treated sewage after chlorine contact tank shall be taken to disposal to the discharge point. The length of the Pipe shall be as per site condition. Capacity of the pipe should be such that it can carry peak flow.

3.07 By-Pass Arrangements

Adequate by-pass arrangement shall be provided from Raw Sewage pump sump & inlet chamber at the entry of STP, to the outfall of the drain in case of necessity

4.0 Solids and sludge handling

4.01 Sludge Holding tank

A tank shall be provided to store sludge from the WAS pumps and to act as a sump for sludge transfer to centrifuge.

Submersible mixer (<500 rpm) shall be provided inside the sludge sump to keep the sludge in suspension. The material of construction of the mixer shall be SS304 along with lifting device with SS 304 square tube.

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

4.02 Sludge Pump House

Screw pumps for sludge transfer from sludge holding tank to centrifuges, polyelectrolyte dosing system and air blowers for mixing of sludge in sludge holding tank will be housed in the sludge pump house. It shall be RCC framed structure with sufficient openings in the form of doors, windows, ventilators etc. and 1 MT capacity chain pully block will be provided in it, for material handling purposes. Minimum carpet area of this building will be 20 sqm.

4.03 Polyelectrolyte Dosing

The polyelectrolyte will be dosed and blended with the sludge in the sludge sump. Min dose of polyelectrolyte shall be 1.5 kg/T of dry solids in sludge. There shall be one poly-dosing tank. Min volume of each dosing tank shall be suitable for 8 hrs requirement of dosing. Each tank shall be equipped with slow speed mixer (100 RPM) to prepare polyelectrolyte solution. To feed the solution into sludge sump by dosing pumps.

4.04 Centrifuge Feed Pump

The sludge pumps will be positive progressive cavity displacement types. There shall be min. two pumps (One Working + One Standby) for pumping this sludge to the centrifuge. The minimum capacity of the pump shall be 1 m3/hr. Pumps will have solid handling capacity of not less than 40 mm sphere. M.O.C. of pump shall generally be C.I.

Pump and motor will be mounted on a common MS fabricated base frame. The coupling will be flexible coupling. The motor will be TEFC and driven through belt drive.

4.05 Centrifuge

Thickened sludge shall be pumped to the centrifuge unit for dewatering. It shall be provided at suitable elevation for the dried sludge from centrifuge to be collected in a trailer/container situated below it.

Centrifuge shall be operated for maximum 18 hours in a day and floor mounted. It shall be suitable to handle excess sludge from biological basins. The minimum solid contents in the sludge at centrifuge inlet shall be 0.8 - 1 %.

The material of construction of all parts coming in contact with the liquid shall be in CS.

Min. Number of Units	: 2 (1W + 1S)
Operation	: Maximum 18 hours running per day
Dry solids in dried sludge	: 15 – 18 percent

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

4.06 Centrifuge Shed

Sludge dewatering system shall comprise of centrifuge shed of appropriate size, which includes thickened sludge pumps, poly dosing tank with mixers, centrifuge unit.

Filtrate from the sludge shall be taken to plant drainage system by gravity.

4.07 Disposal of Solid Waste

Disposal of all solid wastes except wet cake as generated from the STP during construction, commissioning, and O & M shall be responsibility of the contractor. The solid wastes shall be disposed of in accordance as per instructions of the Engineer. The Sludge Land Fill (SLF) identified for disposal may be assumed maximum at a distance of 10 kms from the proposed new STP site for bidding purposes. Loading, unloading, transportation shall be to Contractor's account.

Grit & Screenings

The evacuated grit and screenings are to be disposed from the site by the Contractor at landfill site identified by the Employer's representative from time to time

Wet cake

The contractor can sell wet cake generated from STP during O & M period at his own level. If it is not possible to sale then wet cake shall be disposed off at land fill site identified by the Employer's representative from time to time considering at least 10 KM from STP site (for bidding purpose)

5.0 Ancillary Structures

5.01 D.G. Room (area as per DG manufacturer's requirements)

5.02 Outdoor Transformer Yard

5.03 Admin Buildings, MCC Room, Blower Room, Operator Room, SCADA Room, Laboratory

Sub-station /Transformer yard (outdoor), Master Control Rooms, D.G. Room shall be constructed at suitable at the location. The buildings shall be designed as per requirement.

The building shall have RCC framework of minimum not less than M25 consisting of RCC columns, RCC roof and beams with brick panels and foundation, suitably designed to take the load of the walls. Rolling shutters of adequate size shall be provided for the above rooms on the external walls. At the entrance of the transformer yard, M.S. gate shall be provided of adequate size.

The floor of the MCC rooms and D.G. room shall consist of 40 mm thick cement concrete laid over 1:2:4 including 15 mm thick ironed finish 150 mm thick 1:3:6 cement concrete. The floor of other rooms shall bewith 20mm thick mosaic laid over 150mm thick 1:4:8 cement concrete. The above floors shall be laid over well consolidate sand with rammed earth filling below floor. The walls shall be provided with 15 cms high skirting with 20 mm thick mosaic finish as per direction of the Engineer.

The brick walls of the buildings shall be plastered internally and externally with cement mortar 1:2:4 (1 cement : 2 coarse sand : 4 fine sand) and provided with distemper inside and water proof cement paint outside as approved by the Engineer. Ceiling shall be plastered with 1:4 cement mortar (1 cement and 4 fine sand) and three coats of white wash. All steel work in the doors/windows/ventilators, rolling shutters etc. shall be provided with a superior class paint/primer etc. approved by the Engineer to give a smooth finish.

The buildings shall be provided with plinth protection all around, 750 mm wide as specified. Necessary slopes shall be given in the plinth protection so as to drain away the rain water from the building. The roof shall be provided with water proofing as per DEPARTMENT specifications. A RCC stair case of required width shall be provided to access different floor levels.

The plinth level of the buildings shall be 600 mm above formation level. Suitable ramps shall also be provided wherever required as desired by the Engineer.

The offer shall include for internal electric wiring of the buildings with light/fan fittings.

The buildings shall be of sufficient size to accommodate all machineries / equipments and controls and an office for operation, toilet, store etc. The tenderer shall verify and provide the required size from the practical point of view and ease of operation.

5.04 Interconnecting Piping and Valves

All piping including valves, specials and other appurtenances, auxiliaries and accessories required as per process design and scope of work. All the piping, valves, specials shall be designed for peak flow.

In case of pumping mains thrust blocks shall be provided whenever required. In case of buried pipes warning tapes shall be provided of the appropriate colours.

Piping: Guideline for Velocity

Sr. No.	**Service**	**Design Velocity m/s**	**Limitations**
1	Gravity Lines for Sewage & Water	0.6 – 1.2 Designed as pipe line flowing full.	Min. Velocity shall not be less than 0.6 m/sec. Max. Velocity up to 1.2 m/sec is allowable at Peak Flow.
2	Pressure Lines for Sewage & Water	0.6 – 2.5	Min. Velocity shall not be less than 0.6 m/sec. Max. Velocity up to 2.5 m/sec is allowable at Peak Flow.
3	Air (Pressurized Lines)	18 – 22	Max. Velocity shall not be more than 25 m/sec in any section.

Sr. No.	Service	Design Velocity m/s	Limitations
4	Scum & Sludge Lines	0.6 – 1.5	Irrespective of flow, Diameter shall not be less than 150 mm for Gravity Lines.
5	Chemical Feed Lines	0.6 – 1.5	Irrespective of flow, Diameter shall not less than 20 mm.

Notwithstanding the above, the Contractor shall submit a Pipe Line Schedule with Tag No., Flow, Size, Type, Material of Construction etc. with detailed P & ID for approval of the Engineer-in-charge prior to any further engineering or procurement/fabrication and installation.

Generally, the Material of Construction shall be selected based on the following guide lines. The Bidder can make suitable selection depending on Service, Type of Flow (i.e. Gravity or Pressurized) and Diameter of Pipe.

Piping: Guidelines for MOC

Sr. No.	Service	Type of Flow	MOC
1	Waste Water / Sludge	Gravity	RCC NP-3 Class
2	Waste Water / Sludge	Gravity/Pressurized	CI Class "LA" / DI K-9
3	Service Water	Gravity / Pressurized	GI "C" Class
4	Air Lines: Headers, Vertical Down-comers	Pressurized	**Above Water:** MS Sand/Shot Blasted, Epoxy Painted **Under Water:** SS 304
5a	Air Grid Piping: Aeration Zone	Pressurized	UPVC Schedule 40
5b	Air Grid Piping: Selector Zone	Pressurized	SS 304
6	Chemicals	Gravity / Pressurized	SS 304 except Chlorine & FeCl3
7	Chlorine & $FeCl_3$	Gravity / Pressurized	Schedule 40 UPVC

Valve: Guide Line

Sr. No.	Service	Type	MOC	End Connection
A	**Sewage / Sludge**			

1	Gravity / Pressurized	Knife Gate	CI Body & SS 304 Gate & SS 410 Spindle	Flanged/Wafer
2	Delivery of Pump	Swing Check	CS Body & SS 304 Internals	Wafer
3	Suction & Delivery of Pump	Knife Gate	CI Body & SS 304 Gate & SS 410 Spindle	Flanged/Wafer
B	**Service Water**			
1	Gravity / Pressurized	Ball	CS Body & SS 304 Internals	Flanged/ Screwed
2	Delivery of Pump	Swing Check	CS Body & SS 304 Internals	Wafer
3	Suction & Delivery of Pump	Butterfly	CI Body & SS 304 Internals	Wafer
C	**Air**			
1	Pressurized	Ball	CS Body & SS 304 Internals	Flanged/ Screwed
2	Delivery of Blower	Swing Check	CS Body & SS 304 Internals	Wafer
3	Suction & Delivery of Blower	Butterfly	CI Body & SS 304 Internals	Flanged
D	**Chemicals**			
1a	Gravity / Pressurized	Ball	As per Chemical Compatibility Chart	Flanged
1b	Gravity / Pressurized	Diaphragm	As per Chemical Compatibility Chart	Flanged
1c	Gravity / Pressurized	Plug	As per Chemical Compatibility Chart	Flanged

5.05 Security Room

The security room at entry of road shall be provided. This shall be a ground floor construction with3m x 5m carpet area and be of RCC frame structure building with in filled rock faced stone masonry and shall be provided with glass panels on three sides and an air cooler. Necessary fans and lights shall be provided as directed by the Employer's representative. Toilet and bathroom shall be attached with security room. There shall be a working platform made of Granite stone.

5.06 Landscaping

Landscaping involves beautification of Sewage Treatment Plant site by cultivating plants, shrubs and trees of environmental value and suitably modifying the appearance of STP site. It shall add scenic value to the STP site to obtain maximum visual impact. Contractor has to develop proper landscaping in the STP site as per guidance from the Engineer in charge. Area for future expansion shall also be considered for landscaping.

5.07 Compound Wall and Retaining wall (if required) of STP site and its Main Gates

R.R Masonry Compound wall of not less than 2.4 m above the finished ground level, 34 cm thickness with suitable foundation, for covering the entire plot boundary around the proposed site.

5.08 Earth Filling Cutting and Dressing

If Area shall have to be filled up, consolidated, levelled and nearly dressed upto required formation levels. In case earth is required over and above the surplus excavated for the same, the tenderer shall have to arrange good sheet earth from its own resources and provide for same in their offer. Filling of such earth in layers with proper consolidation as per specifications shall be done.

5.09 Walkway and Pathway/Footpath

All Elevated RCC walkway 1.2 m wide shall be of RCC with M-20 grade concrete. The floor of the walkway shall be finished smooth with 40 mm thick cement concrete. It shall be provided with one meter high GI pipe railing on both sides of the walkway with connecting platforms.

All pathway and footpath over ground connecting individual units to bituminous road shall be 1.2 m wide and be 100 mm thick cement concrete (1:3:6) finished with 40 m thick (including base mortar 1:4) checkered cement concrete tiles. The base concrete to be laid on 150 mm thick hard core with 40 mm down stone ballast and murram rammed and consolidated properly as per direction of Engineer.

5.10 Roadway

Roads as per lay out shall be provided around all units as directed.

5.11 Parking Space

Adequate parking space should be provided. The area shall be paved as per WBM specification.

5.12 D. G. Set

D. G. Set shall be provided to cater for the power failures. Capacity of D.G. set shall be minimum 50% total connected electrical load (STP + RSPS). D.G. Set will be placed in DG Room, to be provided in the STP premises.

5.13 <u>Scope of Work for Operation & Maintenance</u>

The Bidder shall operate and maintain the Raw Sewage Pumping Stations, Sewage Treatment Plant and all other allied works under this Contract for a period of 10 years including 2 years defect liability period. For this period, the scope of work shall include, but not be limited to the Operation and Maintenance of the following:

- Raw Sewage Pumping Station and Sewage Treatment Plant at ------ including all the Civil Units and Electro-Mechanical Equipments as per the Bidder's Proposal to ensure that all the output guarantees are met.
- General Facilities and Utility Services.
- PLC/SCADA based Automation system.
- All other in-plant facilities listed in the detailed Scope of Work

The Bidder shall also dispose-off the sludge, screenings, grit and any other material, as per specifications and to the satisfaction of the Engineer In-charge. It is to be noted that all costs during the Operation & Maintenance period excluding cost of power and diesel for DG is to be borne by the Contractor. Within his quoted cost, the Bidder is to ensure that the following guarantees are maintained:

- Guarantee for Quality of Treated Sewage.
- Guarantee for Power Consumption.
- Guarantee for Automation System.

The Bidder shall provide on job training to the Employer staff as per specifications.

The Bidder shall, at no extra cost to the Employer, repair and re-condition all the required mechanical equipments in the concluding year of the Operation & Maintenance period and Hand over the facility to the Employer in proper & fully working condition.

5.14 Operation and Maintenance Cost

All the cost for Operation and Maintenance of the Plant such as Chemicals and Consumables, Disposal of Screenings, Grit and Dewatered Sludge, Manpower, Spares, Repair and Maintenance of Civil, Mechanical, Electrical, Instrumentation Items including all other major/minor repairs, breakdowns, replacements etc. **excluding Cost of Electricity and Diesel for DG** shall be in the scope of the Bidder. **No extra payment other than whatever has been quoted in Price Schedule will be entertained by the Employer.**

1. General Obligations

The Bidder shall during the O&M Period, undertake all services relating to operation and maintenance of the Project Facilities in conformity with O&M Requirements.

a. The Bidder shall submit to the Engineer-in-charge a plan for operation and maintenance of the Project Facilities ("O&M Plan") in conformity with the Construction Requirements, O&M Requirements and Performance Standards as set out in Tender Document after the completion of the construction period.

b. The O&M Plan shall set out in detail the standards, schedules, procedures, type, periodicity and other details of the operation and maintenance activities to be carried out for the Project during the O&M Period so as to meet the O&M Requirements as well as details of the management information system to be incorporated, reports to be submitted and procedure for reviews, including developing a mechanism for corrective actions.

c. Engineer-in-charge shall review the same and convey its comments/observations to the Bidder on the O&M Plan, including the need, if any, to modify the same. If the comments/observations of the Engineer-in-charge require the O&M Plan to be modified, the Bidder shall suitably modify the O&M Plan. The O&M Plan shall be finalized with mutual consent.

d. Notwithstanding any review or failure to review by the Engineer-in-charge or the comments/ observations of the Engineer-in-charge, the Bidder shall be solely responsible for the adequacy of the O&M Plan and the conformity thereof with the Performance Standards, Construction Requirements and O&M Requirements and shall not be relieved or absolved in any manner whatsoever of any of its obligations hereunder.

e. The Bidder shall inform engineer-in-charge details of its key personnel responsible for O&M and subsequent changes, if any, from time to time. However minimum manpower as given in the tender document shall be provided for the Operation and Maintenance of the project at all times.

f. The Bidder shall undertake operations and maintenance of the Project Facilities by itself or through Contractor possessing requisite technical/financial/managerial expertise/ capability, but in either case, the Bidder shall remain solely responsible to meet the O&M Requirements.

g. The Bidder shall incorporate good management practices and appropriate technologies required for meeting the Performance Standards.

h. During operation of the plant, all instruments which requires calibration should be calibrated as per the frequency specified by the manufacturer/technology provider. Such calibration report must be submitted on monthly basis.

i. The Bidder shall, during the Agreement Period;

   (i) have requisite organization and designate and appoint suitable officers / representatives as it may deem appropriate to supervise the Project, to deal with the Engineer-in-charge and to be responsible for all necessary exchange

of information required pursuant to the tender provisions; following minimum Manpower as required for the plant operation and maintenance as per the Tender Document shall be provided at all times.

