

The direction of travel of the actuator may be reversed without first stopping the unit; this facility being available in either the “Local” or “Remote” mode.

JAMMED VALVE PROTECTION:

In the event of jammed valve the control circuit will automatically switch off power to the motor.

ESD (EMERGENCY SHUTDOWN):

Whenever ESD signal will be applied to actuator the controller will override existing signals and if the actuator is in remote mode the valve will move to pre-selected shutdown position.

ANTI HAMMER PROTECTION:

Once a torque switch has operated the control circuit prevents energisation of the contractors in the same direction until a signal in the reverse direction has been applied.

DRAWINGS:

1. Tenderer must mention the model and make of each item in the technical bid with necessary technical details. Failing to this price bid will not be opened.
2. Contractor shall have to provide detailed drawings, detailed designing, detailed of Actuator (make, model no, rated torque etc.), details of gear box, MOC of equipments, Drawings of control panel etc. and same shall be got approved from SMC before execution.

TESTS AND INSPECTION:

The following drawing shall be submitted approved during detail engineering.

1. Each actuator must be performance tested and individual test certificates shall be provided. The test equipment should simulate a typical valve load, and the following parameters should be recorded.
 - Current at max. torque setting
 - Torque at max. torque setting
 - Test voltage and Frequency.
 - Flash test voltage
 - Actuator output speed or operating time.
2. In addition, the test certificate should record details of specification such as gear ratios for both manual and automatic drive, closing direction, wiring diagram code number and , when applicable, remote position transmitter signal range.
3. The certificates should clearly indicate the model for which testing has been done.
- 4.

FOLLOWING TO BE SUPPLIED/SUBMITTED AFTER THE AWRD OF CONTRACT:

1. Each actuator shall be supplied with a start-up kit comprising any necessary special setting tools, installation instructions, electrical wiring diagram and sufficient spare cover screws and seals to make good site losses during the commissioning period.

2. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:-

- a) Serial number
- b) External voltage values
- c) Wiring diagram
- d) Terminal layout.

3. MANUAL:

The system must be provided with 3 sets of operational manual along with all required drawings for further maintenance work.

ITEM NO.7 : AIR BLOWERS FOR DIFFUSED AERATION SYSTEM

SCREW TYPE AIR BLOWER

Air blower shall be designed to perform satisfactorily under specify start up condition, max. Differential pressure operation and relief valve setting pressure and up to trip speed. All the compressor casing shall be air cooled type.

Air blower shall consist of the following accessories:

- Screw Blower with special coating screws.
- Lubricating system: Splash Lubrication
- Base support with suction filter, and reactive suction silencer integrated. There should not be any absorptive material used in Silencer.
- Belt drives transmission POLY-V type.
- Discharge silencer.
- VSM Relief Valve.
- Check valve.
- Electric cabinet for auxiliary power supply.
- Acoustic sound enclosure with hot air extraction fan.

Gas:	AIR
Spec.Weight (Kg/m3):	1.08
Capacity at discharge (m3/h):	As per datasheet
Dif.Press. (mbar):	As per datasheet
Inlet Press.(mbar a):	1007
Outlet Pres.(mbar a):	As per design
Dif.Temp. (°C):	Vendor to Specify
Inlet Ambient. (°C):	40
Outlet Temp. (°C):	Vendor to Specify
Noise Level DbA:	85 ± 3%
Shaft Power (kW):	Vendor to Specify
Speed (rpm):	As per design requirement
Motor IEC:	Vendor to Specify.
Power (kW):	Vendor to Specify
Voltage (V):	415+/- 10%

Poles:	Vendor to Specify
Frequency (Hz):	50
Turn Down Ratio % of full capacity at rated pressure:	Vendor to Specify
Tolerance:	Capacity \pm 5%, Shaft Power \pm 5%

Material of construction of various part of the air blower shall be as under:

Casing	Cast Iron UNI-EN 1651 G250
Rotors	Carbon Steel C40 EN 10083/1 with Teflon Coating
Gears	UNI-EN 10084 18 NiCrMo5
Shaft	Steel C40 EN 10083/1
Base Frame	High Strength Steel Plate

All the necessary accessories and protections of compressor etc. are to be provided which are helpful to smooth running of the process of the plant.

Detailed Technical Specification:

- 1) **Screw Air Blower:** The blower should be Air Cooled, low speed and highly energy efficient. Rotor RPM should not exceed more than 2500 RPM of Bare Screw Blower. The rotors should be designed with Wide-diameter shaft to reduce the deformation caused by internal and external loads, thereby ensuring the blower to work efficiently even in harsh condition. The bearing should be designed considering increased life time and the seals used on conveyed gas side and lubricating oil side should be "Wear Free".
- 2) **High Efficiency and High Reliability Belt Drive:** The belt drive must be designed keeping in mind auto-tensioned arrangement which helps belt to take care of elongation happen at later stage. Poly-V Belt Drive or better than this belt drive is recommended to reduce flapping issue.
- 3) **Motor with Self-tensioning System:** All Blowers units need to be shipped with the motor mounting system locked, preventing vibration and stress on bearing and belt during handling/freight. To achieve the correct belt tension, locking plates have to be removed when commissioning screw Blower.
- 4) **Noise Enclosure:** The noise enclosure is designed with optimized Air passages and sound reduction capacity. Once installed, the enclosure is completely separate from the blower so there is no transmission of vibration moves to enclosure body. Fresh Air circulation inside the enclosure keeps the operation temperature cool, provides greater efficiency with normal operation. Electric Motor driven cooling fan must be located to the blower air end and discharge silencer are which is the warmest area of enclosure to dissipate the heat from noise enclosure. Noise enclosure must be equipped with doors and key-lockers for ease of maintenance and allow the installation of additional units side-by-side.
- 5) **Lubrication System:** Splash Lubrication system to be used in Blowers. Should be simple, compact with minimal maintenance.
- 6) **Inlet and Discharge Silencers :**

Inlet Silencer: The suction side silencer should be reactive in nature i.e. there should not be any adsorptive material used. The design of silencer should be such that it should accommodate filter inside. The filter used should be cartridge type for ease of maintenance.

Discharge Silencer: Adsorptive discharge silencer in accordance with the Directive 97/23/CE (PED) as in line accessories, combining the most effective noise reduction with no contact between the air and the sound absorbing material.

7) **Relief Valve:** VSM Relief Valve with an automatic actuator for optimum accuracy and reliability, the emergency relief valve protect the blower and its components in case of clogging of discharge pipelines or accidental pressure spikes in the plant / process. The valve should be designed in such way if there is modulation pressure requirement than by adding bypass valve in line the requirement can be meet. Also Valve should help in reduction in starting torque by gradually opening the valve to the system.

8) **Immediate Oil Level Check:** The blower should have provision to check indicative oil level on the Noise Enclosure.

9) **Instrumentation:** The blower must come with clogging gauge for suction filter and discharge pressure gauge.

10) **Control Panel :** The blower must be supplied with control panel having below features :

- Suction Pressure
- Discharge Pressure
- Oil Level Sensor
- Emergency Stop
- Start & Stop

Possibility of RS485 Modbus communication of Data

TURBO AIR BLOWER

Air blower shall be capable of operating continuously and satisfactory at all design points mentioned in the tender without surge, vibration, hunting or excessive heating of the blower equipment

Air blower shall consist of the following accessories:

- Single / Multi stage Centrifugal Turbo Blower
- Air Cooled Motor
- Base frame and fabricated acoustic enclosure supplied with noise attenuating media
- Pneumatically operated Blow-off Valve and integral Blow-off Valve Silencer
- Discharge check valve and discharge expansion joint
- Inlet air filters
- Local control panel

Gas:	AIR
Capacity at discharge (m ³ /h) :	As per datasheet
Dif.Press. (mbar) :	As per datasheet

Inlet Press.(mbar a)	:	1007
Outlet Pres.(mbar a)	:	As per design
Dif.Temp. (°C)	:	Vendor to Specify
Inlet Ambient. (°C)	:	40
Outlet Temp. (°C)	:	Vendor to Specify
Noise Level Db	:	85 ± 3%
Shaft Power (kW)	:	Vendor to Specify
Speed (rpm)	:	Vendor to Specify
Motor IEC	:	Vendor to Specify.
Power (kW)	:	Vendor to Specify
Voltage (V)	:	415 ± 10%
Poles	:	Vendor to Specify
Frequency (Hz)	:	50
Turn Down Ratio % ge of full capacity at rater pressure	:	Vendor to Specify
Tolerance	:	Capacity ± 5%, Shaft Power ± 5%

All the necessary accessories and protections of Air Blower etc. are to be provided which are helpful to smooth running of the process of the plant.

Detailed Technical Specification:

1.01 ENCLOSURE

- A. Each blower should come with enclosure.
- B. Enclosure shall be capable of attenuating noise levels emitted from the package to eighty five(85) dBA at one (1) meter distance from the package ± three (3) dBA, free field. Noise attenuation of the discharge piping, silencers and inlet piping (if applicable) shall be the responsibility of the OWNER.
- C. Blower shall be mounted on a sturdy steal base frame with forklift slots on each of the four (4) sides and four (4) suitably sized eye bolts welded to the enclosure allowing the unit to be placed on any level floor capable of taking the weight of the unit, no foundation or fixation should be required.
- D. Enclosure shall be designed for ease of inspection and maintenance of all blower system components. Hinged or removable panels shall provide access to the blower and the auxiliary systems. Doors shall have a welded, reinforced perimeter frame and a welded support structure to prevent sagging or misalignment.

1.02 ELECTRICAL

- A. Blower will be given 415 Volt (V), 3 Phase, 50 Hertz (Hz) power connection.
- B. Blower should be compatible with External VFD.
- C. Variable Frequency Drive (VFD)
 1. VFD shall be provided in separate canopy.
 2. Make of VFD – ABB / Siemens / Danfoss
 3. VFD shall provide means for manual operations, data access and troubleshooting.
 4. VFD shall include all features necessary for self-protection and for protection of the connected motor.

5. VFD shall have remote communications capabilities utilizing MODBUS protocols or equal.
6. VFD shall be selected and sized for proper operation with the specified blower motor.
7. All adjustments, settings and programming shall be performed by the SUPPLIER or VFD supplier.

D. Motor

1. Blower shall be equipped with a 415 Volt (V), 3 Phase, 50 Hertz (Hz),
2. Motor shall be rated for continuous operation in ambient air temperatures up to 50°C.
3. Motor shall have an insulation rating no less than Class H , Temperature Class B.
4. Motor shall be capable of operation at the rated voltage with a variance of \pm Ten (10) percent of the nameplate frequency.
5. Motor shall be capable of continuous operation at full load and rated frequency with a voltage variance of \pm five (5) percent of the nameplate voltage
6. Motor shall be suitable for VFD operation.

1.03 LOCAL CONTROL PANEL (LCP)

- A. The blower LCP shall be PLC/Microprocessor based with processor The LCP shall be mounted in the electrical enclosure.
- B. LCP shall be supplied with suitable power connection. LCP shall contain all instruments and equipment provided as part of the blower package.
- C. LCP shall have an emergency stop button so that in the event of an emergency, this button could be used to stop the blower immediately.
- D. LCP shall perform the following functions:
 1. Monitor and display all temperature, pressure, and vibration data readings.
 2. Shutdown blower and report conditions regarding temperature, vibration or surge endanger the blower or drive.
 3. Modulate (increase/ decrease) blower flow as commanded by the MCP.
 4. Report to MCP all status indicators including:
 - a. Run status (On/ Off)
 - b. Not available (Locked out or Failed)
 - c. Speed (RPM)

1.04 SURFACE PREPERATION AND SHOP PAINTING

- A. Machine carbon steel or iron surfaces that are not painted shall be protected by coating with a corrosion-resistant compound.
- B. Enclosures shall be prepared and powder coated on all interior and exterior surfaces with the manufacturers standard powder coating and standard color.

1.05 FACTORY PERFORMANCE TESTING

- A. Performance Testing

1. Upon completion of assembly, the blower package unit(s) shall be performance tested. If required by the OWNER, the test shall be witnessed by a representative of the OWNER at the expense of the OWNER or Bidder. The witnessing party shall sign, stamp and date the test procedure and results, certifying that the assembled systems were tested together, as a system, in the SUPPLIER's facility.
 2. Performance test should be in accordance to ASME PTC-10
 3. Functional testing of entire package, instrumentation, ancillary components, and LCP shall also be performed.
 4. All test equipment shall be calibrated and certified by an independent test agency no more than twelve (12) months prior to the test date.
 5. The measurement of power consumption with the power meter shall be measured with all of the components inside the enclosure and all doors closed as the normal operation condition.
 6. Test Report shall present computations in accordance with the appropriate section or testing codes with performance curves showing flow, pressure and power inputs.
 7. Test Report shall be submitted for approval prior to equipment shipment.
- B. The following practice shall be performed to ensure and verify performance guarantees.
1. System Description: For the purposes of determining overall power consumption (power to package) the system shall consist of a blower, motor, variable speed drive, filters, and air cooling system to cool motor and the inverter including external piping, wiring, instrumentation and appurtenances up the point of connection to the OWNER's equipment.
 2. Blower unit(s) shall be capable of operating continuously at any point between the minimum and the maximum flows without surge, vibration, idling or excessive heating.

Test Report shall include a certified factory test performance curve showing flow and pressure at 100%, 70% and 50% of full speed. Factory test curve shall also include curves for package demand power.

ITEM NO.8 : SUBMERSIBLE TYPE PUMPS

The total head / capacity curve shall be continuously rising towards the shut off with the highest at shut off. Pump shall be suitable for single as well as parallel efficient operation at any point in between the maximum and minimum system resistances. The pump shall be designed to handle solid size of upto 65mm. Pump shall run smooth without under noise and vibration. The pump set shall be suitable for starting with discharge valve open and/or closed. The pump set shall be capable of withstanding the accidental rotation in reverse direction.

Pump shall be submersible, centrifugal, vertical spindle, nonclog, wear resisting, and single stage type. Pump casing shall be of robust construction. Liquid passages shall be finished smooth and designed as to allow free passage of solid. The volute tongue shall be filed to a smooth round edge. Double mechanical seals shall be provided to protect the motor from ingress of sewage along the shaft. The preliminary and secondary seals shall be oil-lubricated with tungsten carbide or silicon-carbide faces and they shall be equipped with an electrical monitoring system for seal failure detection. Impeller shall be non-clog enclosed type with smooth blunt edges and large water way so as to allow free passage of the large size solid. It

shall be free from sharp corner and projection likely to catch and hold rage and stringy materials. The critical speed of the rotor shall be at least 30% above the operating speed. Pump set shall have double bearings. The bearing life shall be minimum 40,000 hrs of operation.

Each pump shall be complete with a cast iron delivery connection arrangement for fixing to the concrete floor of the suction well. The joint between the pump discharge flange and the delivery piping shall be made by merely lowering the pump into guide rails/rope from access level. It shall be provided with all necessary fixing for guiding the pumps during lifting/lowering. Each pump shall be provided with a stainless steel lifting chain conforming to BS 1663 and BS 4942. Each pump shall be providing with an automatic coupling device for attaching the crane hook to the pump is submerged, without the need for personnel to enter the well. This automatic coupling device shall easily and automatically couple and uncouple the hoist hook and be complete with necessary accessories. All links and cables shall be multi-stranded stainless steel.

The pump parameters of the submersible pump shall be as follows

The materials of construction for submersible pumps shall be as follows:

Component	Material
Impeller	Stainless steel : ASTM A 743 CF8M
Casing	Cast Iron to IS:210 Gr FG 200 with 1.5 to 2% Nickel
Shaft	Stainless Steel : BS:970 Gr 410
Guide rail pipe	Stainless Steel : BS:970 Gr 304
Fasteners and Foundation Bolts	Stainless Steel : BS:970 Gr 304

Material test certificates shall be furnished by the contractor

a Induction Motor (Submersible Pump)

The submersible motor shall conform to IS: 9283:1979 and the submersible cable shall conform to clause no. 4.4 of the IS: 9283:1979. Motor shall be capable of giving rated output without reduction in the expected life span when operated continuously under the following supply conditions:

- i Variation of supply voltage from rated motor voltage 10%
- ii Variation of supply frequency from rated frequency 5%
- iii Combined voltage and frequency Variation 10%

The starting current of motor shall not exceed 200% of rated full load current for star/delta starting. Under any circumstances motors shall be suitable for full voltage star-delta starting. Motor shall be capable of starting and acceleration the load with the applicable method of starting, without exceeding acceptable winding temperature, when the supply voltage is in the range 85% of the rated motor voltage to maximum permissible voltage. The locked rotor current of the motor shall not exceed 600% of full load current (subject to tolerance as per the applicable standard) unless otherwise specified. Motors shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage, in either direction of rotation. The motor vibration shall be within the limit specified in applicable standard unless otherwise

specified for the driven equipment. Except as mentioned herein, the guaranteed performances of the motor shall be met with tolerances specified in applicable standards, IS 9283-1979. protection against increase in stator winding temperature (150C) bearing temperature, leakage in stator housing and terminal box shall be provided. Minimum three number thermostats in series are to be provided to sense the stator winding temperature. Sensors are to be provided to detect if leakage of sewage into the oil housing is above 30% concentration. Bimetallic thermal switch to trip the motor against increase in temperature shall be provided.

The power rating of the motor shall be larger of the following:

- 115 % of the maximum power input at any point on entire performance curve of the pump at rated speed.

b Submersible Cable

The cable shall be flexible multi strand, copper rubber cable with sheath of chloroprene sealed over its length. The size of the conductor shall be adequate for continuous use under water and air. The half core shall be used for earthing. The control cable shall be PVC insulated PVC sheathed, flexible, flat type and shall be adequate for continuous use under water and air. The control cable for stator winding temperature sensor (Thermostats) 3 core X 2.5 sq.mm copper conductor and for bimetallic thermal switch 2 core X 2.5 sq.mm copper conductor shall be provided. The size of the conductor and length of cable should be suitably selected so that the voltage drop at motor terminals does not exceed 3 percent of the rated voltage. Earthing of the motors shall be done in accordance with the relevant provisions of IS: 3043:1966. for the purpose of earthing these motors, earthing connection may be made to discharge pipe.

Any joints in the motor insulation such as at coil connection or between slot and end winding section, shall have strength equivalent to that of the slot section of the coil. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid and tropical climate. The tropical sing treatment shall be as per the applicable standard. The stator winding shall made from high conductivity annealed copper conductor, PVC insulated winding wires conforming to IS: 8783:1978 for wet type motors. The stator winding shall be of high conductivity annealed copper enameled insulated wires conforming to IS: 4800(part-VII): 1970 for dry type motors.

The temperature-rise test of the motor shall be taken with the motor coupled to the suitable pump to give the full load output the motor. When the various temperatures are stabilized, the set is stopped and the temperature-rise of the stator winding by the resistance method shall no exceed 350C. As the cable resistance method, due care is taken to account for the correct hot and cold resistance of windings.

The motor shall be suitable for continuous use in fully or partially submerged condition. A built in cooling system must allow the motor to operate continuously at its rated output regardless of whether the electric motor is submerged or not, by providing either external or internal cooling arrangement.

Terminal box shall be of weatherproof construction to eliminate entry of water and dust. The terminal shall be the stud type with necessary plain washer, spring washers and check nuts. They shall be substantially designed for the current carrying capacity and shall ensure ample phase to phase to ground clearance.

This item includes the pump, pump motor, SS bellow (with sleeve), pressure gauge, necessary C.I. fitting, pipes etc. in side the pump house. Pump set and accessories shall be fitted with delivery gate / non return valve in side the pump house.

It should be very clearly noted that duty conditions i.e. discharge and head as specified must be achieved at the available speed of motor running at full load under specified supply condition mentioned. No allowance / calculations shall be permitted to compute discharge / head at a particular speed. The specified discharge and head must be available at site at actual speed of motor / pump and not to be computed from designed parameter. No relaxation in this regard permitted.

ITEM NO. : 9 : C.I. FITTINGS & SPECIALS

1. SCOPE

The scope includes manufacture, delivery at site, storage at site, installation, testing and commissioning of double flanged cast iron pipe with fittings, specials including all flanged crosses, bands, duck foot bends, flanges, nuts, bolts and gaskets for all pumping stations.

2. GENERAL:

1. The cast iron pipes shall generally conform to Class B IS: 1537 / IS: 1536 /IS: 7181/ IS-1538 (part 1) 1976 and pipe fittings shall conform to IS: 1537/ IS-1538 (part 1) 1976. Ductile iron pipes shall conform to IS 8329 / BS 4772. All pipes and fittings shall be flanged.
2. The material for cast iron pipes and fittings shall be of gray cast iron conforming to IS : 210, Gr FG 200 Minimum.
3. The pipes shall be of uniform bore and straight in axis. Length of the straight double flanged pipes shall be within a tolerance of ± 3 mm. The flanges shall conform to IS 1538 Table IV & VI.
4. The flanges of the straight pipes shall be square to the axis of the pipe. The faces of the flange shall be parallel. The bolt holes circle shall be concentric with the bore and bolt holes equally spaced. In straight pipes the bolt holes in one flange shall be located in line with those in other.
5. The faces of the flanges of the fittings shall be square to the directional axes. The holes shall be located symmetrically off the center line. The intersecting axes of the tees shall be perpendicular to each other.
6. The bolt holes on flanged pipes and fitting shall be drilled with the help of drilling jig. The blank flanges are to be machined and drilled.
7. All nuts and bolts used for jointing the C.I. pipes and fittings shall be of cast steel or hot dipped galvanized.
8. The approximate quantity for the pipe shall be furnished.

9. If any fittings/ specials are not included in IS the same shall be manufactured as per site requirement but the thickness shall not be less than the thickness specified in IS for identical fittings or specials.
10. The rate should be inclusive of pipes, specials, fittings complete with packing sheet, necessary size of high tensile hot deep galvanized nut bolts, washer, material (lead , lead wool), manila rope etc.
11. Contractor should also supply and fitting necessary C.I. fittings like blind flanges etc in common header delivery line of spare pumps (future pumps) and All CI fittings shall be flanged type only.
12. C.I. fittings, specials, etc. shall first be given two coats of zinc based primer after completely cleaning of surface and then it shall be coated with three coats of coal-tar base epoxy paint.

The quantity of C.I. pipes are tender purpose only. So during ordering of CI pipes & fittings, contractor should have to measure the actual quantities required as per execution of the site & prior approval should be taken from SMC.

ITEM NO. : 10 CAST IRON ADJUSTABLE DISMANTLING JOINT

1. SCOPE :

This specification covers the design requirements, features of construction, inspection, testing, painting, delivery, installation and commissioning of Dismantling Joint including all the accessories, tailpieces, rubber insertion, fasteners, etc.

2. CODES AND STANDARDS :

The design and manufacture of the Joint shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall relieve the vendor of this responsibility.

3. DESIGN REQUIREMENTS:

- Double flanged Cast Iron Adjustable Dismantling Joints shall be provided with all the accessories, tailpieces, rubber insertion, fasteners, etc. complete
- MOC: C.I. FG 220 (MINIMUM), IS 210.
- It shall be used to create space in pipeline up to a maximum of 0 mm to 100 mm.
- It should absorb/limit vibration/expansion contraction.
- The pressure rating shall be match with all adjacent items.
- It should comply with IS-1538 (part 1) 1976.
- The all fasteners shall be of Stainless Steel 304. T

4. CLEANING:

Prior to factory inspection, all manufacturing waste such as metal chips, debris and all other foreign material shall be removed from the interior of the joint. All mill scale, rust, oil, grease, chalk and all other material shall be removed from the interior and exterior surfaces.

5. PAINTING:

Dismantling Joint shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint. The resulting coating shall be uniform and smooth and shall adhere perfectly to the surface.

6. DRAWINGS:

The following drawing shall be submitted approved during detail engineering.

1. Preliminary outline dimensional drawings.
2. Typical cross sectional drawing.
3. Flow v/s head loss.

7. TESTS AND INSPECTION:

1. Dismantling Joint Valves shall be offered for visual inspection and dimension check.
2. Dismantling Joint shall be tested as per relevant with latest amendments.

The hydro static testing and water tightness test shall be witnessed by the Owner.

ITEM NO. : 11 : DOUBLE ACTING KINETIC AIR VALVE WITH ISOLATION VALVE:

SCOPE :

Supply, erection, testing and commissioning of water works pattern Double acting Kinetic air valve with required size isolation Knife valve and complete with hardware. Tail piece etc.

DESIGN REQUIREMENTS:

- 1) Water works pattern Kinetic Double acting air valve required for sewage application shall have a combination of small & large orifice plate air valve with common connection to the main lobe. The function expected of small orifice is to automatically releasing air which may accumulate under pressure in a section of pipeline during normal working condition & large orifice is to automatically exhausting air when a pipe is being filled with water or automatically ventilating a pipe when it is being emptied of water. It should be suitable for continuous use of at pressure rating mentioned within the temp. of 45⁰ C. It should be flanged ended machined and drilled according to IS 1538 & IS 6416.
- 2) Thickness of body shall be as per manufacturer standard.
- 3) The clearance between the floats and guide shall not exceed 3 mm per side.
- 4) The cover for large orifice chamber shall be sufficient thickness so as to withstand the full operating thrust in working condition. The float for high-pressure orifice and low pressure shall be as per data sheet.

Air valve shall be offered for testing at manufacturer's work and the detail drawing for the same shall have got approved prior to manufacturing.

ITEM NO.: 12 : CHLORINATION SYSTEM

Chlorinator	:	
Required no.	:	As per Design Requirement
Capacity	:	As per design
Type	:	Vaccume Type Solution Feed
Electric Power	:	415V ± 10% 3 phase 50 c/s.

General Description:

Chlorinator shall be vacuum operated sonically regulated type system consist of a vacuum regulator, flow meter with rate valve and injector.