- Plant supervisor/Manager – 1 no. with minimum qualification of MSc in environmental or greater having experience of minimum 7 years of operation of the STP on aerobic treatment processes.
- Plant operators – minimum one number in each shift with minimum qualification of ITI or greater having experience of minimum 5 years of operation of the STP on aerobic treatment processes.
- Mechanic/Fitter - minimum one number in general shift with minimum qualification of ITI or greater having experience of minimum 5 years of maintenance of the STP on aerobic treatment processes.
- Plant chemist – minimum one number in general shift with minimum qualification of Bsc or greater having experience of minimum 5 years of analysis of all the sewage parameters.
- Electrical/Instrumentation – Minimum one number in general shift with minimum qualification of ITI in relevant field having experience of minimum 5 years of maintenance of the electrical/instruments of STP.
- Helpers/gardeners/security/office staff – should be provided round the clock as per the requirement

(ii) for the purposes of determining that the Project Facilities are being maintained in accordance with the Construction Requirements and O&M Requirements, the Bidder shall with due diligence carry out all necessary and periodical Tests in accordance with the instructions and under the supervision of the Engineer-in charge Bidder shall maintain proper record of such Tests and the remedial measures taken to cure the defects or deficiencies, if any, indicated by the Test results.

(iii) conduct all Tests / guaranteed trial runs to ascertain compliance with Construction Requirements and O&M Requirements.

(iv) suspend forthwith the whole or any part of the O&M activities upon receiving a written notice from the Engineer-in-charge who may require the Bidder to suspend the activities in whole or part if in the reasonable opinion of the Engineer-in-charge, the operations are being carried on in a manner that is not in conformity with the O&M Requirements.

(v) be responsible for the security of the Project facilities and comply with all applicable laws, statutory requirements as may be applicable from time to time.

(vi) be responsible for the routine as well as any capital replacement that maybe required either to meet the agreed specifications and performance of the Project facilities.

(vii) The Bidder shall as per pre agreed format record the system performance and periodically provide the same to Engineer-in-charge.

1.1. Other Obligations during O&M stage

The Bidder shall:

a. from the Date of commissioning, undertake all services relating to Development,

operation and maintenance of the plant in conformity with O&M Requirements.

b. and shall meet its Performance Standards as per the Tender Document and all statutory laws as applicable.

c. From the Date of commissioning, carry out the following activities in the Project Area:
   - Ensure that treated sewage is recycled and used within the plant battery limits for various non-human consumption activities to the extent possible.
   - Obtain the desired Performance parameters from the plant, such that it is necessary that each unit's treatment process is operated and maintained to function at optimum level and the process parameters to be maintained at each unit of treatment plant is closely monitored.

d. The Bidder shall Operate & Maintain the Project facilities with the following scope of work:
   1. For a period of 10 Years from the date commissioning.
   2. Treat Raw Sewage to desired treatment standards and with the treatment process specified in the Tender Document.
   3. Supply of necessary chemicals and consumables as required for treatment specified in the Tender Document under functions and responsibility of the Bidder.
   4. Provide the qualified staff required including security for watch and ward, necessary skilled and trained men for preventive and breakdown maintenance of all the equipment's and components of the Project facility.
   5. Cost of all repairs i.e., major and minor to all the equipment's, plant and machinery, electrical and mechanical equipment's, instrumentation and civil works etc.
   6. Cost of all spares/replacements to all the equipment's, plant and machinery, electrical and mechanical equipment's, instrumentation and civil works etc.
   7. Cost of all labor, materials, special tools and ordinary tools and parts required for maintenance of all equipment's.
   8. Cost towards disposal of screenings, grit and dried sludge within 2.0 Km radius of the STP site.
   9. Supply of engine oil, lubricants, necessary spare parts.
   10. Cost towards salary of staff, guidance and training of staff, monitory of the treatment process by Public health engineer as specified.
   11. Carrying out Raw and Treated sampling, testing, according to the standard test procedures.
   12. Cost of necessary chemicals reagents, and glass ware for testing the samples by the chemist employed including monitoring and control of treatment process and ensuring that the raw sewage is treated in accordance to the performance standards prescribed in Schedule - 7.
   13. Maintaining log books/ registers for daily inputs and outputs , flow rates, quality test results , chemicals consumed , energy used, staff attendance , preventive and break down maintenance works done for each equipment and other plant Operation & Maintenance data etc.
   14. Maintaining gardens, trees, roads and drains in the plant premises and keep the Project Facility / Project Area and equipment's in good working conditions conforming to all the requirements set out under this Agreement.
   15. Any other item left out and necessary as per guidelines of statutory agencies will be carried out within scope of above work.
   16. Take necessary action as may be appropriate and in accordance with Prudent Utility Practices in the event of an emergency or risk of danger or damage to persons or property (including the Project Facilities).

1.2. O&M Cost Obligations

The Bidder rate quoted by him in the Price Bid shall include following O&M Cost obligation with other contractual obligation within the Project Area.

a. Water usage cost
b. Establishment cost
c. Chemicals & other consumables cost
d. Manpower for Plant operation
e. Maintenance & repairs / replacement of Project facility.
f. O&M obligation under this Contract unless excluded by this Contract.
g. All expenses towards Statutory permissions
h. Any other expense required for upkeep and smooth operation of the Project Facility.

1.3. General activities during Operation & Maintenance period

During Operation & Maintenance Period, contractor shall perform, not limited but including, following general activities:

2. Operations

2.1. Daily Operations of Facility

The Contractor shall carry out all facility operation and waste water conveyance, treatment & disposal operations indicated below; in accordance with Good Operating Practices, as set out in this Contract. The Facility operation and waste water disposal operations shall include, but not be limited to the following:

- Operating & Maintaining Raw Sewage at ------ and Conveyance of Raw Sewage to STP site at ------ .
- Operating & Maintaining Sewage Treatment Plant to maintain the quality of treated sewage within the standards prescribed in the Tender, operate electrical equipment during power failures by operating generators and operate Sludge Handling Facility.
- Removal and Disposal of screening, grit and sludge on regular basis at the designated place.
- Carrying out continuous flow measurements of treated & untreated sewage and recording the same online / offline.
- Collecting samples of influent and effluent and analyzing them daily to determine the quality of sewage and performance of the treatment plant and
- Providing security for facilities and system at all times.

2.2. Contingency Plan

Developing and implementing contingency plans in respect of responses to natural disasters, periods of power failure, storm water inflow into sewers during monsoon, de-silting of units of treatment plants, constraint operations or other similar emergencies to maintain the quality of treated sewage.

2.3. Energy Audit

The Operator shall take all necessary measures to minimize the power consumption in carrying out its operations. The energy audit operations shall include, but not be limited to the following.

- Reducing electricity consumption by regulating equipment operation through suitable modifications to the operating schedules.
- Maintaining power factor and demand to avoid penalty
- Installing more efficient pumping equipment and following better maintenance practices for electrical installation.

2.4. Repairs and Maintenance

The Contractor shall carry out preventive, routing maintenance and break down maintenance Operations for proper upkeep of plant in accordance with good operating practices. The following items shall be included in such maintenances.

2.4.1.Machinery and Treatment Plant Equipment

- Dewatering and de-silting of sludge Sump, chlorination Tank, chemical dosing tanks at least twice a year as per approved programs and disposal of silt.
- Cleaning and maintaining all rising mains/sewers in the plant area at least four times a year.
- Repairing and replacing damaged pipes, fittings and valves for suction and delivery pipe.
- Repairing and replacing pump impellers, body, bearings shafts column pipes.
- Repairing and replacing motors
- Repairing and replacing starters, circuit breakers, capacitors
- Repairing and replacing vanes and/or gears of agitators
- Repairing and replacing transformer.
- Repairing of blowers, decanter, diffusers, chlorinator, chemical dosing equipment's & Centrifuges.

2.4.2.Building and Civil Structures

- Water proofing leaking roofs of the Buildings.
- The preventive and routine maintenance shall include all repairs and provision of spares material and tools required for these repairs. The Contractors shall also carry out breakdown maintenance and repairs. The labour, tools and plant, spares shall be arranged by the Contractor. The following spares shall be the respective responsibility of the Contractor and the Employer during preventive routing and breakdown maintenance.

3. Advice Early Warning:

The Contractor is to warn the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the operations or the condition of the facilities and / or system. The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstances can be avoided or reduced and in carrying out any resulting instruction of the Engineer

The Contractor shall also advise the Employer from time to time, on improving the quality of operations, reduction in water / energy losses and betterment practices.

4. Reporting

The Contractor shall utilize the office space, provided by the Employer to establish its monitoring and reporting office along with computer and peripherals. It shall also obtain a telephone connection and maintain the same through the Contract period. All data transfers and updates made to the Employer shall be affected through the said telecommunications medium.

The Contractor shall carry out all reporting indicated below and as set out in this Contract. The reporting shall include, but not be limited to the following

- Daily summary of Operations at Sewage Treatment Plant – A daily report of operation of the diffuses, agitators, decanter and other equipment at the sewage treatment plants providing information on the quantity of sewage treated, hours of operation of equipment, energy consumed and use of chemicals.
- Sewage Quality Monitoring – A daily report monitoring the quality of raw and treated sewage through the analysis of samples.
- Sewer / Storm Water Drains / wet well & other units etc. Monthly cleaning report sewer / storm water drain de-silted and record of silt disposed at disposal sites.
- Continuous flow measurements of Raw & Treated Sewage and recording the same.

5. General Responsibilities

The Contractor shall maintain properly and keep intact all assets / works/facilities / system of the Employer throughout the Contract period and shall hand over the same in good working

condition at the end of the Contract. The Contractor shall not modify or alter any operations regarding the facilities and / or system without prior written permission of the Employer or its representative.

The Contractor shall procure all spare parts required for the maintenance of equipment excluding those to be supplied by the Employer. The Contractor shall warrant to the effect that all the spares shall be procured from the authorized sources and be of the best quality and fit for the purpose for which it is being used.

The Contractor is expected to carry out the work in such a manner as not because any damage to public property on account of negligence or otherwise. The Contractor shall be fully responsible for making good the damages so caused by him entirely at his own cost.

The assets / works / facilities / systems of the Employer shall be at the risk and in the sole charge of the Contractor and it shall be responsible for making good any loss or damage there to arising from any cause whatever including that due to a theft or robbery.

The Contractor shall provide adequate engineering equipment, maintenance staff, inventories plant and machinery and all other things, whether of a temporary or permanent nature required for carrying out operations under the Contract.

The Contractor shall carry out its Operations, so far as compliance with the requirement of the Contract permits, so as not to interfere unnecessarily or improperly with:

- The convenience of the public
- The access to use and occupation of public or private roads and footpaths to or of properties.

Permissions: The Contractor shall obtain all required permissions, sanctions clearances and permits for carrying out its Operations, including Contractors clearances and shall be fully responsible for carrying out the operations in a safe and secure manner, consistent with the law of the land, laws and regulations regarding such facilities and / or System and directives of any Authority and planning permissions.

Safety: The Contractor shall be responsible for the safety of all activities on the site and shall be absolutely and solely responsible for any and all kinds of injuries or damages to persons and property of any description whatever may be caused by or result from the operations carried out, whether these may have been carried out skilfully and carefully and strictly in conformity with the provision of the specifications or not.

Discoveries: All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall as between the Employer and the Contractor, be deemed to be the absolute property of the Employer. The Contractor shall take reasonable precautions to prevent its workmen or any other persons from removing or damaging any such article or thing and shall, immediately upon discovery thereof and before removal, acquaint the Engineer of such discovery and carry out the Employer instructions for dealing with the same.
The Contractor shall be responsible for payment of reinstatement charges for roads, footpaths and land as per the Employer's rates.

The Contractor shall take full responsibility for the adequacy stability and safety of all Site operations.

6. Staff & Labour:

6.1. Engagement of Staff & Labour

The Contractor shall employ skilled, semi-skilled and unskilled labour in sufficient numbers to carry out its operations at the required rate of progress and of quality to ensure workmanship of the degree specified in the Contract for timely fulfilling of the Contractor's obligations under the Contract and to the satisfaction of the Employer.

The Contractor shall not employ in connection with the operations any child who has not completed his/her fifteenth year of age. It shall also not employ an adolescent who has not completed his / her eighteenth year unless he/she is certified fit for carrying out operations as an adult as prescribed under clause b) of such section (2)(of Section 69 of the factories Act 1948.

The Contractor shall provide its staff, a minimum of two sets of uniforms with the titles the Employer inscribed on the back and subject to approval of the Employer. Each worker on duty shall wear a clean uniform whenever on duty.

The Contractor shall be required by the Engineer deliver to it, to such forms and at such intervals as the Engineer may prescribed a return showing the numbers of the several classes of staff employed by the Contractor on the site and such other information as the Engineer may require.

If the Employer asked the Contractor to remove a person who is a member of the Contractor's staff stating the reasons, the Contractor shall ensure that the person leave the site within seven (7) days and has no further connection with operations under the Contract.

At all times during continuance of the Contract, the Contractor and its sub-contractors shall abide by all existing and future labour enactment and rules made there under, regulations, notifications and bye-laws of the Central, State or Local Government. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by any Authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments.

If the Employer is caused to pay or reimburse such amounts as may be necessary to carry or observe, or for non-observance of the provisions stipulated in the notifications/bye-laws/acts/rules/regulations including amendments if any, on the part of the Contractor and in connection with labour enactment, the Engineer shall have the right to deduct any money due to the Contractor including its amount of security deposit. The Engineer shall also have the right to recover from the Contractor, any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

6.2. Contractor's Superintendence

The Contractor shall provide all necessary superintendence while carrying out its operations and as long thereafter as the Employer may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor shall nominate a competent and authorized representative (Contractor Representative) approved of by the Engineer which approval may at any time be withdrawn. The Contractor's Representative shall give its whole time to the superintendence of the operations. The Contractor's Representative shall receive, on behalf of the Contractor, instructions from the Engineer which shall be deemed received by the Contractor.

7. Repairs and Maintenance Schedules

7.1. Sewage Treatment Plant Complex:

As per indicated period checking the operation, correcting defects, attending to calibration and setting is required attending to minor repairs and proper up keeping) such as cleaning and painting) required for the following :

i. Monthly

- Roof and surroundings and
- Lightning arrestors.

ii. Annual

- Leakages in structures
- Ladders
- Railings

- Structural damages to the wet and dry well and
- Overflow drain.

7.2. Pumping Machinery and Treatment Plant Equipment:

As per indicated period checking the operation, correcting defects attending to calibration and setting is required attending to minor repairs and proper up keeping) such as cleaning and painting) required for the following:

i. Daily

- Screens/ Grit Channels
- Moving parts of screens and grit removal equipment, Blowers /Agitators / Pumps/ Agitators /Return Sludge pumps/ Chemical mixer/Centrifuge/Decanter
- Stuffing box
- Bearing and
- Cable insulation near the lugs.
- Panels Breaker and Starter
- Contacts of relay and circuit breaker and
- Setting of over-current relay, no-volt coil and tripping mechanism and off in the dash pot relay.
- Transformer Sub-station
- Ground Operated Dis-connectors (GOD)
- Contacts of GOD and of Over Current (OC) relays
- Radiators and Earth pit

ii. Monthly

- Screens and Grit channels
- Chains in mechanically operated components
- Screens performance
- Transformer
- Oil in transformer
- Relay alarm circuit
- Load (Amperes) and
- Voltage

iii. Quarterly

- Transformer
- Bushing and
- Dehydrating breathers

iv. Half -Yearly

- Pumps / Blowers /Agitators / Compressor /Decanters/Centrifuge
- Gland of stuffing box
- Gland bolts
- Gland packing
- Alignment of pump aerator and drive and
- Oil lubricated bearings
- Motors
- Tripping elements for motor protection
- Contact points and
- Fuse ratings

v. Annual

- Paint screens, grit removal mechanism, scrapers, scrapers , motors, pipes,
- Valves, fittings agitators and inlet/outlet weirs with two coats of anticorrosive paints.
- Replace worn out parts of mechanical equipment in sewage treatment plant.