Each Chlorinator should consist of:

- Remote Vacuum regulator
- Injector Assembly
- Differential pressure regulator
- Chlorine Pressure Gauge
- Vacuum Gauge
- Water Pressure Gauge
- Chlorine flow-meter (rota meter)
- Motorised Chlorine rate control valve
- Inter connecting withdrawable type pipes of PVC with sealing rubber “O” rings.
- High pressure solution discharge rigid PVC/HDPE pipes with fitting and protecting enclosures as per requirement.
- Vacuum and vent tubing as per requirement.
- Cylinder connecting valve with clamp to connect copper coil
- Line stop valve.
- 18 mm schedule 80 Carbon steel pipes with fitting for Chlorine gas line including Chlorine pressure regulating valve.
- Four nos. isolating valve at tonner and near chlorinator on common header.
- Residual Chlorine test kit of range 0.2 PPM to 5.0 PPM to color glass comparator type.
- Set of erection and maintenance tools
- Manual covering erection and maintenance instruction, spare parts list.
- Required length of ‘C’ class GI piping fitting along with brass valves/ NRV/ Strainer for connecting suction and delivery piping of booster pump to chlorinator and main piping.
- Roller support for chlorine tonner.
- The chlorinator should be complete with suitable self priming booster pump sets directly coupled by flexible coupling of steel pin and rubber boost type to a motor of suitable HP and mounted on a common base plate. The pump should have SS impellers and stainless steel shaft with ball bearing at both ends.
- Necessary automatic safety devices like gas-off-etc. in case of emergency like failure of power, water supply, should be incorporated. Further safety devices for back water entry in chlorinator due to failure of NRV should also be incorporated.
- Safety devices such as breathing apparatus /gas mask with rechargeable respirators, ammonia torch for leak detection, emergency safety shower and eye wash fountain, ton container repair kit shall be provided.
- Each set shall also comprise of all std. accessories, sub assembly that is required for smooth operation of chlorinator.
- Minimum 4 nos. chlorine leak detectors including electric hooter and automatic chlorine scrubber operation shall be provided in the chlorination equipment room. Leakage detection shall be at 0.2 to 0.5 ppm level and also at 2 to 5 ppm level.

ITEM NO. 12 : CENTRIFUGE – MECHANICAL DEWATERING SYSTEM

The centrifuge shall be suitable for de-watering the sludge of municipal sewage treatment plant. It shall have capacity of de-watering the liquid sludge of capacity as specified / as per design and having operational duty of 24 hr/day. Centrifuge shall be capable of handling sludge consisting of minimum 8% solids by weight. The dewatered cake shall be based on minimum consistency of 20% by weight dry solids.

Centrifuge shall work on mechanical sedimentation principal. Centrifuge shall have two phases for liquid and solid separation and removal. Separated solid in the decanter bowl are continuously removed by means of screw conveyor.

Centrifuge bowl cylinder shall be made of stainless steel. The feed pipe and shaft opening in the casing shall be fitted with seals. The standard inlet to the hollow axis of the conveyor body handle most of liquid sludge without risk of choking. The tips and leading flanks of the flights are hard faced with tungsten carbide alloy. The solid outlet opening shall be lined with hard metal bushings. Longitudinal strips shall be welded to the inside of bowl wall retain a thin layer of sediment that acts as an abrasive shield.

Screw conveyor shall be fine pitched and made of stainless steel. Screw conveyor edge shall be hard faced with tungsten carbide alloy.

The centrifuge shall be solid blow centrifuge of co-current / counter-current designed having steep cone (20 Deg.) with active baffle disc, so as to achieve maximum solid accumulation / transportation in the conical (feed) section of the bowl itself. 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. However, centrifuge of co-current current design may also be offered by bidder subject to approval of engineer-in-charge.

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 1m 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).

BOWL

The centrifuge bowl material shall be centrifugally cast AISI 316 grade. The inlet slurry shall be fed to the Centrifuge from small (conical) end of the bowl via stationary feed tube. To protect the wear due to Cake discharge, the bowl shall be fitted with easy replaceable satellite wear bushes. The bowl shall be fitted with axial ribs/strips from inside. The bowl assembly shall be independently balanced before assembly as per standards.

CONVEYOR

The centrifuge inside conveyor material shall be stainless steel AISI 316 grade. The conveyor shall be steep cone design with active baffle disc.

The inlet shall be of ‘Esberg’ design to facilitate very smooth distribution and acceleration of liquid in the pond without turbulence. The conveyor leading flights shall be protected against wear, by means of flame sprayed tungsten carbide alloy powder having content of nickel-chromium for higher bonding strength.

GEARBOX

The gearbox shall be of planetary design for compact & high performance operation, to monitor and control differential speed of the Conveyor.

BACK DRIVE SYSTEM

Eddy current type back drive with automatic differential speed controller shall be provided to facilitate automatic adjustment of differential speed during the process.

FRAME

Special sub frame fabricated from box section M.S. material shall be provided giving operational height to the machine. The sub frame shall be such a way designed so as to mount the flanged motor and eddy current back drive in vertical structure and to achieve economy of space.

VESSEL/COVER

The vessel and/or collecting cover shall be fabricated from AISI 316 sheet steel. On the cake discharge side, the vessel shall be protected with wear liner of thick SS 316 sheet. The upper part of the vessel shall be hinged to the lower part for easy opening and closing of the vessel of operator. Cover switch shall be provided to indicate cover open alarm in the panel.

DRIVE MOTOR

The drive motor shall be suitably capacity, continuously rated, 415V, 3 phase, TEFC, Class H insulation with class B temp. rise, squirrel cage induction motor to take care of initial accelerating torque load of the centrifuge rotating assembly in star-delta starting. The main drive to be coupled with fixed pulley with belts for easiness in maintenance. The electric drive shall meet all requirements as specified in electrical specifications and bidder shall adhere to the same.

CONTROL PANEL

The centrifuge starter panel shall meet all the requirements as per electrical specifications and shall have suitable interlink for motor overload, motor overheating and cover open condition. Interlock for stopping feed pump motor incase of alarm condition shall be provided.

Main bearings, conveyor bearings, etc. shall be compact, grease lubricated with proper sealing arrangement.

TECHNICAL DATA OF CENTRIFUGE AND ITS ACCESSORIES

Sr.	Particular	Details
-----	------------	---------

- A. Centrifuge
- Manufacturer Name
 - Capacity
 - Bowl speed
 - Screw conveyor speed
 - Differential speed adjustment
 - Differential speed control device
 - Inlet sludge consistency required
 - Guaranteed outlet sludge cake dryness
 - Poly dosing required
 - Recommended poly electrolyte
 - Operating duty
 - Start up time required
 - Shut off time required
 - Life of equipment
 - Recommended spare parts
- C. Poly electrolyte dosing pump
- Capacity
 - Efficiency
 - Power consumption
 - Motor HP
 - Pump make
 - Motor make
- C. Poly dosing tank dimension
- D. Total power consumption
- Centrifuge main drive
 - Poly dosing pump
 - Poly dosing mixture

DOSING / METERING PUMPS-RECIPROCATING TYPE

GENERAL:

Dosing pumps shall be mounted in a bund separate from the storage tanks and shall be fully accessible for operating and maintenance purposes without personnel having to enter the bund itself. Where appropriate, the pump bund shall be interconnected with the tank bund at an intermediate level.

The pumps shall be of the reciprocating mechanically actuated diaphragm type driven by electric motors. The pump, motor and drive arrangement shall be mounted on a robust combination base plate. Unless otherwise specified, only one liquid end shall be driven by any motor.

Pumps shall comply with API standard 675, positive Displacement Pumps-controlled Volume.

Capacity of pump : As per the Centrifuge Manufacturer requirement

Head : As per the Centrifuge Manufacturer requirement

PUMP HEAD MATERIALS:

Pump heads and diaphragms shall be manufactured from thermoplastic materials suitable for the duty conditions.

PUMP STROKE ADJUSTMENT:

Variable stroke mechanisms shall be incorporated in the drive arrangement to allow infinitely variable adjustment of pump output by means of a micrometer, hand wheel or similar mechanical device whilst the pump is running.

Where the pump is part of an automatic coagulation control or other process control loop, the stroke mechanism shall be fitted with a three phase bi-directional motor with torque limiter and automatic stops at both extremes of travel. A position feedback potentiometer shall be provided to facilitate control and remote indication of position. The operational range of stroke adjustment shall be not less than 6:1.

DRIVE ARRANGEMENT:

The pump head shall be driven through a totally enclosed speed reduction gearbox with integral reciprocating drive or the adjustable crank or mechanical lost motion type. The gearbox and reciprocating drive shall be oil bath lubricated. The unit shall incorporate filling and drain plugs for oil and an oil level indicator.

DRIVE MOTOR:

Drive motors shall be of the three phase cage induction type whether for fixed speed or variable speed operation.

Where variable speed operation is specified, the speed turn-down ratio shall be not less than 5:1.

PUMP PERFORMANCE:

The performance characteristics of the dosing pumps shall be adequate in terms of linearity, accuracy and reproducibility as designed in API standard 675 to achieve the stated plant performance guarantee. The deviation from flow linearity of the pump shall not exceed $\pm 3\%$ of the rated capacity. The steady state accuracy shall not exceed $\pm 1\%$ of the mean delivered flow under fixed system conditions over the entire turndown range. The flow rate repeatability expressed as a percent of the rated capacity of the pump shall not exceed $\pm 3\%$ of the rated capacity.

This item includes the pump, pump motor, SS bellow (with sleeve), pressure gauge, necessary pipe fitting, pipes etc. inside the pump house. Pump set and accessories shall be fitted with suction and delivery ball / non return valve inside the building.

ITEM NO.14: SUBMERSIBLE SUMP DRAINAGE PUMPS

Sump pumps shall be of the open-impeller type, vertically-mounted and close coupled to their fully submersible electric motors.

Sump pumps of 1.5 KW and under shall incorporate an integral low/high level detector for auto start/stop operation of the pump, control and motor starter and shall be powered only with a suitably-fused three phase or single- phase low-voltage supply and with supply isolated at the supply point.

Sump pump over 1.5 KW shall be controlled and stated from the supply point. Control shall be by means of adjustable float level switches mounted near the pump.

Pumps shall be supplied with all necessary pipe work to discharge to surface drainage. Each pump shall be provided with delivery reflux and isolating valves, and suitable lifting gear for lowering and lifting the pump from the sump.

Pumps weighing 40 KG or more shall be lowered in to the sump on guide rails and be located to their respective discharge pipe work with an angle flange connection and self-locating clamps. Pump impellers shall be designed to pass solids of the sizes which pass through the inlet ports of the pump and shall be capable of pumping solids of up to 50 mm diameter.

This item includes the pump, pump motor, SS bellow (with sleeve), pressure gauge, necessary C.I. fitting, pipes etc. in side the pump house. Pump set and accessories shall be fitted with delivery knife gate / non return valve in side the pump house.

ITEM NO. 15 : SCREW TYPE PUMPS

Pumps shall be of the type in which a pumping action is generated by a helical rotating eccentrically within a resilient stator in the form of a double internal helix. The eccentric motion of the rotor shall maintain a constant seal across the stator as it travels through the pump to give a uniform positive displacement.

Pumps shall be arranged generally with a single shaft seal at the suction end. Mechanical seals shall be used. If a flexible shaft is used to accommodate the eccentric motion, a corrosion-resistant shroud shall be fitted to prevent fiber build-up on the shaft. Enlarged inspection access holes shall be fitted to the suction chambers of all pumps for periodic removal of accumulated debris.

The shaft bearings shall be positively isolated from the fluid being pumped.

The rotor material shall be selected for corrosion and abrasion resistance for the fluid being pumped, and for prolonged service life. Hard chrome or other approved coatings shall be not less than 100 micron thickness and shall be diffused in to the base material. The rotor shall generally be single-stage and shall incorporate not less than 360° of twist, but for high-head applications, it may be necessary to use more than a single-stage.

The stator shall be of a resilient material selected for chemical and abrasion resistance for the fluid being pumped.

Pump speed shall suit the application, where variable delivery output is needed, the pump shall be provided with a variable-speed drive. The size and speed range of the pump shall ensure that the highest expected duty point shall lie within the available speed range.

Pumps shall normally be driven by a fixed-speed electric motor through reduction gearing and the combined drive shall be continuously rated. Pump and motor shall preferably be mounted in-line on a common base plate. Alternatively, the drive motor may be top-mounted above the pump to minimize floor area, and shall be connected by external V-belts and pulleys. V-belt drives shall have full guards of the type that allow the belts to be observed without removal of the guard. Facilities shall be provided for ready adjustment of belt tension.

Coupling guards shall be provided, which shall be rigid, securely fixed, and designed so that removal is not necessary during normal operation, routine maintenance and routine inspections.

All motor enclosures shall be provided with ingress protection to IP55. Motor anti-condensation heaters shall be provided and shall be suitable for use on a 220V single-phase, 50Hz supply.

All bearings shall have a B10 design life of not less than 40 000 running hours and shall be designed for loading 20% in excess of calculated maximum loading.

Pumps shall be fitted with individual dry-running protection to initiate pump trip. Dry-running protection by 'under-current' monitoring or 'pipeline-intrusive' device shall not be used.

MATERIAL OF CONSTRUCTION

Pump Housing	CI
Rotor	SS AISI 410
Shaft	SS AISI 410
Stator	Nitrite black
Type of drive	V belt & Pulleys
Base plate	MS fabricated
Seal type	Gland packing

This item includes the pump, pump motor, SS bellow (with sleeve), pressure gauge, necessary C.I. fitting, pipes etc. in side the pump house. Pump set and accessories shall be fitted with suction and delivery knife gate / non return valve in side the pump house.

ITEM NO. 16 AGITATORS / MIXERS (FOR CHEMICAL TANKS, SLUDGE SUMP, ETC.)

The mechanical mixing device shall comprise rapidly rotating blades mounted on a vertical shaft coupled to the gear box shaft through rigid coupling and driven through a suitably rated four pole, continuous duty, TEFC motor with IP 55 protection (motor shall be as per electrical specifications) operating through a reduction gear box to ensure uniform dispersal of the chemical solution / keep the sludge in suspension.

General Specification

- Agitator component shall be designed to fit through agitator opening on tank manhole.

- Pressure containing part shall have minimum corrosion allowance of 3 mm.
- Gear unit
 - A worm reduction gear shall be provided with a minimum service factor of 1.5 on the driver rated HP.
 - V belt operation is not acceptable.
- Flexible coupling shall be selected with a minimum service factor of 2 and shall be capable of continuous operation at the max. anticipated misalignment.
- Rigid coupling shall have tapered bores with key in nut arrangement. All rigid coupling shall be made from cast steel as per IS 1030 grade 2 or forged steel as per IS 2004 Cl. 3 or CI as per IS 1030 Gr 30 in tank rigid coupling in forged steel may be welded to the shaft.
- Shaft sleeve with harden surface shall be provided at standby barring and in packing areas.
- The shaft shall be suitable for transmitting full torque available at the driver name plate rating (starting torque).
- Shaft shall be suitable for jamming conditions considering that impeller is jammed at 0.75 R from centre (R = Radius of impeller).
- Shaft assembly designed with critical speed at least 30% removed from any operating speed.
- Impeller blade shall be of one piece construction.
- Bearing housing shall be designed with a span suitable for the minimum radial cum thrust loading used for the design of the shaft.
- It is preferred that the design of the agitator does not incorporate the use of a steady bearing at the shaft end. However if the use of such bearing is imperative the design shall be such that the bearing is of set aligning type and his product lubricated.
- The delivery pipe of the dosing pump shall be of SS 304 material.

MECHANICAL DATA:

Agitation provided Agitator	:	Top entry vertical shaft.
Level gauge	:	Required
Type of level gauge	:	Float & board type
Agitator type	:	Axial pitched turbine/low speed
No. of Agitators	:	One for each tank
No. of Blades	:	As per manufacturers design
Impeller dia, mm	:	As per manufacturers design
Gear box	:	Worm/worm wheel oil bath type vertical single reduction
Agitator RPM	:	60-100
Material of construction	:	
Reaction Tank	:	RCC M250 epoxy lined / coated
Agitator	:	SS 304
Impeller	:	SS 304
Shaft	:	SS 304

ITEM NO. 17 : CHLORINE SCRUBBER SYSTEM :

The system consists of Hoods for covering the chlorine tonner where chlorine gas outlet valves are fitted. The storage tank are fabricated as one piece. Highly efficient centrifugal

blowers of suitable size, necessary Hoods and Ductings are provided as per the number of tonner accounted for service. Centrifugal pumps for caustic solution re-circulation is also a part of the tonner based system.

1) FRP HOOD FOR CHLORINE TONNER / CYLINDER – FULL HOOD :

The system consists of a hood covering the complete chlorine tonner / cylinder where liquid / gas chlorine outlet valves are fitted. Hoodas are provided with 20 mm peripheral air gap for entry of fresh air during working of system.

2) DUCTING :

Required quantity of PVC Ducting of size 150 MM ID is provided for leaked chlorine gas from Hoods to Centrifugal Blowers and From Blowers to absorption tank.

3) BLOWER WITH ELECTRIC MOTOR (1W+1S) :

The system consists of 1 No. of highly efficient centrifugal blower of 1200 M3/Hr at 300 mm WG capacity for suction of leaked chlorine from Hoods to the Absorption Tank.

4) DAMPER FOR BLOWER :

01 No. FRP Dampers of size 150 mm ID is provided at discharge line of Blower and per Hoods 01 No. FRP Dampers of size 150 mm ID is provided at suction line of Blower to control the flow of Chlo – Air mixture through FRP ducting.

5) PRESSURE INDICATOR ON CAUSTIC PUMP DISCHARGE :

01 No. Pressure Indicator is provided on discharge line of Caustic Pump for indication of caustic line pressure.

6) PRESSURE INDICATOR ON BLOWER DISCHARGE :

01 No. Pressure Indicator is provided on discharge line of Blower for indication of pressure of Blower Discharge Line.

7) CAUSTIC SOLUTION TANK (For Toner) :

01 No. Caustic Tank of Capacity 10 M3 made of PP + FRP is provided for storage of 20 % conc. Caustic Solution.

THE CAUSTIC TANK

01 No. – Level Indicator of Glass Tube type for indication of level of caustic solution in the tank. Various Nozzles for inlet and outlet of caustic solution, Drain Valve with Drain Line, Overflow Line, Water Supply Inlet Line, Manhole, Vent, Diffuser, High/Low Level Switch etc.

8) CAUSTIC SERVICE PIPING :

Required quantity of UPVC Caustic Service Piping of size 63 mm OD as per ASTM standard is provided for re-circulation of caustic solution.

11) ‘Y’ TYPE STRAINER FOR CAUSTIC SERVICE:

02 No. Polypropylene ‘Y’ Type Strainer of size 2“ is provided on Caustic Service line at suction line of Caustic Pump to avoid passage of small particles.

12) NON RETURN VALVE FOR CAUSTIC SERVICE:

02 No. Polypropylene Non Return Valve of size 2“ is provided on caustic service line at discharge of Caustic Pump.

13) CAUSTIC RE – CIRCULATING PUMP WITH ELECTRIC MOTOR (1W+1S) :

02 No. Caustic Re-Circulating Pump of capacity 20 M3/Hr at 20 Mtr head along with suitable motor is provided on caustic solution line to re – circulate the caustic solution in to the absorption tank.

14) WATER SUPPLY PIPING FOR CAUSTIC TANK :

Required quantity of GI water supply pipe of size 1“ to deliver water into the Caustic Tank for dilution of Conc. Caustic Solution.

LUBRICATION SCHEDULE :

The lubrication schedule is mainly required for the rotating parts of the Caustic Pumps and Blowers. The Caustic Pumps and Blowers are required to be lubricated once in three months time. Caustic Pumps shall be replenished with oil as per SAE – 30 or equivalent.

CHLORINE GAS ABSORPTION CAPACITY = 1000 KG

LEAKED CHLORINE ABSORPTION SYSTEM :

The system is designed to absorb leakage of chlorine leaking from one filled Toner / Cylinder in one hour time. The system is designed to absorb the chlorine gas and not liquid chlorine leaked from the Toner / Cylinder. To stop the leakage of liquid chlorine from toner is the difficult task as the liquid chlorine expands as soon as it enters into the atmosphere. Normally as soon as you find the liquid chlorine is leaking from the valve or body of the toner, you must rotate the toner in 180 degree to convert the liquid chlorine leakage into gas chlorine leakage. The chances is very less for leakage of liquid chlorine from cylinders because it is always used in vertical position.

PROCESS DESCRIPTION OF ABSORPTION SYSTEM :

The absorption system is used for absorption of leaked chlorine gas from chlorine ton container / chlorine cylinder. FRP Hoods are placed to cover the chlorine ton container / chlorine cylinder. FRP duct is provided through each of the Hoods interconnected to a common header maintaining the pressure drop uniformly in each of the hood. A common duct is extended and connected to the Blower inlet which is further extended and connected from Blower outlet to the Absorption Tank for discharging the chlorine gas. The Leak Detectors when senses the leaked Chlorine to a set level initiates the Blower and pump for absorbing the leaked chlorine. The sensors are placed nearest to the Hoods to sense the leaked chlorine immediately. The system will have sight level gauge for see the level of caustic solution of absorption tank.

1. CAUSTIC CIRCULATING PUMP

1.	Type	Horizontal Centrifugal Caustic Pump
2.	Liquid to be handled	20 % wt caustic solution
3.	Specific Gravity	1.2
4.	Temperature	Ambient
5.	Location	Outdoor
6.	Duty	Continuous
7.	Rated Capacity	20 M3/Hr
8.	Diff. Head in MWC	20 MWC
9.	Pump Model	SCP SM 25 150 GP
10.	BKW duty	1.21 KW
11.	Recommended motor	3 HP / 2900 RPM
12.	Suction & Discharge	40 mm Suction & 25 mm Discharge
13.	Type of Impeller	Closed
14.	Type of Casing	Radially Split
15.	Type of shaft sealing	Gland Packing
16.	Type Of Coupling	Flexible
17.	MOC	Casing : CF 8 M
		Shaft : SS 410
		Shaft Sleeve : SS 410
		Impeller : CF 8 M
		Base Fram : MS + Anticorrosive Paint
18.	Dia of Impeller	100 mm
19.	Noise Level	85 to 90 Decibles
20.	Vibration Level	75 Microns
21.	Flange Drilling	ANSI B 16.5 Class : 150
22.	Bearing Lubrication	Oil
23.	NPSH	1.4 Mtr
24.	Shutt of Head	11.2 Mtr
25.	Weight Of Pump & Motor	75 Kg
26.	Desing Standard	DIN : 24256 & ISO 2858
27.	Testing Standard	IS 5120
28.	Qty	01 No
29.	Make	Pump : As per approved Vendor List Motor : As per approved vendor list

2. BLOWER

Type	:- Centrifugal
Standard / Code to which blower Design confirmed :	IS 4894
Capacity	:- 1200 m3 / hr
Pressure head	:- 300 mm wc .
Drive	:- V Belt Type
Motor	:- 7.5 HP / 2880 RPM
Volts / Freq./ Phase	:- 415 V / 50 Hz / 3 Phase
Casing Type	: Vertical up Blast
Fan Efficiency	: 65 %

MOC	:	-
1) Casing	:-	PP+FRP (Isophthalic)
2) Impellers	:-	FRP (Isophthalic)
3) Base Frame	:-	MS + anti corrosive Paint
4) Shaft	:-	En8 with FRP
Qty.	:	2 No
Motor	:	Crompton / Equivalent

3. CHLORINE LEAK DETECTOR

1.	Range	0 to 10 PPM
2.	Input	Accept Input From Transmitter 4-20 mA
3.	Resolution Point	0.1 PPM
4.	Accuracy	0.2 % Max over full scale range of input
5.	Loop Open	Display Required
6.	Sensor Type	3 Wire Transmitter
7.	Display	4 Digit 15 mm, 7 segments red LED for process value 4 Digit 15 mm, 7 segments red LED for set value
8.	No. Of Set Point	2 Independent set point
9.	Setting	4 Feather touch keys inside the display board
10.	Set Point Display	Parameter/Set point can be seen on display
11.	Set Point Adjustment	Filled adjustable over the full range
12.	Set Point Out Put	1 NO/C/1 NC Potential free contact rated 230 V/ 5 A for each alarm 1 and alarm 2
13.	Fault Out put	1 NO/C/1 NC potential free contact rated 230 V/ 5 A for any open loop
14.	Power Supply	230 V AC +/- 10 % , 50 HZ
15.	Construction	Weatherproof , IP 55 Enclosure
16.	Mounting	Wall Mounting
17.	Transmitter Supply	24 V DC, 200 mA supply from various process transmitter
18.	Qty	02 Nos

4. CAUSTIC TANK (FRP)

1.	Application	For Chlorine Scrubbing System
2.	Type	Circular
3.	Capacity	10 000 Ltr
4.	Shell	5 mm (PP) + 8 mm(FRP- Iso Pthalic Resin)
5.	Bottom & Roof	5 mm (PP) + 8 mm(FRP- Iso Pthalic Resin)
6.	Height & Diameter	1850 mm (Height) & 2500 mm (ID)
7.	Chemical to be used	20 % Wt Caustic solution with chlorine fume
8.	Sparger	MOC : PP+FRP Pipe
9.	MOC Tank	PP + FRP (Iso Pthalic Resin)
10.	Qty	01 No

5. LEVEL GAUGE (REFLUX TYPE)

1.	Type	Reflex Type
2.	MOC	SS – 316
3.	Isolation Valve	3 Nos, MOC : PP
4.	Qty	01 No

6. MS SKID

1.	Design & Engineering	Drawing attached for approval
2.	Steel	Hot Deep Galvanized
3.	Qty	01 No

7. FLANGES

1.	Flanges	All Flanges are of Class 150 rating and as per ANSI B 16.5 Standard
----	---------	---

8. FIRST LOAD CHEMICAL

First Load Chemical	Caustic Solution of 20 % wt
Qty	1200 Ltr

9. SPLIT TYPE HOOD FRONTAL HOOD

Reinforcement Material :- FRP (Std. Chopped Material & ISO Pathalic Polyester Resin)

Size Width X Height X Length :- 1065mm X 1100mm X 900 mm

Handle :- FRP

Nozzle Size :- 150 mm NB

Weight of Hood :- 35 Kg.

Type : Split Type

ITEM NO.18 : RETURN SLUDGE & DIGESTOR SLUDGE MIXING PUMP HORIZONTAL / VERTICAL CENTRIFUGAL TYPE PUMP SET :

SEWAGE PUMP SET COMPLETE WITH NECESSARY C.I.FITTINGS, SPECIALS, PIPING, MOTOR, WITHIN EACH PUMP-HOUSE ETC.

PART 1 - GENERAL

DESCRIPTION

A. General

Specifications given herein are subject to the General Conditions of Contract. Work under this Section consists of the supply, installation, testing and handling over of sewage pump system at the sewage treatment plant, inclusive of pump, TEFC

motors, valves and heavy duty cast iron piping, suction sluice valve, suction and delivery side S.S. bellow (with inner sleeve) non-return valve and delivery sluice valve, C.I. specials, base plate etc. as shown on data sheets of the pump or drive manufacturer (contractor) and shall be complete with electric motor drives, intermediate drive-shafts, couplings, intermediate shaft guards, pump bearings and grease lubrication system.