7.3. Buildings and Civil Structures:

Carry out routine maintenance and minor repairs including cleaning, repairs to plaster, doors, windows and painting.

i. Daily

- Sweep the premises
- Clean the floors and parts inside the Building
- Clear the cobwebs and other biological growth
- Maintenance of horticulture
- Disposal and transportation of dewatered sludge

ii. Half - Yearly

- Repair damaged floor, plaster, roof, leakages and
- Repair damaged doors, windows and other fixtures

Chapter 5

PART - 1 : PUMPS FOR SEWAGE PUMPING

1.1-GENERAL DESIGN CONDITION SUBMERSIBLE NONCLOG PUMPS FOR SEWAGE PUMPING

The pump shall be of low head. The pump shall be of non clogging design & should be equipped to operate satisfactorily at various zones for pumping sewage fall to manhole and from sump well to STP.

CODES AND STANDARDS

The designed performance requirement, material requirements, manufacturer, inspection and testing of the pumps shall generally comply with the requirements of all applicable Indian/British/American/DIN slandered, in particular the following:

IS 5120 : Technical requirements – Rotodynamic special purpose pumps

IS 5600 : Sewage and drainage pumps

IS 9137 : Code for acceptance for centrifugal, mixed flow and axial flow pumps

IS-1537 & IS- 15325 : Centrifugal Cast (spun) iron pipes and fittings for wastage'sand

Waste Water.

IS- 1239: GI Pipes & Fittings

IS- 99254 HDPE Pipes

IS- 250025 HDPE fittings

IS- 7534 Code of practice for laying HDPE pipes

IS- 3114 Code of practice for laying cast iron pipes.

IS- 7250 Cast iron sluice Valves

IS- 6325 Rubber for flanged joints

IS- 12567 MS hexagonal bolts and nuts

IS- 6392 Steel pipe flanges

IS- 7634 Testing of HDPE pipes

IS-3589 Steel Pipes for Water and Sewage

Relevant IS for SS bolts & fixtures.

DESIGN AND CONSTRUCTION

a) Each pump shall be a mono unit, equipped with a motor on single shaft, with rating so selected as to have at least 15% margin over the maximum power required by the pump throughout its range of operation.
b) Motor shall be of submersible squirrel cage induction motor type, F class, Oil filled, suitable for 415 volts (+6/-15%) & 50Hzs (+/-3%).

PUMP CASING

a) Casing shall be so designed to allow free passage of specified maximum size of solid.
b) Casing shall be designed to withstand the maximum shut off pressure developed by the pump

c) The casings shall be cast, free from blow hole, sand holes, other detrimental defects. The casing shall be complete with suction and discharge connections.
d) For pumps adequate seal arrangement shall be made to keep leakage of liquid from casing to column assembly to minimum and adequate drain shall be provided in column assembly to permit escape of the leakage flow. The casing shall also include the bearing housing of the bottom pump shaft bearing.

IMPELLER

a) The impeller shall be non-clog type, cast in one piece and specially designed to pass large solids or unscreened liquids. The clearance between stationary and moving parts should be such as to allow sustained performance without excessive maintenance.

PUMP SHAFT

a) Shaft size selected shall be such that critical speed is at least 20% away from the operating speed and the runway speed.
b) The shaft shall be ground and polished to final dimension and of ample size to withstand all stresses resulting from rotor weight, hydraulic loads and across the line starting.

BEARINGS

a) Adequate nos. of properly designed bearings shall be furnished. Bearing for fixed type sump pumps shall be oil lubricated and bearings shall be antifriction type.
b) Thrust bearing of adequate design shall be furnished for talking the entire pump thrust arising from all probable condition of continues operation through out its "Range of operation" and also the shut off condition life of thrust bearing shall be 20,000 working hour minimum for the load corresponding to the duty point.

WEARING RING/ PLATE (As required)

a) Renewable wearing rings/ plates shall be provided either on impeller or on the casing or on both impeller and casing.

BOLTS NUTS AND WASHERS

All bolts, nuts and washers shall be of SS-304.

PRESSURE INDICATION DEVICE

Each installation shall be equipped with pressure gauges of good quality make to give indication of delivery pressure. The pump pressure gauges should be designed in such a way that the readings shall not be affected due to mechanical vibration. The connections sizes small be 12mm and diameter size 150mm in addition to above each pump shall be fitted with electronic pressure transducer with electronic digital display type indicator in control panel to indicate the delivery pressure of the pump

MATERIAL AND CONSTRUCTION

Material Of Construction Of Pump Shall Be Such As To Resist Erosion & Corrosion. Material Of Construction Of Various Components Shall Be As Under

Pump casing	:	CI
Impellers	:	CF8M
Pump shaft	:	AISI -410
Nuts, Bolts & Washers	:	SS-304

INSPECTION AND TESTING

All the inspection, examination and testing shall be carried out in accordance with relevant in diameter standard specification

LABORATORY TEST

Laboratory pump test shall be carried out as per IS: 9137, with latest amendment each pump to assess the pump discharge Vs head, Hoare power and efficiency figure. The pump casing shall be subjected to a pressure test of 1.5 times the working pressure at duty point

FIELD TEST

If need be the field test be carried out as per IS: 9137, with latest amendment these test may be witnessed by the engineer-in-charge or his authorized representative. If they desire the tolerance as specified in relevant IS code of particle shall not be quoted efficiency of pump during of testing

GUARANTEES PERFORMSNCE & TECHNICAL PARTICULARS

The contractor shall submit the details of guaranteed performance and technical particulars as desired in the Proforma enclosed vide schedule “B” along with the TENDER & the preliminary out line drawing indicating principle dimension and weight of pumping equipment and cross section drawing indicating the assembly of pumps & major parts thereof with materials of construction and special features, complete descriptive and illustrated literature on the equipment and accessories offered.

PART - II

SPECIFICATION FOR 415 V INDUCTION MOTORS

2.1 TYPE

The motor shall be horizontal SOLID shaft squirrel cage type for raw sewage pumps suitable to operate on 415 V, 3 phase, 50 Hz. AC supply (with allowable variation of 10%) directly coupled with pumps. The rotations of raw sewage pumps shall be 1500 RPM. The motor rating generally conform to latest revision of IS 325-1971 and other relevant I.S.S.

2.2 VARIATION IN SUPPLY VOLTAGE

The motors shall be capable of deliver integrated output and rated power factor with following variations :

VOLTAGE	:	$\pm$10%
FREQUENCY	:	$\pm$5%
COMBINED	:	$\pm$10%

2.3 RATES CAPACITY

The minimum continuous rated capacity of motors shall be such that it meets the power requirements of pumps in the complete range of its operations. It shall also provide additional power requirement in the motor by 5% at the maximum power requirement or by 10% at the duty point of operation whichever is maximum. The contractor shall ascertain the KW requirement and provide the motors of suitable capacity.

2.4 ACCELARATION CHARACTERISTICS

The accelerating characteristics of motor shall be matched with the driven equipment so that acceleration is obtained without over heating of motors.

2.5 METHOD OF STARTING

The motors shall be designed for star/delta/soft/starting at full voltage with starting current not exceeding 2 times the rated full load current.

2.6 NUMBER OF START

Motors when started with the drive imposing its full starting torque under the specified supply voltage variation shall be capable of withstanding at least two successive starts from hot condition and one start from cold condition without damage to the winding.

2.7 CLASS OF INSULATION

The motor winding shall be provided with insulation conforming to thermal class F. The maximum temperature rise of the winding shall not exceed the limits specified for class 'B' insulation. The insulation shall be given tropical and fungicidal treatment for successful operation of motor in hot, humid tropical climate. It shall be of thermo-setting type and shall remain unaffected by heat. The coils shall be highly uniform with uniform insulation strength and uniform dielectric lose. The dielectric losses shall be low and the star delta measurement should be not exceed 1% at 440V.

2.8 MOTOR CONSTRUCTION

The motor construction shall be suitable for easy dismantling and reassembly at site with the help of simple over head crane. The motor shall be of core pack construction attached to the stator frame to facilitate easy removal and replacement of the winding for maintenance purpose. The over head for winding at both ends of the core shall be accessible for usual inspection without resorting to major dismantling.

2.9 MOTOR FRAME

Motor frame shall be of rigid casted steel. They shall be suitably annealed to eliminate up any residual stresses introduced during process of fabrication and machining.

2.10 STATOR LAMINATIONS

Stator laminations shall be made of suitable grade sheet varnished on either side and shall be adequately designed to avoid over heating during the starting and running conditions stipulated above.

2.11 ROTOR

Rotor should be desisted dynamically balanced and having carbon steel shaft hydraulically fitted.

2.12 LOCKED ROTOR WITH STAND TIME

Locked rotor with stand time under hot conditions at 110% voltage shall be more than starting time at minimum permissible voltage by at least two seconds.

2.13 TYPE OF ENCLOSURE & DEGREE OF PROTECTIONS

The degree of protection provided by the enclosures of motor shall conform to IS : 4691. The enclosure for the motors shall be closed air circuit air cooled (CUIDSSMT) type, having of protection I.P. 55.

2.14 BEARING ASSEMBLY

Bearing assembly shall be such that it prevents dust and water from getting into the bearing. Further, bearing lubricant shall not find access to the motor winding. The bearing assembly shall be provided with proper lubricating nipples.

2.15 EARTHING

The motor body shall have two separate earthing terminals for earthing in compliance with I.E. RULES.

2.16 DIMENSIONS OF MOTORS

Motors shall be properly dimensioned to have greater stability and low vibration limits. Mounting dimensions should confirm to IS : 2254.

2.17 COUPLING TO PUMPS

The motors shall be coupled to the pumps by means of polished steel shaft and flexible coupling. The size of line shaft and flexible coupling shall be calculated on the basis of maximum combined shear stress as per the relevant IS and shall not exceed 30% of the elastic limit in tension or 10% of ultimate tensile stress, shaft shall be designed taking into consideration that critical speed of the shaft which shall be higher than the operating or runaway speed.

PART-III CABLING AND MOTOR CONTROL PANNEL

3.1 CABLE SEWAGE PUMP HOUSE

In case of sewerage pump house the soft starter panel of each motor of sewage centrifugal pump shall be connected in L.T. panel in the pump house, through suitable sized armored cable. Suitable sized 3-1/2 core armored cable. The cable sizing calculation shall be submitted for approval.

3.3 PUMP WELL WATER LEVEL INDICATOR

One No. electrical water level indicator with alarming system shall be provided for the pump well near which the pump house of sewage has been constructed.

3.4 CIVIL WORK

1. Construction of covered cable trenches / tray from L.T. panel to panel board in pump house. The cable trenches should be covered with sand and type should be broken type connected to bridge with bolts etc. by suitable civil work and shall be covered with chequered plates of minimum thickness 7mm.
2. Construction of all other civil works required for erection of pump and motor with all foundation bolts, washers including all work pertaining to it.

PART - IV - NON RETURN VALVE

5.1 GENERAL

The non-return valves shall be single door type, free acting quick opening, giving rapid non-clam closure & with low head loss characteristics when in open position. The valves shall be provided with by passes and isolating valves conforming to relevant Indian Standard.

Specification ofthe valves shall generally conform to IS : 5321 (Part-II)

5.2 MATERIALS OF CONSTRUCTION

Body, Cover, Door and Hinges	:	Cast steel construction
Hinge pins, Door pins & Door	:	12% Chromium steel conforming to IS:1570
Suspension pins		
Bearing Bushes	:	Leaded Gun Metal Gr. 2, Conforming to IS:318
Body rings and door faces	:	Leaded Gun Metal Gr.2, conforming to IS:318

5.3 TESTING

The valves shall be subjected to closed ends tests as per relevant IS standard. Test certificate in triplicate shall be furnished. If necessary, test shall be witnessed by the Engineer's representative.

WORKING PRESSURE	:	20 KG/SQ.CM.
TEST PRESSURE BODY	:	40 KG/SQ.CM.
SEATING	:	20 KG/SQ.CM.

PART - V DELIVERY PIPES

6.1 GENERAL

The scope of the work is providing, laying & jointing of all delivery pipes, specials valves of all the pump and their connection to the common manifold as shown in drawing inclusive of the jointing of the manifolds to the respective conveyance mains.

1. The contractor shall design and fabricate the common manifold which would be made out of MS 6mm thick plates conforming to IS : 226 in such a way that it gives minimum frictional loss of head to the flow of water and also avoid cavitations or vortices in the manifold. The manifolds should be in line and coated with suitable material to protect it from corrosion in case of sewage.
2. The contractor shall provide an expansion joint of his own design duly approved by the Engineer-in-charge.
3. Flanged joints shall be adopted for valves and butt welding joints or flanged joints in jointing of delivery pipe with dismantling joints.
4. Concrete saddles for valves and thrust blocks shall be provided by the contractor as per the design and drawings to be furnished by the contractor and subsequently approved by Engineer-in-charge.

6.2 MATERIAL OF CONSTRUCTION

All the pipes of works shall be fabricated out of steel plates conforming to IS:226-1962. The fabrication of pipes shall generally conform to IS : 3589-1966.

6.3 TESTING

The pipes and common manifold shall be hydraulically tested to a pressure of 2 times the working pressure. Test certificate to that effect shall be furnished by the contractor.

The Engineer-in-charge witness the above test if so desired, the contractor shall arrange for such test in presence of Engineer-in-charge.

PART - VI RATING AND NAME PLATES

7.1 RATING PLATE

Each main and auxiliary item of plate shall have permanently attached to it a rating plates in a conspicuous position. This shall be a non-corrodible material preferably chromium plates steel. The inscription shall be engraved in black on the plate.

7.2 NAME PLATE

1. Each item of plant shall be provided with a name plate or label designating the service of the particular equipment. The shape and size of the plate and inscription shall be approved by the Engineer-in-charge.
2. Such name plate shall be non-corrodible material preferably chromium plated steel having engraved black lettering.
3. In case of indoor equipment like circuit breakers, starters etc. the plate shall be of transparent plastic material with black lettering engraved on the back.
4. The name plate shall be screwed to the body of the equipment.

PART - VII OTHER MECHANICAL EQUIPMENT

MULTIRAKE MECHANICAL COARSE BAR SCREENS

PURPOSE & SCOPE:

Mechanized screens should be suitable for installation in Sewage pumping stations for removal of floating wastes coming along with sewage. These screens should be capable to screen out most of the medium and large floating material such as plastic bags, floating debris, weeds, paper wastes, clothes and rags etc. which are generally clogging the impellers of the pumps installed downstream of the screens.

The mechanical screen should be sturdy against full blockage from waste and high force of water acting on the complete mechanical screen, the design of mechanical screen should withstand all condition.

The operation of the screen shall be automatic through the timer. An ultrasonic type differential level sensor shall also be provided to sense the head loss through the bar and give the signal to the traveling raking mechanism to start/stop its operation.

A complete electrical control system shall be supplied with each screen and shall be mounted independently near to the screen installation. The system shall provide for total automatic operation of the screen with the feedback from the level controller.

GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS:

Fabrication and design features:

- Use power grinder to dull and produce smooth edges.
- Use bolted field connections. Field welding will not be allowed.
- Design all components for continuous 24 hours per day service.