B. System Description

All the pumps should be switch off when the pre-determined low level will reached in the wet well. The sensor used for above system shall be only non-contact and ultra sonic

SUBMITTALS

A. Shop Drawings

Shall be submitted in conformance with details showing fabrication, assembly, foundation and installation details and dimensions, together with detailed specification, power covering performance and materials of construction, power drive assembly, parts, devices and other accessories in accordance with the requirements of "Shop Drawings" and the Supplementary requirements stipulated herein. Data and specifications for the equipment shall include ,but not be limited to the following --

1. Certified pump performance curves indicating total dynamic head, flow rate, brake horse power, shut-off head, net positive suction head and efficiency.
2. Motor data including the name of the manufacturer, the guaranteed efficiency and power factor at full load, 3/4 load 1/2 load, and main duty point, locked rotor current in amps, full load current in amps., the motor speed in rpm, and mounting details. Refer to Data Sheet for motors for additional details to be submitted.
3. Data certifying conformance with Indian Standard 5600-1970 and any additional requirements specified herein and other more stringent standards.
4. Anchor bolt placement measured from contraction joints in the concrete structure, and anchor bolt details including projections from concrete.
5. Materials of pump construction including shafts, bearings, impellers, casings, pump bases, stuffing boxes and shaft guards.
6. Complete details on all ancillary equipment including piping, valves, etc. and interface requirements for work by others.
7. Details of grease lubrication system including the proper quantity of grease and frequency of bearing lubrication.
8. Complete details on pump control package including all interface requirements for work by others.

9. Results of shop testing performed in accordance with Paragraph 7 of this Section.

QUALITY ASSURANCE

Pumps provided shall have been manufactured by organisation having previous experience in manufacturing pumps of comparable capacities, speeds and other characteristics and which have been in successful operation for a minimum of 5 years on sewage projects under similar conditions.

The tenderer is hereby advised that overall unit operating efficiency is of particular concern to the owner. Accordingly, a preference will be made for systems providing high overall system operating efficiency. There are a series of schedules at the end of this section which shall be completed by the tenderer and submitted with his tender. The data shall be used in tender evaluation resulting in a credit preference for more efficient equipment. Likewise, however, there is incorporated a liquidated damages provision for failure to achieve guaranteed efficiencies.

PART 2 - PRODUCTS

PUMPS

A. Pump Type

The sewage pumps shall be non-clog centrifugal, vertically direct mounted VNC/HNC single stage, dry pit installation driven by single speed electrical motor. Motor ratings shall be at least 10 percent in excess of power required by pump at the highest point of pump performance curve and must be non-overloading at all points on the pump operating curve. Dewatering and sludge filtrate pump shall be sewage water self priming non-clog and side suction.

For all the pumps motor ratings shall be at least 10 percent in excess of power required by pump at the highest point of pump performance curve and must be non-overloading at all points on the pump operating curve

The power rating for motors to drive pumps should be selected as per table furnished in motor specifications.

B. Rating

The characteristics of the pumping sets required at various pump stations will be given forwarded by the Contractor. Pump performance shall be stable from zero flow to run out.

C. Reverse Rotation

The pumps shall be designed to operate safely in the reverse direction of rotation, due to wastewater returning through the pump, from shut-off to maximum pressure. The weights of the revolving parts of the pumps, including the unbalanced hydraulic thrusts of the impellers, shall be carried by thrust bearings provided in each pump assembly.

D. Pump Construction

1. Pump Casing

The pump casings suction covers and stuffing box covers shall be of cast iron and conform to IS: 4771 (with clarifications, where necessary, as given in IS: 3896) and any additional requirements specified herein, and shall be hydrostatically tested to 1.5 times the rated maximum working pressure but not less than 1.5 times the shut-off head with maximum impeller size. Then stuffing box heads and suction heads shall be removable from the pump casings. The required reducers/increaser valves both on the suction and delivery sides shall be furnished by the contractors to match the corresponding process piping shown on the Drawings. The pump casings shall be provided with vents, drains, pressure gauge, connections, hand holes, inspection cover and lifting lugs or eye bolts. The replaceable wearing ring/side plate shall be provided.

2. Impellers

The impellers shall be stainless steel and shall be of the single stage type. They shall be dynamically balanced and keyed and positively held on the shafts to prevent damage if the direction of rotation should reverse due to water flowing backward through the pump. The impellers shall have openings of adequate size to pass a sphere of minimum diameter of 100 mm for R.S. pump and 40 mm for others centrifugal pumps. The leading edge of the vanes shall be rounded and cut back to prevent rags, stringy material etc. from impinging on the impeller vanes. The impellers and the entire rotating elements shall be removable from the top of the pumps without distributing the suction and discharge connections or drive units. The impeller weir ring shall be provided.

3. Pump Shafts

The pump shafts shall be manufactured from SS not inferior in quality.

4. Pump Bearings

Pump bearings shall be of the antifriction type mounted in cast iron bearing frames independent of and alongside the stuffing box cover. The bearings shall be able to take normal axial thrust loads due to unbalanced hydraulic loads on the impellers plus the weight of all rotating parts of the pumps. Pump bearings shall be designed with a minimum B-10 life of 60,000 hours. The bearings shall be grease lubricated and SKF/FAG/RHP make

5. Couplings and Shafting

Spacer couplings shall be provided with shafting of sufficient length to allow the pump rotating element to be removed. The shaft shall be so designed to operate without undue stress or vibration over the entire range of operation.

6. Stuffing Box

Pumps shall be provided with deep stuffing boxes with bronze rings. An easily accessible bronze split gland shall be provided to facilitate adjustment or removal and replacement of the packing. An arrangement for controlled drainage of the stuffing box leakage shall be provided.

7. Shop Testing

Pumps shall be shop tested, witnessed by the Engineer-in-Charge or his representative, according to the requirements specified in Paragraph hereinafter.

8. Pump Supports and Anchor Bolts

Each pump shall be furnished with a cast iron suction fitting cast integral winged feet and cleanout hand hole, designed to bolt to, and rigidly support the volute and bearing housing. All shims, base plates, bearing plates, anchor bolts, etc. required for the installation of the pumping units shall be furnished by the pump manufacturer. All anchor bolts and fasteners shall be of stainless steel.

9. Pump Balance

All rotating parts shall be accurately machined and shall be in rotational balance. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case, the amplitude of vibration as measured at any point on the pumping unit shall not exceed the limits set forth in the latest edition of the Hydraulic Institute Standards. At any operating speed, the ratio of rotative speed to the critical speed of a unit or components thereof, shall be less than 0.8 or more than 1.3.

10. Shaft Guard

Each pump shall be furnished with a shaft guard, complete with all necessary mounting appurtenances conforming to the safety requirements. All materials shall be galvanized steel. Screens shall be designed for easy disassembly to facilitate shaft removal. The guard shall have bolted connections and assembled in sections not exceeding 70 Kilo grams.

E. Motor :

It shall be IP-55 protection type and as per details specification mention elsewhere in tender.

The power rating of the motor shall be larger of the following:

- 115 % of the maximum power input at any point on entire performance curve of the pump at rated speed.

F. S.S. bellow (with sleeve) for suction and delivery line.

- G. Supply, erecting, testing and commissioning of complete lot of heavy duty double flange cast iron pipe, special fitting including suction bell mouth to delivery line up to the outside of the dry well. For each pumping station. The above pipe special and fitting etc. should be comply with IS:1538-1976 in general if possible.
- H. Cast Iron non-return Valves 100 mm to 350 mm diameter valves shall be swing cast iron non-return valves of the lever and spring type, flanged, and shall have cast iron body and cover, renewable bronze seat, bronze hinge, stainless steel hinge shaft. The valves shall conform to relevant latest IS and, the valves shall be adjustable for non-slamming closure and shall be seat tight. An arrow showing direction of flow shall be prominently cast on body of valve. The water working pressure shall be 10 kg/cm² except that the valve shall have pressure rating same as the piping where the pipe class is higher.
- I. Pump Non-return Valves Larger Than 400 mm Diameter All non-return valves larger than 400 mm diameter installed shall be flanged ductile iron body, cover disc, arm and levers.

IMPORTANT :

The diameter/size of C.I. piping/S.V./NRV etc. will be one (1) size higher than recommended by the Pump Manufacture Company.

For sludge pumps the minimum size of C.I. piping S.V./NRV etc. should not be less than 150 mm dia.

PART -3 - EXECUTION

INSTALLATION AND START-UP

The Contractor shall provide the services of factory trained representatives of the pump manufacturer to inspect the installation, certify in writing to the Engineer-in-Charge that the installation is correct and in accordance with the pump manufacture's recommendations, all equipment is ready for start-up, and supervise the initial operation of the units. This includes the coupling of the two units and ensuring that they work smoothly and efficiently in accordance with these specifications. An appropriate allowance for this aspect of the supply and installation of the pumps shall be included by the pump manufacturer in the price of his equipment.

EQUIPMENT TESTING

Shop Testing

1. General

Each major component of the pumping equipment shall be subjected to a complete shop

test as specified herein, witnessed by the Engineer-in-charge or his representative. Three copies of certified test reports shall be submitted to the SMC. All costs for the shop tests shall be borne by the Contractor and shall be included in his bid price.

2. Pumps

Each assembled pump shall be shop tested by the manufacturer to determine the following characteristic within the operating range as specified in the Schedule.

- a. Head - Capacity Curve
- b. Brake horsepower Curve
- c. Efficiency Curve
- d. NPSHR Curve
- e. Balance
- f. Vibration
- g. Bearing temperature and alignment.

All tests shall be conducted in accordance with the requirements of the latest Hydraulic Institute Standards.

In the event of any pump failing to meet the specified test requirements, it shall be modified and retested until the requirements are attained.

Each pump performance shall be documented by obtaining concurrent readings showing motor voltage and amperage, pump suction head, and pump discharge head. Such readings shall be documented for at least three pumping conditions. One test shall be at shut off head. The motor manufacturer's representative too shall be present at these tests and each power lead shall be checked for proper current balance.

Bearing temperature shall be determined by a contact type thermometer. A running time of at least 20 minutes shall be maintained for this test, at shut-off head if sufficient water is not available for a complete test.

After it has been demonstrated to the satisfaction of the Engineer-in-Charge that the pumping equipment complies with these specifications the Engineer-in-charge shall be furnished with the Manufacturer's Test Certificate.

Material Test Certificate for impeller shaft, casing, wearing ring shall be submitted by the manufacturer.

Material of Construction for all pump :

Casing	CI IS 210 Gr FG 260 with 1.5% Ni.
Impeller	SS ASTM A743 Gr CF8M
Shaft	ASTM A276 SS 410
Shaft sleeve	ASTM A276 SS 410
Casing ring	SS AISI 410
Shaft Seal	Gland and staffing box.
Base Plate	CI/Epoxy Coated MS

Pressure Gauge : Stainless steel 4" size Glycerin filled diaphragm type.)(If required)

All motor should be TEFC, Class F with temperature rise limited to Class B, duty S1 type only.

All pump set should grease lubricated only.

This item includes the pump, pump motor, SS bellow (with sleeve), pressure gauge, necessary C.I. fitting, pipes etc. in side the pump house. Pump set and accessories shall be fitted with suction and delivery knife gate / non return valve in side the pump house.

It should be very clearly noted that duty conditions i.e. discharge and head as specified must be achieved at the available speed of motor running at full load under specified supply condition mentioned. No allowance / calculations shall be permitted to compute discharge / head at a particular speed. The specified discharge and head must be available at site at actual speed of motor / pump and not to be computed from designed parameter. No relaxation in this regard permitted.

ITEM NO.19: HOT CRANE :

GENERAL REQUIREMENTS

Cranes shall be designed and constructed in accordance with BS 2573 and shall comply with the requirements of BS 466: Class 2 medium-duty operation.

The term 'crane' shall be deemed to include gantry rails, platform with handrails for maintenance use, down-stop conductors, end stops, holding-down bolts and all other items required for complete installation.

Cranes shall be prominently marked with their SWL on both sides of the crane bridge girders.

Crane hooks shall be fitted with safety catches and the hook block shall incorporate fully guarded rope sheaves.

The maintenance platform shall be designed to provide safe access to the crane machinery and all high-level lighting and roof-mounted ventilation plant. Access to the platform shall be by fixed stairway from a convenient point in the pump hall.

Enough slings, ropes, shackles, lifting beams and the like shall be supplied to handle all the plant to be served by the crane. They shall be labeled or marked with the safe working load (SWL) and the purpose for which they are intended.

The crane, and all other lifting equipment supplied shall be tested by the manufacturer at his works. The tests shall be at 125% of safe working load, and test certificates shall be submitted by the Contractor.

Site tests shall be done by the Contractor who shall supply the necessary materials for the test loads. The test loads shall be removed from site by the Contractor after successful tests have been completed.

ELECTRICAL REQUIREMENT:

All movements shall be electrically powered and be suitable for operating with the hook fully loaded. Motors shall be of the quick-reversing type with electro-mechanical brakes suitable for the duties specified. Limit switches shall be incorporated to prevent excess travel, or over-hoisting and over-lowering of the crane hook. Facilities shall be provided for the accurate location of the hook by means of 'inching' all the motions.

Crane operation shall be from ground floor level by bridge-mounted pendant push-button controls. Controls shall be mechanically and electrically interlocked to prevent inadvertent operation of opposing motions. The pendant shall be supported independently of the electric cable and shall be arranged for extending for operation when necessary.

Down shop conductors shall be of the fully-insulated shrouded bus bar type. The current collectors shall have renewable contact pieces. Festoon cables may be used for cross travel.