The screen shall be so constructed so as to mechanically remove the waste from the bottom most portion of the bar using a traveling type multiple raking mechanism without shutting the water flow through the screen. The raking mechanism shall then travel up to the top of operating platform and automatically discharge the waste through a discharge chute.

The screen shall have protection against overload conditions, which otherwise might damage the equipment.

All screens shall be constructed and shipped as an integrated product comprising of frame structure and guides, rakes, dead plate, cog wheels / sprockets and chains, discharge chute & drive unit.

The screen shall be supplied factory assembled and duly tested at manufacturer's works before dispatch. This integrated and factory assembled screen shall involve minimum dismantling and assembly at site for erection.

Upon receipt at site the screen shall be installed resting on the channel floor and mechanically or chemically anchored to the parallel sidewalls of the channel (without making grooves in concrete or breaking open the concrete side walls and thereby weakening the civil structure) in a way that there are minimum chances of misalignment.

All parts shall be designed to withstand the stresses that will be imposed upon them during handling, shipping, erection and operation.

All stainless steel fabricated materials will be pickled and passivated before dispatch to remove ferrous contamination, if any.

CONSTRUCTION & SPECIFICATION:

Material of construction:

All parts of screen including fixed bars, rakes, screen frame, guide rails, dead plate, link type roller chains & sprockets, Cogwheel/sprocket, discharge chute shall be constructed from stainless steel material grade Minimum SS 304 for long life in aggressive sewage environment. Suitable measure shall be taken to ensure long life of the parts.

Screen Construction:

The bars shall be of flat profile having minimum 10 x 50 mm size with an average bar spacing of 20 mm.

The bar rack shall be firmly anchored to the channel floor and supported by a dead plate at the top.

The rake shall be made of Stainless-Steel SS 304.

The complete screen frame shall be constructed with 4mm plate stainless steels of suitable grade.

The drive chain for the rakes shall be link type roller chain with a minimum breaking load of minimum 63kN and made of stainless-steel grade AISI 304/316. This is very essential considering highly corrosive sewage atmosphere.

Drive chains, chain guides, sprockets and their bearings shall be replaceable without removing the screen from the channel.

To effectively remove the debris from the bottom most portion of the screen, the screen shall be provided with curved structure at the bottom of the screen.

The dead plate shall be of minimum 2 mm thick in stainless steel and shall be suitably braced to ensure rigidity and prevent caving / bending due to increased water flow in monsoon.

The upper sprocket bearing shall be re-greaseable and flange type.

Lower bearings shall be made of non-re-greaseable special ceramic bushes or better.

The screen should have integrated scraper for discharging the screenings to discharge chute. The scraper / wiper shall be cushioned during travel to the rest position.

The rake mechanism should be operated by a Geared motor and be suitable for automatic operation controlled by a level sensor and electric control cabinet.

Torque switch should be provided to protect the screen from damages resulting from excessive torque.

After fabrication and assembly, the stainless-steel parts, all welded joints are to be further cleaned by acid pickling and after that they should be passivated to remove any ferrous contamination that might have taken place during manufacturing / handling / movement of raw and fabricated material.

Level Sensor

The level sensor shall be of ultrasonic differential type.

Electrical motor

The drive shall be Geared motor and the motor shall be of TEFC type with IP 55 protection & Class F insulation and be suitable for operation on 3 phase, 415V+/- 10%, frequency of 50 Hz+/- 5% and IE3 class efficiency as a minimum.

Control Panel

The control panel shall have IP 65 protection, powder coated and shall be comprising of

Mushroom head emergency stop.

Overload relays for motor protection.

PLC Circuitry to operate the screen with differential type ultrasonic level sensor.

Selector switch to operate the screen in Auto, off and JOG mode.

Provision to run the screen on timer in case of failure of level sensor.

SHOP TESTING

The screen must be completely manufactured and subsequently offered for inspection at the plant of the manufacture only. A screen assembled by a vendor and offered for inspection at the plant of a vendor / sub contractor shall not be accepted. The screen shall be subjected to following tests at manufacturer's premises before dispatch:

Dimensional Check: Important dimensions of the screen to be verified with respect to approved G.A. drawing.

Operational Test: The complete screen including its carriage, rake, drive system and motor shall be mechanically operated and tested in dry condition to verify interference free movement and satisfactory operation.

Positive Material Identification (PMI) test: To ensure that Screens are actually made of Stainless-Steel Grade SS 304 positive material identification (PMI) test to be conducted for all important screen components like Bars, Frame, Dead Plate during inspection and PMI reports to be submitted to client / corporation along with joint inspection report.

Dye Penetration test: Dye penetration test to be conducted at random for checking the soundness of welding joints during the inspection. Both Procedure as well as person conducting the dye penetration test should be certified by the outside agency as per relevant standard.

Review of test certificate: Material test report / certificate, Motor certificate, Control Panel certificate at el to be offered for review during the inspection.

Review of WPS, PQR & Welder's qualification certificate: To be offered for review during the inspection and copy of same to be submitted to client / corporation along with joint inspection report.

MECHANICALLY OPERATED STEP TYPE FINE BAR SCREENS

GENERAL: Mechanically operated step screen completely made of Stainless Steel grade 304/316L having 6 mm average spacing between the bars shall be provided in inlet screen channel(s) for screening out floating materials such as plastic pouches, bags, rags, floating debris, weeds, paper wastes and other floating materials from the raw sewage coming from the pumping station / gravity mains.

The screen shall include discharge chute as required to discharge the screenings on the belt / screw conveyor without employing any external mechanism / rake mechanism.

The screen shall be factory assembled & movement tested at plant before dispatch to site & shall be installed at the site in factory assembled condition only thereby avoiding chances of misalignments.

SCOPE: Design, Supply, Installation, Testing & Commissioning of screening equipment consisting of following:

- Mechanized step screen having 6 mm average spacing between bars and suitable for installation at an inclination of 40 degrees in channel.
- Level sensing instrument for automatic operation of screen mechanism and allied accessories.
- Local control panel installed near screen.

- Belt / screw conveyor to discharge the screened material to the waste bin.

SPECIFICATION:

Material of construction:

The fixed as well as movable bars, mechanism, support frame, fixings discharge chute shall be manufactured from stainless steel grade 304 for long life in the aggressive sewage environment. No component of the screen assembly shall be made of carbon steel or any other material, which can get corroded in sewage environment.

Screen Construction

The step screen shall be a complete unit comprising of main frame with an integral mechanism containing movable bars located in between fixed bars without engagement of external mechanism / rake mechanism for pulling out the screened material ensuring minimum movement of the mechanism.

The mechanism comprising of movable bars located between fixed bars shall gradually move the screened material upward in the form of a mat and deliver up to the discharge chute.

The fixed as well as movable bars shall contain a series of steps to prevent the screenings from falling back into the main flow.

The mechanism shall be mechanically operated by hydraulic system and shall be suitable for automatic operation controlled by a level sensor.

The screen shall operate automatically when the upstream water level increases beyond a pre-set limit and it shall stop when the upstream level decreases to a preset low level due to upward travel of screened material.

The fine bar screen shall be capable of being tilted out of the sewage flow up to horizontal position for the purpose of cleaning & maintenance.

The base of the screen shall be fitted with a specially profiled stainless steel plate to direct any grit that may be present towards the screen and taken out along with other screened material thus reducing the possibility of building up of grit in front of the screen.

Level Sensor

The level Sensor shall be of upstream type Ultrasonic level switch.

Electrical Motor

The motor shall be TEFC type with IP 55 protection & Class F insulation and shall be suitable for operation on 3 phase, 415V + 10% and frequency of 50Hz + 5%.

Control Panel

The Control Panel shall have IP 65 protection, powder coated and shall be comprising of

- Mushroom Head Emergency stop.
- Overload relays for motor protection.
- MCB’s, HRC Fuses and Glass Fuses.

- Circuitry to operate the screen with level sensors.
- Selector Switch to operate the screen on JOG mode.
- The specification given hereunder shall supersede other specification in case given elsewhere in tender document.

TESTING:
The Fine bar screen shall be Factory assembled and shall be subjected to following tests at the manufacturer's premises before dispatch.

Dimensional Check: The overall dimensions of the screen shall be conforming to the approved drawing.

Operational Test: The complete screen including its mechanism, hydraulic operating mechanism and control panel shall be integrated and mechanically operated in dry condition to verify interference free movement and satisfactory working.

Positive Material Identification (PMI) test: To ensure that Screens are actually made of Stainless Steel Grade 304 positive material identification (PMI) test to be conducted for all important screen components like Bars & Frame during inspection and PMI reports to be submitted to client / corporation along with joint inspection report.

Dye Penetration test: Dye penetration test to be conducted at random for checking the soundness of welding joints during the inspection. Both Procedure as well as person conducting the dye penetration test should be certified by the outside agency as per relevant standard.

Review of test certificate: Material test report / certificate, Motor certificate, Control Panel certificate to be furnished for review during the inspection.

Review of WPS, PQR & Weldor's qualification certificate: To be offered for review during the inspection and copy of same to be submitted to client / corporation along with joint inspection report.

MECHANICAL GRIT SEPARATOR
The grit separator shall be square in size and twin unit construction. A Central drive mechanism of worm reduction type driven through helical gear and motor or by geared motor shall be mounted on the RCC platform spanning the tank. All exposed steel parts shall be sand blasted and painted with epoxy. All wetted parts shall be in stain steel 304. The drive shall be provided with electro-mechanical device, torque indicating arrangement and mechanical trip contacts with electrical overload relays. Flow regulating vanes shall be provided at the inlet side of the collection chamber and shall be of FRP. The vanes shall be adjusted as per the flow requirement. The weirs at the outlet of grit chamber shall be SS 304 with minimum 3-mm thickness or FRP with minimum thickness of 6 mm. The spacing of anchor bolts of SS 304 for the fixing of the weir shall not be more than 450 mm.

The classifier mechanism shall comprise of a screw driven by a suitable motor. The material of construction of the mechanism shall be SS 304 of suitable dia. The length of screw shall be such that the grit can be elevated up to the discharge end. SS puddle pipe shall be provided in the concrete trough at the discharge point of wet grit. An organic return pump with wetted parts in SS304 shall be provided.

AIR BLOWERS FOR OXYGENATION

The blowers shall be provided for providing adequate oxygen into the reactor tank for aeration. The air requirements shall be calculated for summer and winter as well as for mixing power the higher duty shall be installed. The summer sewage temperature shall be taken as 35 degrees C and that in winter at 10 degrees C.

The blowers shall be capable of developing the required total pressure at the rated capacity for continuous operation. The blowers shall be Tri lobe or Twin lobe type. The blowers shall be provided with suction air filter, reactive silencer, dead weight pressure relief valve and pressure gauge and the air delivered shall be clean, dry and oil free. The blower noise level and velocity of vibration shall be within 85 dB (A) at a distance of 2 m respectively. Blower shall be provided with soundproof canopy as per standards. The blower must be V-belt driven by squirrel cage induction motor.

The speed of the blowers shall be below 1,500 rpm. The power rating of motor shall be at least 10% above the maximum power requirement by the blower. The kW of single blower shall not exceed 250 kW. The blowers shall be mounted at a level necessary to avoid back flow or siphoning of sewage into the blower.

Material of construction:

Casing : C I conforming to IS: 210 Gr FG 260

Rotor : Alloy steel

Shaft : Carbon steel C40/EN 24/19

Timing gear : Cast alloy steel

Pulley and gear side plates and cover : CI conforming to IS 210 Gr FG 260

- **Tests**

Sr. No.	Tests	Specs
1	Hydrostatic tests	Twice the maximum working pressure
2	Performance test	As per BS : 1571
3	Strip test	Clearances with tolerance limit
4	Mechanical balancing	ISO 1940 Gr. 6.3 or better
5	Visual Inspection	Before painting

Decanting Device

- The Decanting Device shall be Moving Weir Arm Device of SS 304 or higher grade with top mounted Gear Box, Electric Drive, Scum Guard, Down comers, Collection Pipe, Bearings. The following type of decanter assemblies are not acceptable:

- Rope Driven Decanters.
- Floating Decanters.
- GRP Products.
- Valve Arrangement.

- Maximum weir loading rate for SBR decanters shall not exceed 140-180 m3/hr/m. Technology provider.

- Bidder shall be provide the evidence along with his bid that the technology provider has provided decanter in at least 1 number of STPs in India, and successful operation for last 5 years.

DIFFUSED AERATION SYSTEM

This comprises piping to diffusers and the diffusers.

- **Type of diffuser system**

A fine bubble diffused aeration system shall be applied to aeration tank for oxygenation. The number of diffuser elements can be varied by the bidder depending on the manufacturer selected, subject to the condition that sufficient design calculations are attached along with it and the manufacturer is a standard one having supplied the diffusers to various waste water treatment plants of similar nature.

- **Diffuser Elements**

The diffuser elements shall be of PU tubular membrane type and resistant to such ingredients as hydrocarbons, oil and grease. This shall afford a high oxygen transfer rate coupled with a minimal pressure drop besides permitting simple erection onto the horizontal air manifold. They shall have self-cleaning properties while in action. The diffuser unit shall be of corrosion resistant material. The membrane diffusers shall permit connection to the air manifolds of circular or square cross section and the entire lot of diffusers shall be capable of discharging designed flow of air at an average flow (maximum of summer and winter requirement) when installed in the said aeration tanks.

The diffuser grid shall be of fixed type. The headers onto which the diffusers are fixed shall be of standard Imported PVC/UPVC pipe sections of suitable inner bore and shape with custom fixtures of the diffuser elements as directed by the membrane manufacturers. Alternative pipe materials shall be acceptable provided the same are a mandatory part of the diffuser supplier and have been in the supplier's line of supply as original equipment. The headers shall also be procured from the equipment manufacturers who are the suppliers of the membrane diffusers. These headers shall have enough counterweight or alternative arrangement to surmount any buoyancy lift from the floor during air charging.

AIR SUPPLY PIPING

The air piping from the blower to the basin header (above water) shall be of MS epoxy painted material and pressure rated for the sewage depth plus frictional losses etc. Each air header shall travel downward from the air piping by aligning itself onto the sidewall of the aeration tank and thereafter travel horizontally onto the tank floor. These shall be fixed securely to the concrete surfaces in the horizontal plane and vertical plane so that they are not clamped horizontally onto vertical sides of the walls. The clamping shall be so designed as to permit "in-situ" screw driven fittings. Breaking open concrete surfaces shall not be permitted.

SPECIFICATIONS FOR EPOXY PAINTING

Zinc rich epoxy primer and epoxy paint of approved quality shall be used for external and internal painting. No primer shall be applied without prior approval from the Employer's Representative. The max of zinc rich epoxy primer shall be prepared at work site not earlier then 15 minutes before applying the same on pipes and special surfaces. One coat of zinc rich epoxy primer of DFT 75 micron shall be applied along with two coats of epoxy paint DFT 40 micron and DFT 30 micron respectively. No thinner shall be added to ready mix paint without previous approval of the Employers' representative and the finishing coats on top of the primer coat shall only be applied after allowing the film to cure for at-least 48hrs.

After application of zinc rich epoxy primer the surface should be cleaned by duster and inspected. If during inspection any portion is found rusting the same shall be removed by emery paper and coated with zinc rich epoxy primer.

Mixed paint should be used within 3 to 4 hrs. of mixing and fresh mixing shall be done for every new application. Every successive coat of paint shall be given only after 48 hrs. of previous coat. Before applying the next coat the surface should be properly cleaned by duster.

THICKENER MECHANISM

General

Gravity Sludge thickener shall be Circular (radial), fixed bridge, central turn table type or central drive.

The circular reinforced concrete thickeners tapering at bottom shall be provided for thickening process. Design shall be such that the sludge after thickening can be extracted from the bottom of the hopper portion. Interstitial liquid flows through peripheral weir at top. Tanks shall be deep enough to allow the sludge to settle by gravity. At least 50 cm freeboard shall be provided. Provision shall be made for collection of thickened sludge and pumping it to the dewatering units.

A full / half diameter bridge with central drive shall be provided with central platform for the installation of the scrapers, their drives, local control panel and a radial scraper system with bottom scraper blades, suspended from the bridge.

The thickener shall have a half or full diameter fixed bridge complete with walkway for personnel access to the centre, access stairs to ground level and hand railing, central drive motor driven sludge scraper complete with all necessary controls, delivery pipe work, a stilling well and overflow steel weir plates. Handrails shall be of tubular construction and made of 32NB pipes.

The scraping gear shall be supported from the tank base and from a fixed bridge carrying the central electrical drive for the rotating gear. The equipment including driving motor, gears, shafting and scrapers shall be designed for continuous operation and sized for the most hazardous operating condition including starting from rest with an accumulation of sludge in the thickeners. The electric motor, gearbox etc., shall be provided with a sunshade.

The main drive shall be in Cast Iron and shall be enclosed in a dustproof enclosure with oil bath lubrication. Suitable overload protection for the drive shall be provided to ensure that the sludge shall not overload the equipment and emergency stop pushbutton shall be provided. The scrapers shall be fitted with over torque protection to alarm in the event of a failure.

Structural design calculations shall be submitted for all structures including scraper arm, bridge etc. and also the calculation for drive head selection including the Torque Rating. V-notch weir shall be provided along the launders for uniform draw-off of the overflow. The weir plate shall be fixed to the launder by means clamping plates and fasteners. The hydraulic equipment will consists of an inlet pipe which runs along the bridge to the central feed well of the thickener or through the bottom of RCC centre pier; sludge draw-off pipe with an manual & Motorized Knife Gate valve for intermittent operation according to an adjustable timer; a drain pipe with manually operated gate valve for the complete emptying of the unit; a discharge pipe/channel from the peripheral collecting channel to the main channel leading to the Supernatant sump.

The sludge thickener mechanism shall be suitable for installation in a circular RCC tank and shall include the following:

- Mechanism support beam spanning the diameter / radius of the tank.
- Walkway and handrail from the edge to the centre of the tank
- Drive mechanism
- Reduction gear box
- Chain and sprocket with guard
- Vertical shaft / centre cage with scrapper arm and picket fence
- Skimmer Scum Baffle and Scum trough
- Overflow weir
- Vertical pickets

 Torque Indicating Device

Material of Construction

Description	MOC
Tank	RCC
Bridge	MSEP
Handrail (32NB pipe)	MSEP
Feed well	SS 304
Centre cage / Vertical shaft	SS 304
Rake arms / blades / pickets	SS 304
V-notch weir	SS 304
Squeegees	Neoprene
Scum & skimmer assembly	SS 304
Hardware's – under water	SS 304
Hardware's – above water	GI

OTHER SLUDGE PUMPS

These pumps shall be of screw type used for pumping sludge to centrifuge. The pumps shall be designed to operate satisfactorily without detrimental surges, vibration, noise, or dynamic imbalance. Over the required head range, the head-capacity curve of the pump shall have a continuously rising head characteristic with decreasing capacity over the whole range of total head. The pump shall have the maximum efficiency at the specified duty point. The unit shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to sewage returning thro the pump at times when power supply of the motor is interrupted.

All rotating parts shall be statically and dynamically balanced as per ISO standards.

A stationary coupling guard shall be provided for the coupling conforming to all relevant safety codes and regulations. Guards shall be designed for easy installation and removal. They shall be complete with necessary support accessories and fastener.

The pumping unit shall be provided with a common base plate. The base plate shall be of sufficient size and rigidity to maintain the pump and motor in proper alignment and position.

The pump design shall be as per IS 6595 and pump performance shall be as per IS 9137. The power rating of the pump motor shall be the larger of following

(i) 115 % of power required by the pump at the duty point

(ii) 110 % of maximum power required by the pump from zero discharge to the runoff point total head

- **Material of Construction & Specifications**

Type Screw

MOC	Alloy Steel
Base plate	CI / MS Epoxy painted
Fastener	SS AISI 304
Pump speed	960 rpm (maximum)
Ball passing size	25 mm minimum
Applicable code	
Design	IS 6595
Performance	IS 9137

- **Testing**

Material test certificate	Casing, Impeller, Shaft
Hydrostatic test	1.5 times shutoff head or twice the rated discharge head whichever is greater
Performance test	IS 5120 and IS 9137 at full speed
Mechanical balancing	As per ISO 1940, Gr. 6.3 or better
Visual inspection	Pump shall be offered for visual inspection before shipment. The pump components shall not be painted before inspection
Field Tests	Field performance tests required for satisfactory operation

DOSING TANK AGITATORS

The equipment shall include drive motor, coupling, turbine impeller assembly, intermediate bearings, basket, walkway with handrails and such other fittings, devices or appurtenances necessary for a complete operating installation.

- **Mounting Arrangement**

The civil tank for the sludge storage will be provided with a minimum freeboard of 300 mm. The agitator drive unit shall be mounted on RCC platform spanning the tank. These shall be mounted above the freeboard elevation over a RCC bridge walkway with necessary cut out for agitator shaft. The walkway will be provided with hand railing in SS 304 and steel ladder with handrails. A portal shall be provided permanently in the platform required for the maintenance work of the agitator components.

- **Drive Motor**

The drive motor shall not exceed an rpm of 1500 and shall be directly coupled with the gear reducer. It shall be wired for 415 volts, 50 cycles, and three-phase service. It shall be totally enclosed, fan cooled, and rated for severe chemical duty with a minimum service factor of 1: 1.15. .

- **Rotary Speed**

The rotary speed of the impeller shall not exceed 100 rpm so that the solids are not sheared.

- **Direct Coupling & Torque**

The drive motor output shaft and the impeller rotary shaft shall be connected by a direct coupling using such couplings as “Lovejoy” type to avoid cumbersome erections and de-erections. The coupling shall be able to withstand continuous duty with occasional upward thrusts. The drive assembly for each agitator shall consist of a suitable drive motor, directly coupled to a helical gearbox. The gear reducer shall be of heavy duty, high efficiency type with a rugged housing and shall have a minimum service factor of 2.0 and suitable for 24 hours continuous service. The gear reducer shall have oil bath lubrication and dry well construction on the vertical out put shaft to prevent leakage of lubricant. The casing of the gear reducer shall be of CI and the gears shall be hardened and ground for precision.

- **Impeller Elements**

The circulating element of the each agitator will consist of a single, axial flow design, 4 inclined impeller having SS304 blades

- **Fasteners & Anchor bolts**

All fasteners and anchor bolts shall be of such metallurgy that shall be compatible with the duty conditions shall be used.

DOSING PUMPS

The dosing solution from the preparation tanks shall be pumped by the use of dosing pumps. The pipe and the pipe fittings shall be HDPE and valves shall be Polypropylene.

These pumps shall be capable of pumping the up to 0.5 % Polyelectrolyte solution. Dosing pumps shall be of the diaphragm type hydraulically operated. These shall permit flow control at both sides of the chosen median duty point for the duty already stated herein. The construction shall be totally enclosed and corrosion proof. The liquid end shall be in SS 304.

CENTRIFUGE

The centrifuge shall be solid bowl centrifuge of co-current/counter current design, as decided by the bidder. The centrifuge shall have sufficient clarifying length so that separation of solids is effective. The centrifuge and its accessories shall be mounted on a common base frame so that entire assembly can be installed on an elevated structure.

Suitable drive with V- belt arrangement and turbo-coupling shall be provided along with overload protection device. Centrifuge shall be with SS304 wetted parts.

Differential speed and bowl speed should be adjusted by changing the pulleys; differential speed may be adjustable by use of epicyclical-gear. The bowl shall be protected with flexible connections so that vibrations are not transmitted to other equipment. The base frame shall be in epoxy painted steel construction and provided with anti-vibration pads. All steps necessary to prevent transmission of structure borne noise shall be taken. The drive motor shall be of 1450 rpm. The noise level shall be 85 dB (A) measured at 2 m distance under dry run. The vibration level shall be below 50 micron measured at pillow blocks under dry run condition. Adequate sound proof shall be carried out for the housing the centrifuges to ensure that the noise level at 5 m distance from the enclosure is less than 75 dB (A).

Centrifuge shall be capable of handling sludge consisting of minimum 0.8% solids by weight. The dewatered cake shall be based on minimum consistency of 20% by weight dry solids.

DISINFECTION SYSTEM

Shall include:

Chlorination System

- **Chlorinators**

(a) Vacuum type chlorinators shall be supplied with one duty and one stand by unit.

(b) Chlorinators shall be free-standing, floor-mounted, and shall have a turn down ratio of 10:1 over the full range of works operation.

(c) The dosing rate shall be manually set and each chlorinator shall be equipped with a 0 to 10mg/l scale and a manual dose setter over the complete range.

(d) Mal-operation of the duty chlorination system shall be indicated in the chlorination room and the central MMI. The change to the standby system shall be carried out automatically in the event of duty chlorinator failure.

- **Dosing Pumps**

a) Dosing pumps (1 working + 1 standby) shall be installed.

b) The dosing pumps shall draw their supply from treated sewage line.

c) The pumps shall be placed inside the chlorination room and shall be made from material resistant to corrosion by chlorine.

- **Injectors**

Two injectors shall be provided, each serving a duty /standby pair of chlorinators. The injectors shall be located in the chlorination room.

- **Chlorine**

Chlorine shall be supplied as liquid from nominal 1 tonne chlorine toner.

1.8.20.2 The Toner Room

(a) Storage shall be provided for chlorine tonners, sufficient for at least 15 day's usage at normal rate of withdrawal.

(b) The system shall be designed to prevent freezing of the liquid chlorine at the maximum rate of withdrawal.

(c) Tonners on line, tonners on standby and full and empty tonners shall be stored separately in the tonner room. Three sets of tonner rollers shall be provided. Tonners not in use shall be stored on concrete cradles.

(d) The container lifting beam shall be specifically designed for handling chlorine containers and equipped with necessary shackles and hooks.

(e) Operation of crane system shall be from the floor level using independent push button pendent controls operating at a 230 volt 50Hz AC supply.

(f) Two lifting beams shall be provided (a duty and a spare) and a one tonner weighed to be suspended from the crane hoist.

(g) When the pressure in the duty chlorine tonner falls to less than 1.00 Kg/cm^2, the automatic change over device shall operate to isolate the empty tonner and to bring the full standby tonner on line.

(h) A chlorine leak absorption system shall be provided to contain and neutralize chlorine in the event of leak. The system shall comprise FRP Half Hoods, NaOH Storage Tank, NaOH Re-circulation Pump, Centrifugal Pumps and interconnecting ducting/piping.

(i) Special consideration shall be given to any floor drainage system in the tonner building; adequate shall be provided to ensure that chlorine gas cannot escape. All leader tubes carrying cables or pipes out of the building shall be sealed at either end to prevent any chlorine gas leaking out.

Chlorination Room

(a) The chlorination room shall be constructed adjacent to the tonner room but with no interconnecting door or other form of access.

(b) Gas lines from the tonner room into the chlorination room shall run in ducts to be sealed after installation and prior to commissioning.

Chlorine Leak Detectors

Chlorine gas leak detectors shall be provided each, with a single detector cell. At least two sensors shall be located in the chlorine tonner storage room and at least one sensor in the chlorination room.

The chlorine leak detectors in the tonner room shall be mounted at each end of the tonner room.

The chlorine leak detectors shall initiate a local audible and visual alarm. Statutory warning notices relating to the storage and handling of chlorine shall be provided. The signs shall be pictorial and provided in Hindi and English.

Ventilation System

a) Each area where chlorine is stored or used as gas or liquid shall be provided with a forced ventilation system.

b) Air intakes shall be sized to allow uniform ventilation and positioned to prevent possible recirculation.

c) An air change rate of four per hour under normal condition and a minimum of twenty changes of air per hour under shall be used in the event that a chlorine leak is detected.

d) Exhaust fans shall be heavy duty industrial pattern manufactured from chlorine resistant materials.

Safety Equipment's

(a) Materials and equipment necessary to ensure the safety of personnel operating the chlorination plant and others shall be provided.

(b) The equipment shall include:

(i) two sets of approved self-contained breathing apparatus, each comprising an air set, carrying harness, face mask and valves and ancillary equipment . Each set shall be provided with three 1200 liter capacity, 140mm diameter, air tonners.

(ii) Two 'instant action' resuscitators;

(v) Four sets of safety clothing in various sizes, each comprising PVC overalls, Wellington boots with steel toe caps, goggles, gloves and safety helmets.

(c) Each set of safety equipment shall be mounted in a glass-fronted, non-locking PVC coated steel cabinet in approved locations on the outside of the building.

(d) Two emergency showers shall be provided and shall be installed outside on either side of the tonner room.

(e) Each shower shall be operated automatically by a quick acting hand or foot valve.

(f) Four eyebaths shall be supplied. Two eyebaths shall be adjacent to each of the showers.

(g) Water for showers, etc. shall be drawn from the service water supply.

A telephone will be provided close by outside the building for emergencies.

UV Disinfection System

All materials, equipment and appurtenances required to provide an open channel, gravity flow, low pressure high output (LPHO) (UV) disinfection system complete with an automatic chemical/mechanical cleaning system and variable output lamp drivers. The UV system shall be complete and operational with all control equipment and accessories as shown and specified herein. This system shall be capable of disinfecting effluent to meet the effluent water quality standards.

The bidder shall have to provide valid USEPA certification or relevant Indian Certification issued by Government of India (ISI) for the proposed UV system under this contract.

Performance Requirements:

Provide a UV disinfection system complete with UV Banks and automatic lifting mechanism or EOT Crane as applicable, System Control Center, Power Distribution Centers if applicable, and Motorized Weir Gate / Other suitable mechanisms as Water Level Controller(s). The ultraviolet disinfection system effluent quality performance shall be evaluated through grab samples taken in accordance with the Microbiology Sampling Techniques found in Standard Methods for the Examination of Water and Wastewater, 21st Ed.

The UV system shall be designed to deliver a minimum MS2 RED of 80 mJ/cm2 at max. flow, in effluent with a UV Transmission of maximum 60%, at end of lamp life (EOLL) after reductions for quartz sleeve fouling to achieve the reuse effluent quality of < 2 MPN/100 ml on 95%ile basis (Below Detect Limit) and or The UV system shall be designed to deliver a bioassay validated dose of 18 mJ/cm2 T1 RED based at peak flow, in effluent with a UV Transmission of maximum 60%, at end of lamp life (EOLL) after reductions for quartz sleeve fouling to achieve effluent quality of < 230 MPN/100 ml on 30 day geometric mean basis.

The RED shall be adjusted using an end of lamp life factor of 0.5 to compensate for lamp output reduction over the time period corresponding to the manufacturer's lamp warranty. The use of a higher lamp aging factor shall be considered only upon review and approval of independent third party verified data that has been collected and analysed in accordance with protocols described in the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003, 2012).

The RED shall be adjusted using a quartz sleeve fouling factor of 0.8 to compensate for quartz sleeve transmission reduction due to wastewater effluent fouling. The use of a higher quartz sleeve fouling factor shall be considered only upon review and approval of independently verified data that has been collected and analysed in accordance with protocols described in the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003, 2012). The data recorded for the determination of the validated fouling factor must be obtained by testing in secondary wastewater effluent utilizing the same lamp, quartz sleeve and cleaning system proposed by the UV manufacturer.

All UV Bank metal components in contact with effluent shall be Type 316 stainless steel. All wiring exposed to UV light shall be Teflon™ coated.

Each channel should have 01 extra connected online standby UV bank or the system should have one standby channel with connected online standby UV banks.

Lamp Array Configuration:

For in-channel systems, the lamp array configuration shall be in a staggered inclined arrangement perpendicular to water flow or horizontal lamp uniform array with all lamps parallel to each other and to the flow.