A crane isolator, lockable in the off position and incorporating a warning lamp, illuminated when the supply is 'on', shall be provided at the bottom of the access ladder. A second isolator shall be provided at the control cubicle located on the crane platform.

The contractor shall supply all necessary contactors, control, and phase and earth fault and fail safe protection if the power supply fails.

All electrical equipment shall be fully trivialized. Motors and switch gear shall be provided with anti-condensation heaters, which shall be energized when the crane is at rest, and suitable warning notices shall be provided.

Supply, erection, testing and commissioning of hand operated traveling crane with singal speed electrically operated chain pulley block suitable for following pump houses.

Span : As per site requirement.

Total Lift : As per site requirement.

Available head room and available end clearance :- As per site requirement The crane and traveling trolley should be as per site requirement. All motions except vertical motion are to be electrically operated through chain, chain wheel and gears. All safety measures should be taken in to consideration. The crane should comply to I.S. 807 and I.S. 3177. The crane should be complete with bridge girder, with rails (on R.C.C. Crobel Beam), hand chain, chain wheels, guards, swiveling hook and other accessories. The chain collection box shall be provided in M.S. material.

The main hoisting hook shall swivel on antifricition bearing and should be fitted with locking device to prevent motion when desired. (hook should be confirm to I.S. 3815-1969 and load chain should confirm I.S. 2429-1979).

The crane and chain pulley block should be made of Morris /INDEF duly tested with overload at manufacturer's work as well as at site. It should be properly scraped, cleaned and painted to prevent corrosion. The crane to be supplied should carry suitable guarantees.

All this HOT should be made of approved manufacturing company.

ITEM NO.20 : HAND OPERATED CHAIN PULLEY BLOCK (CPB) WITH TRAVELING TROLLEY:

Cranes shall be designed and manufactured in accordance with BS 2573 and shall comply with the requirements of BS 466 class-2 medium duty.

The crane details and ancillary equipment provided shall conform with applicable parts of the general requirements specified above for electrically operated over-head cranes, except that the crane shall be manually operated by conveniently mounted endless chains, arranged for operation by one man.

Total Lift : As per site requirement.

Available head room and available end clearance :- As per site requirement The crane and traveling trolley should be as per site requirement. All motions shall be manually operated through chain, chain wheel and gears. All safety measures should be taken in to consideration. The crane should comply to I.S. 807 and I.S. 3177. The crane should be complete with girder, hand chain, chain wheels, guards, swiveling hook and other accessories. The chain collection box shall be provided in M.S. material.

The main hoisting hook shall swivel on antifriction bearing and should be fitted with locking device to prevent motion when desired. (hook should be confirm to I.S. 3815-1969 and load chain should confirm I.S. 2429-1979).

The crane and chain pulley block should be made of Morris /INDEF duly tested with overload at manufacturer's work as well as at site. It should be properly scraped, cleaned and painted to prevent corrosion. The crane to be supplied should carry suitable guarantees.

All this HOT should be made of approved manufacturing company.

ITEM NO.: 21 FABRICATION WORK:

1. MATERIALS

The structural steel work shall conform to M-22 and its latest amendment.

2. WORKMANSHIP: -

- 2.1 The steel section as specified or required shall be cut, square and correct lengths, as per design. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of member, except as indicated in the drawing or permitted prior to starting of work as directed. All straightening and shaping to form shall be done by application of pressure and not by

hammering .Any bending or cutting shall be carried out in such a manner so as not to impair the strength of the metal. All operation shall be done in cold state unless otherwise directed /permitted.

- 2.2 Welding shall generally be done by electric process. Gas welding shall be restored to, using oxyacetylene flame with specific prior approval. Gas welding shall not be permitted for structural steel work.
- 2.3 The welding work shall conform to I.S.816-1969, and its latest amendment.
- 2.4 Preparation of surfaces: Surfaces which are to be welded together shall be free from loose mill scale, rust, paint, grease or other foreign matter. A coating of boiled linseed Oil shall be permitted.
- 2.5 Assembly for welding: Before welding is commenced, the plates shall first be brought together and firmly clamped or spot welded at specified distance. This temporary connection has to be strong enough to hold the plates accurately in place without displacement.
- 2.6 Precaution: All operation connected with welding and cutting equipment shall conform to safety requirements given in I.S. 1118-1968 and its latest amendment.

The following points shall be borne in mind during the process of welding-

- a) Welds shall be made in flat position wherever practicable.
 - b) Arc length, voltage and amperage shall be suited to the thickness of material type of groove and other circumstances of the work.
 - c) The segments of welding shall be such that where possible the members which offer the greatest resistance to compression are welded first.
- 2.7 The defective welds, which shall be considered harmful to the structural strength, shall be cut out and re-welded.

All the members shall be thoroughly cleaned, of rust, scales, dust etc. before fixing them in position. Testing of welding to be added in the specification.

The complete fabricated structure shall be scraped, cleaned and painted with two coats of epoxy paint after applying one coat of red oxide primer.

ITEM NO. 22 : DIFFUSED AERATION SYSTEM

Only fine bubble PU membrane diffusers shall be acceptable with minimum membrane diffuser to floor coverage area of 5%. Diffusers shall be submerged fine bubble / fine pore, high transfer efficiency, low maintenance, non-buoyant type. Diffusers shall be strip (membrane) type. 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.

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 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 minimal coupling / attachments to the air manifold and shall have self-cleaning properties while in action. Flat surfaces facing upwards as membrane surfaces shall not be accepted. 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) with the nominal air flow per diffuser per element shall not exceed 70 m³/h/m² of diffuser surface area 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 PE/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 sub-headers shall have enough counterweight or alternative arrangement to surmount any buoyancy lift from the floor during air charging.

The diffusers shall be fixed to bioreactor floor, Fine Bubble Diffused Aeration membrane diffusers with a maximum flux through the diffusers not exceeding 70 m³/m² membrane area. The air from the blowers which shall have high temperature and should be cooled suitably to avoid damaging the diffuser membranes.

The material of diffuser and associated fixtures shall be:

Diffusers Membranes	PU Membranes
Diffusers Membranes Support	Engineering plastics Non Corrosive material
Under water Air Piping to diffusers	UPVC / PE
Air downers to under water pipe	UPVC / PE

The in tank diffuser piping shall be sized for a velocity less than 21 m/sec

ITEM NO. 23 : FIXED FILM ACTIVATED SLUDGE SYSTEM SPECIFICATIONS

The Fixed Film Activated Sludge system shall be designed to encourage attached growth of biomass on the plastic media and limit the suspended solids in aeration tanks to be below 3200 mg/L. Addition of this system shall increase the biomass inventory in the aeration tank, through attached growth, and thus logical treatment capacity. It shall ensure sufficient BOD and TSS removal while encouraging nitrification of ammonia in the aeration tank.

The system should be made up of biotextile sheets aligned in metal cages. The fixed film media needs to be of plastic curtains mounted on SS 304 cages. The plastic shall be 100% Polypropylene. The clamps and fixing accessories shall be of water resistant PP.

The fixed plastic curtain media should be arranged in the direction of flow. There shall be no double wrapping of textile on cages. The fixed film system shall use discreet, parallel textile sheets on the cage.

Rigid media shall not be allowed.

Biotextile sheets shall be knitted fabric with growth surface strips. The specific growth surface shall be 23 m²/m² design/specifications.

The systems shall require low maintenance and shall be a high energy efficiency system. It shall not use any suspended media to avoid media loss. Further, the fixed film system shall be provided in conjunction with high efficiency fine bubble diffuser mounted on the aeration tank. The diffusers shall be spread throughout the basin to provide uniform aeration. The fixed film system requiring coarse bubble aeration shall not be acceptable.

ITEM 24 : DOUBLE MEMBRANE GAS DOME FOR ANAEROBIC DIGESTERS

The scope of work includes dismantling of existing gas dome and disposing off the debris. It also includes sludge removing from digester and cleaning of digester from inside.

The Membrane Gas Domes shall be Dual Membrane Type. The Membrane cover(s) shall be stable under design load conditions, including localized static and dynamic loads. The external membrane shall be designed to maintain a spherical shape that allows the cover(s) to support the maximum possible applied loading taking into consideration Dead load, Vacuum load, Wind load and other Static load.

Membrane Gas Domes shall consist of two membranes clamped firmly on top of the Digester.

The internal membrane shall hold the gas evolving in the Digester and shall have a low permeability to digester gas. The internal membrane shall inflate and deflate with the change in gas supply and usage. The external membrane shall be constantly inflated by pressurized air supplied by a blower and distributed uniformly into the annular space between the outer & inner membrane through an integral air flow channel on the side of the external membrane which shall regulate and maintain the external membrane at constant pressure. The internal membrane is protected by an over/under pressure valve that allows the evacuation of the biogas in case of over pressure & also safe guards against extreme under pressure.

Anchoring of both the external and internal membranes shall be by profiled anchor members/flanges and seals bolted to the top area of the concrete tank periphery. In case the Digesters are of metallic construction, the clamping mechanism shall be slightly different & makes use of a special gasket material in combination with a steel profile which shall seal the membrane material to the tank. The profiled flange sections shall form a continuous ring to seal the membrane to the top of the tank wall. The restraining flanges and anchors shall be fabricated of hot dip galvanised steel or SS304 (as optional) or special fastening devices, as appropriate.

All structural steel for fixing the membrane to the tank shall be hot dip galvanised steel or Type 304 stainless steel (for special applications optional). All steel fabrication and welding shall be in accordance with latest edition of Structural Welding Code. Sharp projections of cut or sheared edges of metal shall be ground smooth to avoid damage to the membranes and also for the safety of installation/operating personnel.

All steel design shall be in accordance with the latest editions of the ISA Manual of Steel Construction and Uniform Building Code (UBC).

Membrane shall be fabricated using High frequency welding with a 37mm minimum width. The manufacturing process will include a peeling test on a specimen which enables the validation of the welding parameters. All welds will be visually inspected. Additionally, all welds and seams shall be tested mechanically through the use of pressure and tension to ensure each weld is complete and has developed full strength.

Membranes

Internal Membrane:

The internal or gas membrane shall be fabricated of a polyester fabric coated with polyvinyl chloride (PVC) and sized to suit the Digester & to accommodate the specified volume of biogas. Membranes shall have low permeability besides being resistant to digester gas. The internal membrane fabric shall be designed and fabricated to resist all design loadings without use of support cables superstructures or other restraining devices and shall meet the prescribed standards.

The internal membrane shall be welded in such manner as to prevent the diffusion of biogas through the yarn forming the internal structure of the membrane. The lack of this feature will not be accepted for the membrane continuously exposed to biogas. During installation of the Inner Membrane, care shall be taken to provide several strong belt supports across the digester diameter such that the inner membrane never comes in contact with the sludge or the medium inside the Digester.

External Membrane:

The external membrane shall be fabricated of a polyester fabric coated with polyvinyl chloride (PVC) designed for use on air-supported structures and high-stress applications and shall be resistant to ultraviolet degradation, abrasion, and weathering in an outdoor environment while meeting the prescribed parameters. A uniform & distributed air flow into the annular space between the outer and inner membrane shall be ensured through an integral airflow passage forming a part of the outer membrane. This feature shall be unique to the Double Membrane Version of Digester Domes.

Membrane cover(s) accessories and appurtenances

The membrane cover(s) shall include the following appurtenances:

Two (2) specially designed, energy efficient, low pressure centrifugal fans for air supply to the annular space between external membrane & inner membrane shall be provided having adequate power and capacity with explosion proof motor at $415 \pm V$ and 50 C/S.

The blower shall be complete with flexible collectors, air piping, check valve, inflation fan, electro mechanical level sensor, air relief walls, air pressure transmitter, gas pressure transmitter and gas detector.

A suitably designed safety valve shall be provided to meet exigencies of over pressure or under pressure as the case may be & shall be integrated into the Membrane Gas Dome System.

ITEM NO.: 25: SUBMERSIBLE MIXER:

- (a) **The submersible mixer shall be installed in the specified plant areas, and they shall be capable of providing a velocity gradient in the range of 500 to 1000 mm/sec.**
- (b) The mixer shall have a self-cleaning propeller optimized for effective mixing and vibration free running, and required power shall be as per process design.
- (c) The mixer shall be driven by a high efficiency 3 phase motors IP68 Class F. Motor shaft and rotor shall be dynamically balanced.
- (d) Bearings shall be lubricated-for-life with a calculated life of more than 100,000 operating hours.
- (e) The mixers shall have the flexibility to be located at different depths and thereby avoiding dead zones.
- (f) The mixer shall be provided with the following:
 - (1) Lifting frame with a winch which can be dismantled, free standing with adjustable boom length.
 - (2) Mounting socket for free standing hoist suitable for wall mounting.
 - (3) Guide for floor fixing components and support brackets for wall mounting.
 - (4) Stainless steel rope for raising and lowering the mixer.
 - (5) Rope block for holding the stainless steel rope where the lifting frame is used in different locations.
 - (6) Support rope for reliable support and guidance of power supply cable.
 - (7) Support clamps and hooks to support the power supply cable in such a manner that it is not under strain.
- (g) The propeller, propeller shaft and motor housing, guide pipe, support brackets and all fasteners shall all be of SS 316. The winch shall be of galvanized steel construction.

Submersible mixers shall be provided for Anaerobic tank.