The UV system shall have minimum of two UV banks per channel. The system shall be designed for complete submersion of the UV lamps under all flow conditions including both electrodes and the full length of the lamp arc.

UV Bank:

Each UV bank shall consist of UV lamps, quartz sleeves and an automatic suitable chemical/mechanical cleaning system mounted in a Type 316 stainless steel frame.

Each lamp shall be enclosed in its individual quartz sleeve, one end of which shall be closed and the other end sealed by a lamp end seal. To be considered as an alternate, lamp quartz sleeves that are open at both ends shall be supplied with twice the amount of specified spare seals and lamps.

The closed end of the quartz sleeve shall be held in place by a retaining O-ring. The quartz sleeve shall not come in contact with any steel in the frame.

Each UV bank shall be rated Type IP65. UV banks that are not Type IP65 rated are not acceptable.

To minimize maintenance, equipment must be provided by the UV manufacturer to enable lifting a complete bank of lamps from the channel at once for inspection and/or servicing.

Each UV Bank shall have separate access to the lamps and cable so as not requiring stopping of the other UV banks while doing maintenance / check-up.

Each UV bank shall have UV intensity sensor and same shall be accessible without requiring stopping of the UV bank for reference check.

UV Lamps:

Lamps shall be high intensity low pressure amalgam design. Lamps that are not amalgam shall not be allowed. The filament shall be significantly rugged to withstand shock and vibration. Lamp wiring shall be Teflon insulated stranded wire. Lamps shall be rated to produce zero levels of ozone. The lamp shall withstand an average of four (4) on/off cycles per day without reducing lamp life, warranty or causing any damage to the lamp.

Lamps shall be operated by electronic lamp drivers with variable output capabilities ranging from 30% to 100% of nominal power. The lamp assembly shall incorporate active filament heating to maintain a minimum lamp efficiency of 35% across varying water temperatures and between the minimum and maximum stated lamp power levels.

Lamp Plugs:

Each lamp plug shall be accessible from the top of the UV bank to facilitate lamp removal without moving the UV banks or any other components.

An integral safety interlock in the lamp plug shall prevent removal of energized lamps.

The lamp plug shall be rated Type IP65.

Lamp Drivers:

Each lamp driver shall independently power two (2) UV lamps. Failure of one lamp shall not affect operation of the other lamp.

The lamp driver shall have a power factor correction circuit to ensure minimum 98% power factor and less than 5% total harmonic distortion (THD) current at the maximum power level and nominal input voltage.

The lamp driver should be able to withstand voltage fluctuation of + 5%.

The lamp driver electrical efficiency shall be minimum 95% at the maximum power level.

A ground fault in the output circuit shall be detected and communicated as a warning to the external controls system while the corresponding lamp operates undisturbed.

The communication protocol shall be Modbus implemented on an RS485 electrical interface, or equivalent.

Quartz Sleeves:

Quartz sleeves shall be clear fused quartz circular tubing containing 99.9% silicon dioxide.

Sleeves shall have minimum UV transmittance at 254nm of 87% (1mm wall thickness).

Sleeves shall be open at one end only and domed at the other end.

Cleaning System:

An automatic suitable in-situ cleaning system shall be provided to clean the quartz sleeves using chemical/ mechanical methods. Wiping sequence shall be automatically initiated with capability for manual override.

UV system not having in-situ cleaning system shall provide offline chemical cleaning system consisting of chemical tank equipped with air blower and air grid for agitation, neutralization chemical tank and dosing pump, recirculation/transfer pumps with disposal piping as a minimum requirement as specified in Fifth Edition of Wastewater Engineering: Treatment and Resource Recovery by Metcalf & Eddy . UV system providing offline chemical cleaning shall provide minimum 50% UV Bank as standby.

The cleaning system shall also incorporate an integrated debris removal device to clear the quartz sleeves of any large solids or debris to maximize the life of the chemical/mechanical cleaning system.

The wiper on the cleaning system shall be parked out of the effluent when not in use.

The cleaning system shall be fully operational while UV lamps and modules are submerged in the effluent channel and energized.

Cleaning sequence frequency shall be field adjustable to enable optimization with effluent characteristics.

Cleaning system operation shall be remote auto (default) or remote manual.

The cleaning system shall be provided with the required solutions necessary for initial equipment testing and for equipment start-up.

The UV intensity sensor shall be cleaned utilizing the same chemical/mechanical cleaning method as that of the lamp quartz sleeves.

Effluent Level Controller - Modulating Weir Gate / Downward Opening Weir.

Gate:

a) Modulating Weir Gates (MWGs) shall be self-contained and shall be designed and manufactured by an experienced and reputable manufacturer, based on the AWWA C561 Standard for Fabricated Stainless-Steel Slide Gates and AWWA C542 Standard for Electric Motor Actuators for Valves and Slide Gates in effect as of the date of this specification or equivalent BIS Standards for these parts.

b) Modulating weir gates shall be designed to maintain the minimum channel effluent level required to keep lamps submerged at all times

c) MWGs shall be designed for the following performance criteria:

- MWG actuation speeds shall be between 250 mm and 350 mm per minute.
- MWG maximum design rate of change of flow shall be limited to 25% of the Peak Design Flow/Channel per minute, or alternatively, flow shall be ramped up (zero to peak) or down (peak to zero) in no less than 4 minutes.
- MWG actuators shall employ AWWA S4-50% duty class motors with a rated minimum 900 starts per hour capability.
- MWG actuators shall employ AWWA Class B solid-state Thyristor based switchgear capable of at least 5,000,000 modulating steps before overhaul; electromechanical type actuators and controls shall not be permitted.

Fixed Weir:

Serpentine or finger type Fixed Weir Level controller is acceptable with proper justifications and calculations.

Weir material shall be of SS 316 type.

Electrical:

All applicable electrical components shall be CE-listed to ensure safety standards are met.

Each UV lamp within a bank shall be powered from a Power Distribution Centre.

UV Manufacturer to supply all cabling between lamps and drivers.

Each electronic lamp driver shall power two lamps.

Power factor shall not be less than 98% leading or lagging.

Power Distribution Centre (PDC):

The Power Distribution Centres shall be installed in a temperature-controlled room.

PDC enclosure material shall be SS 304 Type 12

All Power Distribution Centers to be CE approved or equivalent.

Each PDC shall be able to electrically isolate each bank of lamp drivers and safely replace a lamp driver without de-energizing any other operating banks.

Control and Instrumentation:

1. System Control Center (SCC):

a) The monitoring, operation and control of UV System Control Center (SCC) should be through HMI screen.

b) Alarms shall be provided to indicate to plant operators that maintenance attention is required or to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. The alarms shall include, but not be limited to:

i) Individual Lamp Failure

ii) Multiple Lamp Failure

iii) Low UV Intensity

iv) Bank Communication Alarm

c) Mode of operation for UV Banks can be manual, automatic or remote.

d) Elapsed time of each bank shall be recorded and displayed on the display screen when prompted.

e) The System Control Center should be connected to the main STP PLC for providing operational and alarm feedback.

2. UV Intensity Sensor:

Minimum 1 no. of intensity sensor shall be provided per UV Bank. A reference sensor shall be provided for reference check. Reference check shall be perform when the UV Bank is in working.

3. Low Level Probe:

Minimum 1 no. of electrode type low level probe shall be provided per UV Channel.

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

SPECIFICATIONS FOR DISC FILTER (If required)

The specification given hereunder shall supersede other specification in case given elsewhere in tender document.

PURPOSE & SCOPE:

Horizontally installed Disc filters shall be suitable for installation in wastewater treatment plant of municipal wastewater to reduce total suspended solids (TSS) of waste water coming from secondary treatment from 30 mg/lit to below 10 mg/lit or as the case may be before discharging in to any water body or subsequent treatment.

The Disc filters shall be completely made of stainless steel of the specified grade and supplied in a concrete basin or with Stainless steel tank for freestanding based on the technology. The units shall include stainless steel rotating filter wheels with drive units, covers, level sensors for level control of the filtrate and complete backwash system comprising of with pump, strainer piping and all other accessories as required. The filter wheels shall be rotating continuously or during the backwash as per the technology.

ELIGIBLE CRITERIA FOR DISC FILTER SUPPLIER:

The supplier who has technical tie up with any international renowned manufacturer and have operating references equivalent to the proposed capacity in India, shall be preferred.

CONSTRUCTION:

Distributor/ Centre tube: The disc filter shall be equipped with a distributor or a center tube based on the Technology or as per the manufacturer's specifications.

In case of the distributor, it shall be structurally welded, fabricated and water tight made of stainless steel.

Drive Mechanism: The drive system of the Disc filter shall consist of a geared motor shaft mounted with helical worm gear and a synchronous drive belt / chain and sprocket arrangement based on the technology. The protection class of the geared motor shall be IP 65.

Filter wheel Assembly: The disc filters shall be comprised of filter wheels shall be mounted directly on to the trunnion rollers made of stainless steel and PA12G and the wheels connected to each other or on a center tube/ drum with sealing arrangement between the discs and the drum based on the technology. Each filter wheel shall be consisting of filter frames or Disc filter shall comprise multiple high strength and separable discs (proposed by manufacturer). Each Disc shall be subdivided into smaller sections to constitute a prefab disc frame (module) so as to ensure easy replacement and maintenance. Each disc consists of total twenty four (24) separable filter panels (12 filter panels on each side).

Filter cloth: The filter cloth shall be either three-dimensional Dutch woven mesh made of stainless steel AISI 316 grade or cloth media or Polyester based on the technology. The nominal opening of the filter media shall be in the range of 5 to 10 microns based on the technology. Filter cloth / SS woven mesh from each filter frame shall be replaceable individually without use of any special tools.

Filtration: The filtration shall be Inside to Outside or Outside to Inside based on the technology. The submergence could be fully submerged or partially submerged based on the technology.

Backwash Cleaning System: Each disc filter shall be equipped with a back-washing system consisting of:

Horizontal Centrifugal pumpt mounted or Submersible Pump set on the tank with dry run protection generating minimum 5 bar pressure or as per manufacturer's recommendation.

The pump body shall be of stainless steel and protection class of IP 55, Strainer(if required) with 200 micron filter and pressure switch,

Adjustable water level sensor for the control of backwash operation,

Stainless steel spray headers(if required) with spray nozzles consisting of stainless-steel coined shape nozzles,

Collection trough (if required) constructed of stainless steel for the removal of solids. The length of the backwash trough shall be equivalent to the combined length of filter wheels.

Mounting brackets, Isolation valve, piping etc.: All necessary mounting brackets Isolation valve at the upstream and downstream and all necessary piping shall be provided as per the recommendation of the technology provider and for the successful operation of the disc filter.

Access walkways, handrails etc.: All necessary staircase, walkways and handrails shall be provided ensuring safety of the operator.

Covers: The Disc filters shall be furnished with covers(if required) made of stainless steel of specified grade or FRP with safety interlocking system for the purpose of service and inspection.

Control Panel: The control panel shall be equipped with PLC , HMI and all necessary switch gears for proper operation of the disc filter. The panel shall be with IP 55 protection.

GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS:

As Disc filter are required in Stainless Steel material, the manufacturer is expected to follow the best manufacturing practice mentioned here under to further eliminate the possibility of corrosion of Disc filters:

Manufacturining shall be done in a stainless-steel clean area i.e. in a plant where no ferrous material is cut or elded or handled thus ensuring no ferrous contamination / pick up leading to corrosion in future.

Must have the facility for Pickling and Passivation to remove any ferrous contamination that might have taken place during manufacturing / handling / storage/ movement etc.

As Disc filters involves, weding, the manufacturere shall have PQR, WPS & Qualified welders as per ASME Section 9.

Disc filters shall be constructed and shipped as an integral product factory assembled product involving minimum dismantling and assembly at site for erection.

Disc filters shall be dry tested at the manufacturers works before dispatch. Upon receipt at site these shall be installed resting into the RCC channel and suitably anchored with no chances of misalignment.

SHOP TESTING:

The Disc filter shall be offered for inspection at the plant of the manufacture only and subjected to following tests before dispatch:

Dimensional Check: Important dimensions shall be verified with respect to approved G.A. Drawings.

Operational Test: The complete Disc filters including Backwash pump and Control panel shall be mechanically operated and tested in dry condition to verify interference free movement and satisfactory operation.

Positive Material Identification (PMI) test: To ensure that Disc filters are actually made of the specified grade of stainless steel, positive material identification (PMI) test to be conducted for all

important components during inspection and PMI reports to be submitted to client / corporation along with joint inspection report.

Dye Penetration test: Dye penetration test shall be conducted at random for checking the soundness of welding joints during the inspection. Both procedure as well as person conducting the dye penetration test shall be certified by the outside agency as per relevant standard.

Review of test certificate: Material test report / certificate, Motor certificate, Control Panel certificate shall be offered for review during the inspection.

Review of WPS, PQR & Welder's qualification certificate: To be offered for review during the inspection and copy of same to be submitted to client / corporation along with joint inspection report.

INSTALLATION:

General: The equipment shall be installed properly to provide a complete working system. Installation shall follow the supplier's recommendations. The installation and commissioning of disc filter has to be done in the presence of manufacturer's representative(s) so as to avoid any possibility of misalignment and faulty installation.

Manuals: The equipment supplier shall furnish three (3) copies of operation and maintenance manuals which will be retained at the installation site to assist plant operators. The manual shall include the supplier's erection and assembly recommendations.

Chapter 6
ELECTRICAL, INSTRUMENTATION, SCADA, OCMS AND AUTOMATION

a) Electrical

6.1 INTRODUCTION

Standards and Specifications

The design, material, construction, manufacture, inspection, testing and performance of all Electrical equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility.

6.1.1 Documentation and Calculations

All necessary documentation, drawings and schedules required to describe the design shall be developed and maintained during the course of the works and be available for inspection by the Client's representative as requested.

Prior to key phases of design: detailed design and construction - these design documents shall be presented to the Client's representative as a base-line descriptions of the works for review and approval.

From the following documents, schedules and drawings the Contractor shall agree, with the Client, those required to describe the works at each baseline. The full breadth, depth and scope of that documentation as well as the programme for their delivery shall be agreed with the Client's representative.

6.1.2 Tests & Tests Report

All tests shall be conducted as per the relevant standards. Tests shall comprise:

Acceptance and routine tests for all supply equipment/component parts shall be carried out as per the relevant standards for the respective equipment before dispatch to ensure compliance with the relevant specifications & agreed quality assurance/testing plan. These test reports and manufacturer's type test reports shall be submitted to Client before dispatch of the equipment.

Certified copies of reports of all type tests carried out on similar type and rating of equipment (offered under this contract) within last five years from the date of submission of Bid shall be submitted to the EMPLOYER for review and approval. In case the type test reports are not found to be meeting the specification

6.2 MEDIUM VOLTAGE SWITCHGEAR

The Medium voltage switchgear and its accessories shall conform to all latest editions of national and international standards indicated in specification and specific requirements as indicated below.

Short Circuit Current Ratings:

The level for the switchgear, circuit breakers, isolators, earth switch, bus bars, etc., shall be arrived at, on the basis of short circuit current.

A margin of 5% over higher of the above S.C current, thus calculated shall be applied and rounded off to the next higher standard ratings and this value shall be adopted for the breakers

and switchgears.

Constructional Requirements:

The switchboard shall be indoor, metal clad having separate metal enclosed compartments for (a) control, metering and relaying devices, (b) circuit breakers, (c) phase bus bars, (d) instrument transformers and (e) power cable terminations and adjacent cubicles (panels) shall have sheets on either side to ensure complete isolation. The bottom of each panel shall be covered by sheet steel and necessary glands plates. Switchgear shall be suitable for extension on both sides.

Required number of high speed trip relays, supervision relays, auxiliary relays, timers, contact multiplication relays, etc., shall be provided in the panels to meet the system requirements and to meet the system operation philosophy indicated in the specification elsewhere.

The circuit breaker shall be draw out type and it shall have test, service and isolated positions. In test position the circuit breaker shall be capable of being tested for operation without energizing power circuits.