ITEM NO.: 26 : ARCHIMEDEAN SCREW THICKENER

Scope of work :

This works includes, supply, erection, testing and commissioning of sludge dewatering system, i.e. considering of Archimedean screw thickener and its accessories with drive motors, backwash pump and control panel. Inlet sludge consistency shall be @1% and sludge outlet consistency after dewatering system shall be 5% minimum.

Capacity of thickener should be minimum of 55 Cu.mt./hour with following scope of supply and detailed specifications:

1. Supply of Sludge Thickener, complete with drive Motors, Back Wash Pump, Control Panel as per following specifications, The unit is complete with:

- One all welded tubular supporting frame work made of AISI 304
- One filtrate collection tank complete with cover, two hinged inspection portholes and DN 250 PN 10 outlet, all made of AISI 304
- Two thickened sludge outlet back chutes, made of AISI 304
- Two inlet sludge, flanged DN 100 PN 10, made of AISI 304
- Two Archimedean screw filter drums, diameter 600 mm, made of AISI 304, lined with polyester filtering cloth.
- Two variable speed worm geared motors, fixed to the filter drums, variable speed from 4.5 to 22 RPM, 0.75 kW, 400 V, three phases, 50 Hz, IP55
- Two filter drum washing feed manifolds 1”GM, fitted with polypropylene quick jet spray nozzles system.
- One control panel assembled with a PRFV panel board, with door interlock canceling switch, control push buttons, alarm lamps and general alarm flashing lamp. Power section drives the filtering drums and washing pump motors. On the terminals board is available one voltage free switching contact to signal if the thickener is running or not, pumps driven by a two position manual selector. Power section is composed of remote switches and adjustable circuit breaker with automatic thermal release, electromagnetic operation.
Power Supply : 400 V, three phases, 50 Hz, IP65
CEI 17 – 13 / 1 – EN60 439/1
- One double impeller centrifuge pumps for belt washing, Max delivery 6 M3/hr. at 5 bar. The pump is complete with Water filter with manometers in glycerin.

2. MOC

- Body : AISI 304a
Filter Cloth contact with sludge : Polyester

ITEM NO.27: DRIVES

A GENERAL

All drive units shall have a rating and service factor suitable for twenty-four (24) hours per day operation under operating load. Drive unit housings shall be constructed of high grade cast iron, welded steel or other suitable approved materials. Three thermal rating of each unit shall exceed the design load or proper cooling devices shall be provided. All drives shall be designed especially for the service which they are required to perform.

B SPECIFICATIONS FOR MOTORS

SCOPE

This specification covers the design and manufacture of TEFC squirrel cage induction motors with rating S1. Motors winding shall have class ‘F’ insulation with the permissible temperature

rise above the specified ambient temperature shall be limited to class 'B'. However, for motors operating with Variable Frequency Drive, winding shall be vacuum impregnated and Class H insulation only and with forced cooling arrangement. Contents of this specification are integral part of the contract documents. All the drive motors shall follow the specifications mentioned below.

REFERENCES

Unless they are at variance with the clauses of this specification, the squirrel cage induction motors and their components shall comply with the applicable Indian Standards listed below. Where Indian Standards do not exist, the relevant British or German (VDE) Standards shall apply.

- IS 325 1978 Three phase induction motors.
- IS 1231 1974 Dimensions of three phase, foot mounted induction motors.
- IS 2223 1971 Dimensions of flange mounted AC induction motors.
- IS 2253 1974 Types of Construction of mounting arrangement of rotating Electrical machines.
- IS 4691 1968 Degrees of protection provided by enclosures for rotating Electrical machinery.
- IS 4889 1968 Methods of determination of efficiency of rotating Electrical machines.
- IS 4772 1968 Methods of determination of efficiency.
- IS 4029 1967 Guide for testing 3 phase induction motors.
- IS 4729 1968 Rotating electrical machines vibration of, measurement and evaluation

OPERATING CONDITION

Ambient Conditions

Motors shall be suitable for operating satisfactorily in humid and corrosive atmospheres found in sewage treatment plants. If not specifically mentioned therein, a maximum ambient temperature of 45 Deg. C and an altitude not exceeding 1000 meters above mean sea level, shall be taken into consideration.

Frequency and Voltage Variation

Motors will be required for continuous, satisfactory operation at rated output under the following conditions --

- A At rated frequency with voltage variations of +/- 10% of nominal value.

B At rates voltage with frequency variations of +/- 3% of nominal value.

C With a simultaneous and combined variation in frequency and voltage of +/- 7.1/2% from the nominal values but with frequency variation not exceeding +/- 3%. More stringent operating conditions may be required in particular cases.

The power rating for motors to drive pumps/equipment should be selected as per table below:

Required BKW of pump	Multiplying factor to arrive at motor rating
Up to 1.5 KW i.e. Less than 1.5 KW	1.4
1.50KW and up to 3.7 KW	1.3
3.7 KW and up to 7.5 KW	1.25
7.5KW and up to 15 KW	1.2
15KW and up to 75 KW	1.15
75 KW and above	1.10

Starting

Unless otherwise specified motors shall be designed for direct on-line starting across full line voltage. On request, motors shall be designed for re-start under full load after a momentary lack of voltage being 100% out of phase with respect to the motor residual voltage.

The motor shall be designed for continuous operation at against full load torque without injurious heating of insulated windings.

Direction of Rotation

The motors shall be suitable for operating in both direction of rotation. The direction of rotation is defined as that looking towards the motor from the non driving end.

Noise

Motors shall have a guaranteed maximum noise level based on the I.S. Performance

- a Starting Current: For all 415 Volts squirrel cage motors the starting current shall be limited to 6 times the full load current.
- b Torque Characteristic: For all 415 Volts motors the minimum starting torque shall be 140% of full load torque, minimum torque during running up 100% FLT and minimum stalling torque 200% FLT.

MOTOR RPM:

All the motor connected to low RPM mechanism through gear box should be 1000 RPM.

REQUIREMENTS AND CONSTRUCTION DETAILS

Windings

a Insulation and Bracing

Unless otherwise specified, motors shall be provided with class 'F' insulation as a minimum and continuous motor rating (S1). In case of motors with class 'F' insulation the permissible temperature rise above the specified ambient temperature shall be limited to class 'B'.

However, for motors operating with Variable Frequency Drive, winding shall be vacuum impregnated and Class H insulation only and with forced cooling arrangement.

Windings shall be adequately braced to prevent any relative movement during operation.

The winding shall be so treated as to resist the action of corrosive agents or substances (solids, liquids or gases) as may be present in the atmosphere of sewage treatment plant and that tend to dissolve the insulation. The winding shall be tropicalised.

The fan motors will be of a three phase totally enclosed outdoor type and shall conform to this specification.

The ventilating system shall include the flanges for the air intake and the mating flanges for the discharge ducts. An air flow indicator as described in paragraph shall also be provided.

Rotor

The rotor for squirrel cage motor shall be balanced to provide a low vibration level and a long life for the bearings.

Shaft Extension

Motors shall be provided with a single, bare-shaft extension with key-way and key as per requirements.

Lifting Hooks

All motors shall be provided with lifting hooks of adequate capacity.

Earth Terminals

Two earth-terminals shall be provided for each motor. These shall not be located inside the terminal box. The size of each terminal shall be adequate to accept the lug of an earthing conductor as specified in the other section. These two terminals shall be diametrically opposite ends.

Windings shall be adequately braced to prevent any relative movement during operating conditions and in this respect, particular attention is drawn to the starter windings of direct-on-line squirrel cage motors. Adequate insulation shall be provided between coils of different phases which lie together.

b Terminals, terminal boxes and cable entries

The ends of the windings shall be brought out into a terminal box. For medium voltage e.g. 415 V motors, they shall be terminated by means of terminals mounted on an insulating base made of non hygroscopic and noninflammable material. 415 V motors shall be provided with six terminals and suitable links to connect them in delta or in star.

All terminals shall be adequately designed.

Line terminals shall be thoroughly insulated from the frame with materials resistant to tracking.

c Terminal Box

The terminal box shall be located on the right hand side viewed from the shaft end. It shall be roto table in steps of 90 to allow cable entry from any direction.

If shown on drawing, a second terminal box shall be provided to house the current transformers employed for differential protection.

The terminal box shall be large enough to facilitate easy connections of the cable. Bolted terminals, suitable for accepting the lugs of cable as shown on drawing shall be provided. The terminal box for 415 V motors shall be of C.I. heavy duty construction and withstand full internal short circuit condition without danger to personnel.

The terminal box for high voltage motors shall be suitable for filling with compound and shall be provided with compound filling and draining holes with suitable plugs.

Nickel plated brass cable glands shall be provided depending on the type of cable specified. Tapped entries for the glands shall be provided on the terminal box for the number and size of the cables shown on drawings.

e Phase Markings

Appropriate phase marketing as per IS: 325-1978 shall be provided inside the terminal box. The markings shall be non- removable and indelible.

f Motor Casing and Type of Enclosures

Motors for indoor installation shall be dust and vermin proof. For outdoor use, they shall be weather-protected., type, I.P. 55 enclosure as per I.S. and with canopy at the top. The motor casings shall be provided with a suitable drain for condensed moisture. External metallic contact with cooling air, (piping, air supply and discharge conduits, protective grills, air deflectors, filters and supports) shall be corrosion resistant material or appropriately treated to resist the corrosive agents which may be of rust proof material or protected against corrosion. Motors shall be TEFC type only.

g Bearings and Lubrication

Motors upto 200 KW shall have grease lubricated ball or roller bearings. Above this rating, they shall be of manufacturer's standard type. In all cases, the bearing shall be chosen to provide a minimum operating life of 40,000 hours. Bearings shall be adequate to absorb axial thrust in either sense from the driven load due to shaft expansion.

h Grease Lubricated Bearings

These shall be capable of grease injection from outside without removal of covers. The bearing boxes shall be provided with lubricant seals, to prevent loss of grease or entry of dust or moisture. Where grease nipples are provided, these shall be associated. Where necessary, with appropriately located relief devices which ensure passage of grease through the bearing. Pre-lubricated sealed bearings will be considered provided full guarantee can be given for 4 to 5 years trouble-free service without the necessity of re-lubrication. All bearing should be of SKF/RHP/FAG make only.

MISCELLANEOUS ACCESSORIES

Foundation Bolts

Motors shall be supplied with foundation bolts where specified.

Special tools and Spanners

Each rating and frame size of motor shall be provided with 4 sets of any special tools, required for dismantling and maintenance of the motor.

Tringlar spanners required for explosion proof or increased safety motors are considered as special tools.

Moisture Trap

A moisture trap drain hole with grab screw should be provided on all TEFC motors.

Name plates

A name plate as required under specification IS: 325:1961 shall be provided on each motor.

PAINTING

Internal and external parts of the casing and all metal parts likely to come in contact with the surrounding air shall be protected with anti-acid paint that will resist the particular ambient conditions.

Test and Test Certificates

The motor shall be tested in accordance with IS: 325 and IS: 4029. Type test shall be carried out on one sample from each HP rating and frame size of motors rated above 40 H.P. Routine tests shall be carried out on all motors.

TYPICAL DATA SHEET TO BE FILLED IN BY SUPPLIER/MANUFACTURER

DATA SHEET FOR MOTORS

Type and rating of motor	:
Speed torque characteristics	:
Pull out torque in % of full load Torque	:
Starting torque in % of full load Torque	:
Full load current in Amp.	:
Starting current in Amp.	:
Efficiency at 50% load	:
Efficiency at 75% load	:
Efficiency at full load	:
Power factor at 50% load	:
Power factor at 75% load	:
Power factor at full load	:
Full load slip %	:
Starting time at 85% voltage	:
Safe stall time at 100% voltage	:
Temperature rise at full load	:

Electrical Motors

All electrical motors supplied under this contract shall conform to all requirements specified. The contractor's attention is drawn here to the fact that requirements more rigorous than those stipulated in general therein or the Indian Standard itself may be stipulated in other Sections of these specifications to meet special process requirements. The contractor shall, accordingly, co-ordinate the work of all the different specialties comprising the integral system and the corresponding functional, safety and code requirements for each installation, in order to comply with these specifications. Drives shall be non-over-loading at all points on the equipment operating curve.

C. V-BELT DRIVE

Where motors are mounted above the driven machine on a pedestal, the belt tensioning shall be accomplished by four studs which are double nutted to the motor plate to raise and over the motor plate. Hinges with jacking screw to tension the belts not be acceptable. One complete set of extra-V-belts must be supplied with the equipment provided with V-belts.

LUBRICATION

Lubrication of equipment shall ensure constant presence of lubricant on all wearing surfaces. Lubricant filling and draining openings shall be readily accessible. Easy means for checking the lubricant level shall be provided. Prior to testing and/or operation, the equipment shall receive the prescribed amount and type of lubricant as required by the equipment manufacturer.

PART - 3 - EXECUTION

CO-ORDINATION

A The drawings shown in a diagrammatic form the arrangements desired for the principal apparatus, piping and similar appurtenances and shall be followed as closely as possible. Proper judgment must be exercised in carrying out the work to ensure the best possible headroom and space conditions throughout, to secure a neat arrangement of piping, valves, fixtures, hangers and similar appurtenances and to overcome local difficulties and obstructions wherever encountered.

B The Contractor shall take all measurements, for his work at the installation sites, verify all sub-contractor's drawings and be responsible for the proper installations, within the available space of the apparatus specified and shown on the drawings and must secure the approval of the Engineer-in-charge for any variations before making any changes.