The current transformers shall be mounted in the fixed portion of the switchgear. Adequate space shall be available for termination using heat shrinkable type cable termination in cable compartment and for mounting of zero sequence current transformers (core balance current transformers).

Withdrawal of circuit breaker shall not be possible unless it is in open position and operation of circuit breaker shall not be possible unless it is fully in service position, or is fully in test position and drawn out position.

Automatic safety shutters shall cover live parts when the breaker is withdrawn and all other standard safety features shall be provided.

All non-current carrying metal work of the switchgear shall be effectively bonded to the earth bus. Hinged doors shall be earthed through flexible for each type of breaker.

The circuit and bus bar earthing facility with earthing trucks shall be provided for each type of breaker.

Switchgear shall be supplied completely wired and inter panel wiring between cubicles of same switchgear shall be provided.

All relays protective, auxiliary, and timers shall be in draw out cases with built in test facilities. Necessary test plugs shall be supplied loose and is included in the scope of supply externally operated hand reset indicators shall be provided on all relays and timers. Timers shall be of electromagnetic or electronic type only. Atleast 1NO + 1NC spare contacts of all relays / timers shall be wired to terminal block. All relays shall be of self reset type unless otherwise specified.

Breaker control switches shall be pistol grip black and selector switches shall be oval or knob, black. Breaker control switches shall be 3 position spring return to neutral, instrument selector switches shall be of maintained stay put type.

Each switchgear panel shall be provided with 240 Volts, 1 phase, 50 Hz, 5 amps, 3 pin receptacles with switch located in a convenient position.

The CTs shall withstand momentary and short time current ratings of the associated switchgear. CTs and VTs shall be of the cast resin type and completely encapsulated.

In case of smaller rated CTs (say 200 Amp and less) at the expected fault level the CT saturation may result in the non-operation of the instantaneous short circuit protection. In such cases separate protection CT core with higher ratio shall be selected to avoid saturation at high fault currents.

VTs shall be single phase, drawout type and housed in a separate sheet metal enclosure. VTs shall be provided with MCBs on both primary and secondary sides. Those terminals required to be connected to earth shall be earthed by an isolating link without a fuse. Fuses on primary side shall have rupturing capacity equal to the switchgear rating.

The termination kit shall be EPDM cold shrink type / heat shrinkable.

Rubber mats suitable for MV grade shall be provided at front and rear of switchgear. Cubicle Components

Each circuit breaker cubicle shall be provided with the following minimum standard accessories:

One control switch `Trip - Neutral - Close' spring return to neutral position.

One control selector switch `Local - Remote’ stay put type.

Indicating lamps -

`Red’ for breaker `On' indication and trip coil supervision.

`Green' for breaker `Off' indication.

Blue' for breaker in 'Service' position.

‘Amber' for breaker in 'Test' position.

'White' for breaker closing spring 'Charged'.

'White' supervision lamp for lockout relays.

The indicating lamps shall be clustered LED type. They shall be bright and visible from any angle.

Mechanical trip push button to trip the breaker when control supply is lost. The push button shall be shrouded type. Mechanical close push button provided shall be accessible only after opening of the front door.

One electrical antidumping relay.

One double pole control supply switch and set of fuses.

One breaker operation counter.

Cubicle lamp, heater with thermostat and plug point.

IPR’s shall be provided for remote operations.

METERING AND PROTECTION

Adequate protection / metering shall be provided for the switchgear panels. All main protective relays shall be numerical with communication interface. Numerical relays shall be provided for prtection. Relay setting software for setting all the numerical relays in MV switchgear & generator protection panels shall be loaded in a dedicated operator station in the main control room. All MFM meters shall be with RS-485 connectivity to PLC. The minimum protections /

metering shall be provided required for various typical feeders shall include.

6.3 TRANSFORMERS

Service transformer shall be 11/33kV (as per availability) Contractor shall confirm the same from the Local electricity authority before start of the engineering activities / 0.433 kV, 3 phase, with off-circuit tap on HV winding for +10% to -10% voltage variation in steps of 2.5%. Transformer shall Oil cooled as per latest amendment of BIS-1180. Vendor can use Dry type transformer in case of space restriction by getting approval from Engineer in charger.

Transformers up to and including 2500 kVA shall be comply the latest amendment of IS-1180 which specifies the requirements and tests including standard loss levels of mineral oi immersed, natural air-cooled, outdoor type, double wound distribution transformers for use in power distribution systems with nominal system voltages up to and including 11/33 kV

Dry type transformer shall be class `F' insulated with temperature rise limited to class B enclosed in sheet steel enclosure of at least IP 23 degree of protection, complete with door and interlocking facility and complying Local Electricity Supplier standard.

Each 415V switchgear shall be supplied by two LV transformers. Each transformer shall be rated to meet the loads connected on both bus sections of the switchboard with 10% design margin. Starting requirements of largest motor with all other base loads running shall be duly considered while sizing the transformer. All the LT transformers shall be selected with 100% standby i.e 2 x 100% rating.

The transformers feeding services located in the powerhouse building are proposed to be located in the switchgear room, adjacent to respective PCC, optimizing LV bus duct routing. Considering indoor installation.

TESTS

All transformers shall be completely assembled at works to ascertain that all parts fit correctly.

ROUTINE TESTS

Routine tests as per specified standards shall be performed on all transformers.

6.4 415V SWITCHGEAR – PMCC & MCC

The 415V switchgear and its accessories shall conform to the latest editions of national and international standards indicated in specification. Also, the 415 V switchgear / MCC and its accessories shall comply with the requirements indicated in Data Sheet – A and specific requirements indicated below

For feeding the 415V/240VV AC loads of the plant, 415V switchgear / motor control centres (MCCs) and AC distribution boards (ACDBs) shall be provided. All 415 V switchgear, MCC's & ACDB's shall be procured from the same source in order to ensure inter- changeability of components.

The 415V switchgear shall be of metal enclosed design with a symmetrical short circuit rating of 50 kA (or as per system requirement) for 1 sec.

CONSTRUCTIONAL FEATURES

The switchgear shall be indoor, metal enclosed, floor mounted of uniform height not more than 2450 mm, made up of the reqanuisite vertical sections, dust and vermin proof

construction with IP - 52 degree of protection, unless otherwise stated and the degree of protection provided by enclosures against external mechanical impacts shall be IK08 minimum. Panels shall be supplied with base channel (ISMC 75/ 100 or so) which will be an integral part of the panel.

Adjacent switchgear cubicles shall be provided with side sheets on either side to ensure complete isolation. The switchgear shall be easily extendable on both sides by the addition of vertical sections.

Each switchgear cubicle shall be fitted with a label in the front and back of the cubicle. Each switchgear shall also be fitted with label indicating the switchgear designation, rating and duty. Each relay, instrument, switch, fuse and other devices shall be provided with separate labels.

Operating devices shall be incorporated only in the front of the switchgear. No equipment needing manual operation shall be located less than 250 mm above ground level.

The switchgear shall be divided into distinct vertical sections comprising of

Individual feeder module which shall be integral multiples of basic module, containing all associated equipment, enclosed in sheet steel enclosure on all sides and the rear except cable alley side and provided with hinged door on the front.

A completely metal enclosed, busbar compartment running horizontally, and a vertical busbar compartment serving all modules in vertical section

A vertical cable alley covering the entire height, except horizontal busbar compartment with minimum 250 mm width for MCC modules at right hand side and minimum 200 mm for circuit breaker controlled modules, with adequate number of slotted cable support arms.

A horizontal separate enclosure or enclosures separated by phylum/FRP sheets for power and control buses with tap off connections to each vertical section.

EARTHING

An earthing bus shall be provided at the bottom and extended throughout the length of the switchgear. It shall be bolted / welded to the frame work of each unit and each breaker earthing bar.All non-current carrying metal work of the switchgear shall be effectively bonded to the earth bus. Hinged doors shall be earthed through flexible earthing braid.

Positive earthing of the circuit breaker frame shall be maintained both in service and test position.

6.5 Illumination levels and choice of lighting fixtures

The area-wise distribution of average illumination levels shall be decided based on illumination levels indicated in relevant standards with 30% margin additionally. LED luminaries shall be considered for all the areas.

Lighting System Design

The lighting system design shall comply with the acceptable norms and the best engineering practices. The lighting layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirement, local rules etc.

Lux levels

Lux levels shall be considered as below –

- Office 300lux
- Control room 300lux
- Switchgear room 200lux
- Pump house 200lux
- DG set room 200lux
- Other indoor areas 100lux
- Roads 10lux
- Transformer area 100lux
- Other outdoor areas 10lux

Maintenance factor

- All indoor area 0.9
- All outdoor area 0.8

Roadway lighting

Lighting design for roadways shall consider a maintenance factor of 0.8 for average conditions.

The mounting height of the luminaires shall be generally 6 to 9 meters.

6.6 CABLING SYSTEM

The Cabling system shall conform to the latest editions of national and international standards indicated in the specification Also, the Cabling system and its accessories shall comply with the requirements indicated in Data Sheet – A and specific requirements indicated below:

Cable Types

For Medium voltage services (up to 33kV), XLPE cables with following specification shall be provided.

Unearthed grade single or multi core, stranded aluminum conductor, screened by triple extruded semi conducting compound gas cured, gas cooled, tree retardant, cross linked polyethylene insulated, cores screened with semi conducting compound is combination with copper tape, laid up, inner sheathed with extruded PVC compound type ST2, armoured with galvanised wire or strips for multi core cables and aluminium wire armoured for single core cables and overall sheathed with extruded FRLS PVC type ST2 cable complying with IS : 7098 part-2.

Cable selection

The HT & LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible voltage drop.

Current carrying capacity

The cable shall be able to carry the full load current of the circuit continuously under the specified ambient temperature and other conditions of installation. For this purpose, suitable

derating factors shall be considered due to:

- Thermal resistivity of soil
- Ambient ground / Air temperature
- Derating factor for grouping of cables over the current ratings at normal conditions given in standards. The design ambient air temperature and ground temperature for this plant shall be considered as 50 deg.C and 30 deg.C respectively.

Control cables

The minimum cross-sectional area for control cables shall be 1.5 sq mm. However, for applications mentioned below 1.5 sq.mm copper conductor can be used.

Wiring of field device contacts (flow/level/pressure/temperature switches) to low burden circuits in annunciator relay panels, interlock relay panels, local cabinets etc., if the annunciator / control/interlock relays are electromagnetic type.

Current transformer leads shall be checked for lead burden, VA capacity and knee point voltage. In case 2.5 sq.mm Copper Conductor is not adequate, higher cross section cables shall be used.

Instrumentation Cables

The cross-sectional area shall be 0.5sq.mm

The instrumentation cables carrying digital signals shall have overall screening and analog signal carrying cables shall have each pair screening and overall screening.

EARTHING SYSTEM

Earthing system design shall be carried out as per IS 3043.

For earth mat design, the size of the earthing conductor shall be arrived at, considering the maximum design fault current for a duration of 1second. Suitable corrosion allowance shall also be considered while sizing the earth mat conductor. The spacing of the conductors shall be such that the touch and step potential are within the limits of permissible values.

b. Instrumentation

6.7 General

Instrumentation & Control system shall be designed, manufactured, installed and tested to ensure high standards of operational reliability. Instrumentation & Control shall be selected with performance parameters appropriate to the process, the process media and the location.

All electronic components shall be adequately rated and circuits shall be designed so that change of component characteristics shall not affect plant operation.

All Instrumentation & Control equipment shall be new, of proven design, reputed make, and shall be suitable for continuous operation. Unless otherwise specified, all instruments shall be tropicalized. The outdoor equipment shall be designed to withstand tropical rain. Instruments offered shall be complete with all the necessary mounting accessories.

Electronic instruments shall utilize solid state electronic components, integrated circuits,

microprocessors, etc., and shall be of proven design.

Wherever necessary, access ladders/ platforms shall be provided for maintenance and operation of the instruments.

On return of power after an electrical power failure, all Instrumentation & Control and controls shall function automatically without any reset action required by personnel. Instrumentation & Control systems shall be designed such that failure of the system shall not result in damage to plant or result in the development of a hazardous situation.

All wetted parts of the sensors shall be made of non-corrosive material. The instruments shall be designed to permit maximum interchangeability of parts and ease of access during inspection and maintenance.

Any instrument /I&C equipment/system located at hazardous area shall be provided with suitable protection complying with ATEX (Explosion proof, Intrinsic safe etc.) as per hazardous area classification.

Unless otherwise stated, field mounted electrical and electronic instruments shall have minimum ingress protection as IP-65. All instruments of submersible type shall be protected to IP-67/68. Where a unit is fitted in a panel or other enclosure, it shall preserve the design IP rating of that enclosure. Cable connections to Instrumentation & Control systems shall not reduce the IP rating of the device.

The instruments shall be designed to work at the temperature, humidity, and other environmental conditions that may prevail at site. Materials which are exposed to the process fluid shall not corrode. In all cases materials shall be chosen that are compatible and that no chemical or electrochemical actions are present other than those intended. Instrument enclosure shall have corrosion–resistant properties. Enclosures of all the field instruments shall have locking arrangement.

All field instruments, and cabinets/panel mounted instruments shall have stainless steel tag plates/name plates permanently attached to them. Details of proposed

6.8 Flow Measuring System

Flow measuring system shall consist of flow sensor/ transducers, flow computer and flow transmitter.

Flow transducers shall be rugged in construction and shall be suitable for continuous operation. Flow transducers shall have waterproof construction and shall be suitable for installation in underground/ above ground pipeline.

To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow sensor shall be provided in accordance with the requirements of the flow meter manufacturer. In case upstream /downstream straight run are not available then electro-magnetic flowmeters which are full bore in design and developed for such installations i.e which do not require straight runs (2D-5D shall not require) must be installed.

The flow transmitter shall be suitable for field or panel mounting and shall accept an input from the flow sensor. It shall process the input signal and provide 4-20mA dc with HART output proportional to flow rate. The flow range shall be adjustable.

A zero span adjustment facility shall be provided for flow transmitter and indicator. The transmitter must have LED display for local interface without any additional device.

Flow measurement shall not be affected by physical properties of sewage viz., temperature, pressure, viscosity, density etc., within given limits. Contractor shall provide compensating electronic circuits if required. The overall accuracy of flow measuring device shall be at least 0.5% of the measured value unless otherwise stated.

6.8.1 Electromagnetic Flow meter

Full bore electromagnetic flow meter shall consist of flow sensors (i.e. flow tube), transmitter and remote flow indicator cum integrator.

Full bore bi-directional electromagnetic flow meters shall be designed, manufactured and calibrated as per ISO/IEC 17025 standard. Meters shall also have actual Flow rate & Totalized value. The accuracy shall be +/- 0.5% of reading.

Meter tube (Sensor) shall be fabricated from stainless steel tube (SS304) and flange shall be of carbon steel anti corrosions, scratch resistance coating in accordance with required pressure ratings. These flanges shall be welded or lap joint (to ensure the proper orientation of flowmeter sensor). The wafer design shall be strictly not acceptable. The flow meter liner shall be Polyurethane.

The sensor's junction box should be as per manufacturer standard suitable for IP68.

The transmitter/converter shall be wall / pipe mounted type with a 4 line display for the indication of Actual Flow rate & Totalized value. A glass window within the protection enclosure for operation shall be provided for local reading purposes. It should have Polycarbonate or Aluminum Housing material of the enclosure

In case the required straight lengths (5D Upstream & 2D Downstream) are not available, then the manufacturer should offer unrestricted full bore flow meter without compromising on ±0.5% accuracy. Reduced bore design/expander reducer scheme is not acceptable as it will lead to additional pressure loss and piping activity.

6.8.2 Open Channel Flow Meter

Open channel flow measuring system shall consist of level transducer, flow computer and flow transmitter. The level of the fluid in the flume shall be measured by the ultrasonic level transducer. The level measured shall be used along with the physical characteristics of the flume to compute the flow rate.

The level transducer shall be suitable for flange or bracket mounting as required and shall be environmentally protected as per IP65. it shall have ambient temperature compensation and adjustable datum setting facilities.

The design and application of ultrasonic level meter shall take into account the channel construction, the material size, shape, environment, process fluid or material, the presence of foam granules, size etc.

The installation shall avoid any degradation of performance from spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuation, specific gravity changes and condensation. For application where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection.

The structure required for supporting the level sensor, platform, railings etc. shall be in the Contractor’s scope.

Ultrasonic Flow transmitter	Service : Water, Non-contact type
Transmitter :	
Type	Open channel Ultrasonic flowmeter
Principle	Pulse Time of flight
Output	4-20 mA HART/RS485/4-20 mA
Number of sensor inputs	1
Material	Polycarbonate for field housing / Die cast Aluminum
Ingress Protection	IP66 / IP 67 field housing
Accuracy	+/- 0.2% of the maximum span of the sensor
Area Classification	Non-Hazardous
Power supply	90-253VAC or 10.5 to 32 VDC
Temperature	from 0 deg C to +60 deg C
Display	LCD/LED graphic display.
Configuration	Using Keypad on display
Sensor	
Range	0 – 5m or as per site requirement
Max Temperature	60 deg C
Materials	PVDF
Process connection	G 1"/ 1" NPT or manufacturers standards
Degree of protection	IP68
Mounting	Top Mounted

6.9 Pressure Gauges

Pressure gauges shall comply with BS 1780. Snubber shall be provided where the gauge is subjected to pressure pulsations and / or vibrations. The internal parts of pressure guage shall be of stainless-steel material. In chlorine applications the diaphragm shall be silver or tantalum for other fluids an appropriate diaphragm material shall be used. The pressure gauges shall be provided with diaphragm seal arrangement.

The minimum diameter for round pressure gauges shall be 150mm unless specified otherwise or where the gauge forms part of a standard item of equipment.

The accuracy of pressure gauges shall be ±1% over the operating range.

The zero and span of pressure gauges shall not change by more than ±0.1% of the span per __OC changes in ambient temperature.

6.10 Level Measuring System

6.10.1 Ultrasonic Level Measuring System

The ultrasonic type of level measuring system shall consist of ultrasonic type level sensors, transmitter and indicator.

Ultrasonic Level transmitter
Transmitter

Type	Ultrasonic
Principle	Pulse Time of flight
Output	4-20 mA HART current/RS485/4-20mA
Housing	Die Cast Aluminum
Ingress Protection	IP67
Accuracy	+/- 2 mm or 4 mm depending on selection or 0.2% of set measuring distance Whichever is greater.
Area Classification	Non-Hazardous
Temperature range	0°C ... +60°C
Display	4 line LCD display.
Configuration	Using Keypad on display
Sensor	
Range	Liquids 0 to 5m and 0 -10m depending on Tank size
Temperature range	0°C ... +60°C
Materials	Sensor: PVDF Seal: EPDM
Process connection	Threaded or universal flange dependent on model selection
Degree of protection	IP68

6.10.2 Ultrasonic Differential Level Measuring System

The ultrasonic type differential level measuring system shall consist of ultrasonic type level sensors on upstream and downstream of screens, differential level computer / transmitter and indicator.

The flow computer / transmitter shall be microprocessor based and shall have facility for programming (i.e. adjustment of set points).

The ultrasonic transducer shall be suitable for flange or bracket mounting as required and shall be environmentally protected as per IP-65. It shall have ambient temperature compensation and adjustable datum setting facilities.

6.10.3 Hydrostatic Level Measuring System

The hydrostatic type level measuring system shall consist of hydrostatic/pressure based level sensors and transmitter.

The transducer shall be suitable for submerged in sewage at 10meter depth. It shall have IP-68 rating. It shall have ambient temperature compensation.

Measuring principle : Capacitive

6.10.4 Conductivity Level Switches

The electrodes used for conductivity level switches shall be stainless steel. Single electrode systems (one electrode per holder) shall be used (except where their use is impractical) with insulated electrodes such that only the tip of each electrode is exposed to the liquid at the operating level.

Relay or control units operating with level electrodes shall have adjustable sensitivity. Electrodes for use in fluids of low or variable conductivity shall be fitted with conductivity discs.

Where relay or control units are not mounted in control panel, they shall be provided with

surface mounting enclosures with a degree of protection to IP-54 for indoor locations or IP 65 for outdoor location.

6.10.5 DO Analyzer

The optical shall be used for DO Analyzer.

The analyzer shall be suitable for submerged in sewage at 10meter depth. It shall have IP-68 rating. It shall have ambient temperature compensation.

The transmitter shall generate dual 4-20mA/RS485 signals for DO and another for Temperature. It shall be fully programmable using front keypads.

The transmitter shall be suitable for outdoor installation. It shall have IP-65 rating whereas sensor will be rated for IP68.

SENSOR	Measuring principle	Optical type
	Measuring Range	0-20mg/l (0-20ppm) or as per requirement
	Temperature compensation	Required
	Operating temp range	–5 to 60 °C (20 to 140 °F)
	Accuracy	0.01 mg/L or +/- 1% of measured value
	Repeatability	+/- 0.5% of measuring range
	Sensor material	Sensor shaft : Stainless steel
	Temperature compensation	Required , internal
	Cable/Cable connector type	Plug in head
	Cable/connector IP rating	IP 68
	Sensor signal output	Digital communication with transmitter /Analog cable
	Sensor memory	Required to store - calibration data, sensor model, serial number etc
TRANSMITTER	Power Supply	100 to 230Vac +/- 15%, 50/60 Hz/12-48 VDC
	No. of measuring channels	* 1 or 2 channel
	Measuring Range	To fit sensor range
	Current outputs	4 to 20mA /RS485
	Display	Graphic display
	Enclosure IP rating	IP67
	Enclosure material	Polycarbonate
	Cable entry	1/2" NPT

6.11 AUTOMATION

6.11.1 Salient Features

PLC system shall have open system features like interoperability, portability, scalability, flexibility and upward compatibility.

It also shall have the capability and facility for expansion through the addition of controller modules, I/O cards, peripherals like LED Monitors, OWS, printers etc.

A Non-redundant PLC shall be considered.

Minimum of three access levels viz. Operator, Engineer, and Manager for access by third party applications and Workstation management. System shall support creation of un-limited unique user accounts. It shall be possible to administer user access rights.

HMI/SCADA capabilities shall include Process displays, sequence screens, permissive criteria, trends, I/O tables, Alarms, Sequence of Events, logs and reports

6.12 PLC System Performance Requirements

Functional Requirements

6.12.1 Processor

PLC Processor shall be non-redundant.

Processor shall have functional capabilities such as mathematical functions, logic functions, Control Techniques and Point, etc.

Processor shall support application programming languages - Functional block diagram, Sequential flow chart, Ladder diagram, Structured text.

It is envisaged to have multiple PLCs in the plant. PLC supplied by OEM for their own system may be non-redundant with minimum 6” color HMI for its operation. However, all such PLCs shall communicate to main PLC for exchange of monitoring, controlling and interlock signals. The Main plant SCADA shall monitor functioning all plant equipment centrally. Preferred communication protocol is Modbus TCP/IP or Modbus RS485, however if OEM PLC and Main PLC protocol is matching the same shall be considered for inter PLC communication.

6.1.1 Input/ Output modules

Status monitoring of all I/O modules from SCADA/HMI shall be possible. All I/O modules shall have LED indication for power supply healthiness

6.1.2 Digital Input modules

All digital input modules shall have 16 or 32 channels with status indication for each channel etc.

The interrogation voltage for digital inputs shall be 24 V DC.

6.1.3 Digital Output modules

All digital output modules shall have 16 or 32 channels with status indication for each channel etc.

Interposing relays shall be provided for all digital outputs.

6.1.4 Analog Input modules

All analog input modules shall have 4, 8 or 16 channels.

Power supply for 2 wire field transmitters shall be 24VDC.

All analog input modules shall have transmitter monitoring for parity, wire break, live zero, monitoring of A/D conversion, conversion to engineering units, alarm limit testing for high, low, high and low substituted values and monitoring of signal out of range for analog inputs.

6.1.5 Analog output modules

All analog output modules shall have 4, 8 or 16 channels.

Individually definable default state for each output shall be possible.

6.2 Human Machine Interface (HMI)/Supervisory Control and Data Acquisition (SCADA)

Operator station shall be provided with Human machine interface for monitoring and operating the plant equipment with the help of various graphics and displays and also generate various logs/reports for effective plant operation. OS shall be freely assignable and shall have features like Process displays, sequence screens, permissive criteria, trends, X-Y plots, I/O tables, Alarms, Sequence of Events, logs and reports etc. Operator station shall be with 32" LED monitor, hardware shall be of latest configuration, tested and certified for this application.

For independently operating machines, color HMI of minimum 6" shall be provided for its operation.

Software

The software supplied shall meet the following requirements:

The SCADA software shall be proven, able to support all the equipment/peripherals and execute all the tasks as stipulated in this specification.

The data acquisition, processing and alarm monitoring/ reporting shall be done through SCADA software.

All software used for DCS/PLC shall be licensed version only.

SCADA software shall have means of historical data storage and retrieval of selected analog and digital data points, SOE alarms, logs, operator journals.

Operational Working hours report of Blowers, Wet well pumps, Decenters, etc. shall be generated in SCADA for minimum up to 6 months.

Inlet and outlet flow report of STP shall be generated in SCADA for minimum up to 6 months.

Provide API to ICC Smart City and UADD server for future integration.

6.3 Third Party Interface

PLC shall support protocols such as Modbus TCP/IP, Modbus RS485, OPC, MIS connectivity. All independent machines with independent PLCs shall be integrated to Main PLC for complete interlocking and monitoring purpose. If OEM PLC and Main PLC protocol is matching the same shall be considered for inter PLC communication.

6.4 Panels /Cabinets

Panels shall be self-standing type with maximum height of 2100mm, minimum 2mm thick CRCA, 3mm removable gland plate, panel - door switch, Fans, Paint RAL 7035 (Both exterior & Interior), illuminated lamp push buttons, suitable Enclosure Protection (Indoor-IP

42,Outdoor-IP 55), Anti vibration pad of minimum 15mm thickness, seismic protection, lock with handle and key, neoprene gaskets, panel earthing: Safety earth for enclosure and Electronic earth for PLC system, Base plate shall be provided for all din rail mounted hardware for proper support, Base frame shall be provided, Utility socket, Louvers, Wiring - Termination and Accessories. Clamps for fixing field cable Supports & clamps for wiring raceways

6.5 Control Desk / Consoles

Control desks/consoles shall be desk top type to house monitors & Keyboards on top and its associated equipment inside (console type). Consoles shall be of minimum 2mm thick CRCA for base frame and doors. Doors shall have concealed type hinges with lock and key. Paint colour shall be RAL7035.

6.6 Uninterrupted Power Supply (UPS)

The UPS shall be floor mounted; self-contained and metal clad and shall be suitable for operating on a nonlinear load. It shall be front door accessible. The UPS system shall be true ON-Line.

The ON LINE UPS shall be incorporating a six-pulse rectifier and pulse width modulation inverter technology with 100% microprocessor control with built in static and manual bypass switch.

The UPS shall incorporate a DC under voltage trip circuit to electrically trip the UPS in order to protect the battery.

The output of the inverter shall be a sine wave having less than 5% THD for linear loads and less than 4% to 50% non linear load. It shall be suitable for load power factor 0.8 lag.

The unit shall have dynamic response such that a 100% step load causes an output voltage transient of less than ±4% with a recovery time of less than 4 ms.

For three phase output units the output voltage shall not very by more than ±1% for an unbalance for 10%.

Indicators to indicate

- UPS status
- UPS alarm conditions
- The UPS shall provide a volt free contact output to indicate:
- Warning. i.e low battery capacity
- Fault
- Static bypass in use.

The UPS shall have an overload capacity of 150% for 30 seconds and shall be protected in the event of a short circuit of the output.

The batteries shall be housed, either within the UPS enclosure or within a separate matching battery cubicle suitable for location adjacent to the UPS.

The batteries shall be maintenance free lead acid type sealed for life.

The UPS battery shall have a backup of 30 minutes at full load and supported with inverter of suitable capacity.

6.9 Online Continuous Monitoring system (OCMS)

STP shall have SCADA-PLC for Controlling and Monitoring of process treatment with online Continuous Effluent Monitoring system (OCEMS) (Spectrum measurement in the UV -VIS range 200-750 nm, double beam with entire spectrum scanning) and IPPTZ Camera at Inlet and Outlet of all STP as per latest CPCB guidelines.

SCOPE OF WORK & TECHNICAL SPECIFICATION FOR OCMS (Online Continuous Monitoring System) are as follows

Supply Installation, Testing, Commissioning of effluent quality monitoring system at STP inlet & outlet for online (continuous) measurement of PH. Total suspended Solid (TSS), Chemical Oxygen Demand (COD), Bio chemical Oxygen Demand (BOD), Flow, including 360 degree moveable night vision IP-PTZ camera and data display monitor at Inlet and Outlet & flow meter connectivity with flow meter at site by single analyzer with various sensors (spectral measurement in the UV-VIS range 200-720 nm, Double beam with entire spectrum scanning) performing reagent and chemical free analysis with automatic cleaning of Sensor, signal cable and power cables, local data acquisition and display of data on continuous basis for up linking the data to CPCB, MPPCB, Local SCADA (at STP Premises) & UADD server, complete in all respect as per central pollution control board (CPCB) latest guideline for online continuous monitoring system scope of work are as follows :-

a. Multi-parameter measuring converter, for connecting intelligent sensors Scope including analog inputs & outputs(0/4-20mA), RS485 output wide- range power supply Optical COD/BOD and TSS probe with spectral processing of the UV-VIS range, for measurement in the inlet & outlet/ effluent of sewerage waste water treatment plants with integrated with automatic cleaning. UV-Vis Spectrophotometry (Double beam with entire spectrum scanning) COD, BOD, TSS Fresh water to Waste water analysis shall have Interference check for color and turbidity compensation.

b. Robust digital pH/ORP sensor for pH/ORP electrodes, with built-in pre-amplifier & temperature sensor with Automatic Temperature Compensation (ATC) Cable length as per site condition directed by engineer-in-charge.

c. Sensor adapter cable for all intelligent sensors. with IP68 water proof connection to the intelligent Sensor Net system. Cable length required as per site condition directed by engineer-in-charge.

d. Providing and installation of GSM based data logger for Data transfer of existing online water quality monitoring System. Parameters in BOD, COD, TSS, pH, flow with installation charges.

e. It shall be responsibility of contractor to arrange the internet facility and running the same during whole O&M Period at site for transmission of real time data to MPPCB, CPCB, and Local SCADA & UADD and ensure Internet uptime SLA of 99.99%. The service provider shall follow the Data Transmission Protocol of MPPCB while communicating data on their Central Server. API is available on https://erc.mp.gfov.in/adminfiles/OpenAPI.pdf

6.7 Air Conditioning

The control room and PLC panel room shall be provided with Air Conditioner. The capacity of air conditioner shall be calculated, and a suitable size AC shall be installed.

Chapter 7

Specification Road Work

The specifications for Road works shall be governed by “Specifications for Road and Bridges works, 5th revision Ministry of Road Transport and Highways, Govt. of India”.

The Relevant IRC codes shall also apply.

Chapter 8

LIST OF APPROVED MAKES

Mechanical equipment makes proposed by the contractor should have working reference in India for minimum Twenty numbers of installations of equivalent capacity proposed under this project and working satisfactory for minimum five years as on date. The details of the same should be submitted at the time of approvals of mechanical data sheets/details.

OCMS Manufacturer should have minimum four years of performance certificate for successful run of any Government Project or PSU and vetted by not below than rank of Executive Engineer. The details of the same should be submitted at the time of approvals of OCMS data sheets/details/QAP.