PROTECTION:

A. All equipment shall be boxed, created or otherwise enclosed and protected during transport, handling and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times. Pumps, motors, electrical equipment and other equipment having anti-friction or sleeve bearings shall be stored in weather-tight storage facilities such as warehouses.

B. Painted surfaces shall be protected against impact, abrasion, discoloration and other damage. All painted surface which are damaged prior to acceptance of the equipment shall be repainted to the satisfaction of the Engineer-in-charge.

C. Electrical equipment, controls and insulation shall be protected against moisture or damage from water. All space heaters provided in the equipment shall be connected and be kept operating at all times until equipment is placed in operation.

- D. The contractor shall erect and maintain on the site temporary storage facilities approved by the Engineer-in-charge. At the option and with the Contractor's approval, the Contractor shall have access to the storage space off the site. The Engineer-in-charge shall have access to the off-site storage facilities at any time to inspect the equipments stored therein
- E. All equipments shall be stored from delivery until installation in storage facilities approved by the Engineer-in-charge.

INSTALLATION CHECK

- A. The Contractor shall have an experienced, competent and authorized representative of the manufacturer or supplier of each major item of equipment visit the site of the work and inspect, check, adjust if necessary and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is first operated. The Contractor shall have the equipment supplier's representative revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are to the satisfaction of the Engineer-in-charge.
- B. Each equipment supplier or his accredited representative shall furnish to the Engineer-in-charge a written report, hereinafter referred to as the Manufacturer's Test Certificate certifying that the equipment
- 1 Has been properly installed and lubricated;
 - 2 Is accurately aligned;
 - 3 Is not unduly stressed by connecting piping or anchor bolts, &
 - 4 Has been tested under full load conditions and that it has been tested successfully and complied with there quirements stipulated in these specifications.
- C. Equipment manufacturers shall furnish the services of competent, factory-trained personnel during the guarantee period specified herein to inspect and repair the equipment where required. Service requests shall be answered and complied with promptly.
- D. All costs for this work shall be included in the prices quoted by equipment suppliers.

EQUIPMENT INSTALLATION

All equipment shall be installed in full accordance with the equipment manufacturer's recommendations and good practice. Where specified in other parts of this section, factory-trained service personnel shall be on site to supervise the installation. Sufficient notice shall be given to the Engineer-in-charge prior to equipment installations in order that the Engineer-in-charge or his representative may be present during installation. In general, the following installation practices shall be followed ---

- A. Examine equipment for damage in Transport and handling. The examination shall include checking for corrosion, poor workmanship, dirt or deleterious substances and poor fits.
- B. Level the base plate or bedplate.

- C. Install equipment
- D. Check alignment of couplings by precision level bottle and dial gauge.
- E. If grout has been used check alignment and levels after ground has set by precision level bottle and dial gauge.
- F. Check direction of rotation and correct, if necessary, to ensure proper operation.

PLACING IN OPERATION

Prior to being put into operation, the equipment shall be inspected by the Manufacturer's factory-trained personnel. All defects discovered during such inspection shall be corrected prior to initial start-up of equipment. Internal coatings applied at factory shall be removed, if necessary. Lubricant shall be applied at the appropriate places and levels shall conform to manufacturer's recommendations. If necessary, full-load tests shall be made and results of such tests shall be recorded. Unsatisfactory performances shall be rectified and tests repeated until the performance complies with the Specifications. The Contractor shall notify the Engineer-in-charge seventy-two (72) hours in advance of the scheduled initial operation of equipment. During the course of initial operation, the Contractor shall instruct personnel, nominated by the S.M.C. in the proper operation and maintenance of the equipment.

SPECIAL TOOLS AND ACCESSORIES

All special tools, equipments or accessories required for the installation and maintenance of plant equipment as well as copies each of instructions manuals necessary for the proper use of such tools, equipment or accessories shall be provided by the equipment manufacturer if the Engineer-in-charge deems such instructions necessary. The Engineer-in-charge's decision in this regard shall be final. The equipment manufacturers shall supply with their equipment all spare parts called for in the respective Sections. The spare parts shall be identical in all respects to the original parts supplied in the assembly. All spare parts shall have a metal identification tag. The tag shall include description of the equipment in which it is to be used replacement

Each spare part shall be suitably packaged and preserved to withstand long term storage in a protected environment without damage. All packaged equipment shall be clearly marked for easy identification from outside.

PAINTING WORK

A. SHOP PAINTING:

All the component of units, equipment, machineries etc. shall be sand blasted. At the shop all units, equipment, machineries, electric motors, gear boxes, and other similar self contained and enclosed components shall be shop primed using zinc chromate primer and finished with a high grade anti corrosive epoxy coating.

All the submerged parts of units, equipment, machineries etc. shall be painted using bituminised coal tar base epoxy paint with minimum 150 microns thickness and remaining parts are painted using anti corrosive epoxy paint with minimum 150 microns thickness approved in writing by the Engineer-in-charge. Surfaces which will be inaccessible after assembly shall be painted or otherwise protected before assembly by a method which provides effective protection throughout the expected economic life of the equipment.

B. SITE PAINTING:

All the equipment, machineries, units, electric motor, gear boxes and other similar self contained or enclosed components shall be painted with one appropriate coat prior to commissioning using spray machine or brush as per site requirement.

C. Machined and polished metallic surface which are not to be painted shall be coated with an approved rust preventive compound.

Galvanizing

Where steel or wrought iron is to be galvanised, it shall be carried out by the hot-dip process and shall conform in all respects with IS: 2629.

Attention shall be paid to the details of members in accordance with BS: 4479. Adequate provision for filling, venting and draining shall be made for assemblies fabricated from hollow section. Vent holes shall be suitably plugged after galvanising.

All surface defects in the steel including cracks, surface lamination, laps and folds shall be removed in accordance with IS: 6159. All drilling, cutting, welding, forming and final fabrications of unit members and assemblies shall be complete before the structures are galvanised. The surface of the steel work to be galvanised shall be free from welding slag, paint, oil, grease, and similar contaminants. The articles shall be pickled in dilute sulfuric or hydrochloric acid, followed by rinsing in water and pickling in phosphoric acid. They shall be thoroughly washed, stoved and dipped in molten zinc and brushed, so that the whole of the metal shall be less than 610 gramms per square metre of surface galvanised, except in the case of tubes to BS: 1387 when it shall be 460 gramms per square metre.

On removal from the galvanising bath the resultant coating shall be smooth, continuous, and free from gross imperfections such as bare spots, lumps, blisters and inclusions of flux ash or dross. Edges shall be clean and surfaces bright.

Bolts nuts and washers shall be hot dip galvanised and subsequently centrifuged in accordance with IS: 2669. Nuts shall be tapped upto 0.4 mm oversize before galvanising and the threads oiled to permit the nuts to be finger turned on the bolt for the full depth of nuts.

During off-loading and erection, the use of nylon slings shall be used. Galvanised work which is to be stored in Works or on Site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining.

Small areas of the galvanised coat damaged in any way shall be restored by:-

- i. Cleaning the area of any weld slag and thoroughly wire brushing to give a clean surface.
- ii. The application of two coats of zinc-rich paint (not less than 90% zinc, dry film), or the application of a low melting point zinc alloy repair rod or power to the damaged area, which is heated at 300 Ec.

Fastenings of galvanised steel work shall be hot drip galvanised and subsequently centrifugal in accordance with IS: 2629. Nuts shall be tapped upto 0.4 mm over size before galvanising and the threads oiled to permit the nuts to be finger turned on the bolt for the full depth of the nuts.

Where surfaces of galvanised steel work are to be in contact with aggressive solutions and/or atmospheres the galvanising shall receive further protection by painting.

Fasteners

Bolts nuts and studs with nominal diameters upto and fasteners including 39 mm required to be made in carbon steel shall conform to BS 6104 and threaded in accordance with IS: 1363 + 1367. Bright steel washers 3.0 mm in thickness shall conform to BS 4320 and shall be provided beneath bolt head and nut.

The above items required to be supplied in stainless steel shall conform to IS: 1570. These items together with holding – down bolts and anchor plates required to be supplied in high tensile steel shall conform to BS – 970 Ref. Symbol T.

Drilled anchor fixings for use on concrete structures shall be of a type Fasteners approved by the Engineer's Representative. The Positions of all drilled anchors shall be approved by the Engineer's Representative and a Contractor proposing to use such fixings shall be deemed to have undertaken to supply, mark off, drill and fit. All exposed bolt heads and nuts shall be hexagonal and the length of all bolts shall be such, that when fitted and tightened down with a nut and washer, the threaded Portion shall fill the nut and not protrude from the face thereof by more than a half diameter of the bolt. Rivets shall conform to BS: 641 and tested in accordance with BS: 1109.

All the fastener like nuts, bolts, washers, anchor bolts, foundation bolts etc. used in submerged units, equipments, machineries etc. shall be of stainless steel (S.S.316) and remaining will be of MS galvanised

ITEM NO. : 28 PRESSURE GAUGES:

All pumps, compressors and air/gas blowers shall have stainless steel body PG at their discharge lines, where pressure transmitter is not provided. Pressure Gauges for process fluids containing sludge/solids and corrosive chemicals shall be of diaphragm type.

PG dial face shall be marked with pressure element material. Ranges shall be so specified that the gauge normally operates in the middle third of the scale and shall conform to IS-3624 standard dials, wherever possible.

Diaphragm seals, filled type or mechanical type shall be furnished where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be of clean out type with flushing connection.

Pressure Gauge Dial Size shall be of minimum 100mm and of white with black engraving, shall be provided with blow out disc, toughened/safety glass window, bayonet type bezel ring, case material of SS304, Bourdon Element / Socket of SS316, movement parts of SS, weather proof to IP-65, offering accuracy of $\pm 1\%$ of FSD. Micro-zero adjustment at the pointer, bottom process connection shall be 1/2" NPT, over-range protection of 130% of FSD.

In case of Diaphragm type Pressure Gauge, Diaphragm / Lower Chamber Wetted Parts shall be of SS316, Upper Chamber of SS304 / SS316, with silicon oil sealing fluid, 2" ANSI B16.5 flanged process connection

All gauges shall be fitted with a pressure snubber to dampen pressure pulsations.

Labels

The Contractor shall arrange for the supply and fitting of engraved identification labels to all valves and items of plant. The reference numbers of all valves shall be as indicated on the schematic diagram to be supplied under the Contract.

All warning labels shall comply with BS: 5378 parts 1, 2 and 3 and screw fixed rigid construction.

Designation labels shall be of 5 mm traffoly with black lettering on white background. Embossed materials and techniques shall not be accepted.

The Contractor shall provide 2 nos. enameled iron plates worked "Men Working of Plant". The plates shall be 200 mm x 75 mm with red lettering on a white background.

N. B. all identification and warning labels shall be in ("Gujarati Language") and English.

Guards

Adequate guards shall be supplied and installed throughout the installation to cover drive mechanisms. All rotating and reciprocating parts, drive belts, etc. shall be securely shrouded to the satisfaction of the Engineer to ensure the complete safety for both maintenance and operating personnel. However, whilst all such guards shall be of adequate and substantial construction, they shall also be readily removable for gaining access to the plant, with out the need for first removing or displacing any major item of plant. The guards shall be of the open mesh type except where retention of fluid spray is required.

Suppression of Noise

All plant offered shall be quiet in operation. The noise level within the building shall not be more than 85 decibels (+5 percent on this over the audible frequency spectrum measured at mid-bans) "A" scale when measured along a contour 3 meters from any single item of plant during starting, running and scoping. The noise level outside the building shall not be more than 60 decibels (+5 % on this over the audible frequency spectrum measured at mid-band) "A" scales when measured along a contour 3 meters from the external wall. Noise test measurement shall be made on completion of the installation of the pant at Site to verify that it

complies with this Clause. Plant which fails to comply with the noise level limits when tested which render it liable for rejection unless it is satisfactorily modified at the Contractors expense by the programmed commissioning date.

ITEM NO.29 KNIFE GATE VALVES

GENERAL:

Knife gate valves shall be suitable for use in waste water and sewage water containing solids and fibrous wastes etc. These shall be suitable for use at suction and delivery side of pumps as well as in branch lines in a sludge handling application of treatment plant or a pumping station.

The valve should be provided with gate made of stainless steel and the gate should have beveled 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.

DESIGN:

The valve should preferably be bonneted up to 300 mm size and bonnet-less for higher sizes. Valves shall be of wafer lug type construction up to 450 mm size and full flanged construction for higher sizes. The valve shall be provided with flange drilling to suit ANSI 16.5B 150# with raised face or DIN PN10 or IS 1538 -1993 flange connections in between pipelines.

The valves shall be designed to withstand minimum 10 bar pressure and 4 bar pressure for above size valves. It should be suitable for uni-directional application and should be able to withstand small bi-directional pressure.

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

The 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.

Bonneted type valves shall be provided with O-rings based arrangement to seal the rear opening and reduce the operating torque. Bonnet-less valves shall be provided with sufficient ply of stuffing seals in the in built stuffing box to seal the rear opening. The seals should be of non-asbestos PTFE to reduce the friction and offer higher life. Provision shall be made to enable tighten the stuffing seals. Replacement of stuffing seals should be possible to be carried out in installed condition of the valve but without there being line pressure.

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

MATERIALS:

The following material of construction shall be offered for the knife gate valves.

Body	:	Cast Iron FG 260 as per IS 210 or ductile iron
Knife gate	:	AISI: 304 Gr. ASTM A240
Retainer ring	:	Stainless steel Gr. CF:8
Inlet Seal	:	EPDM
Spindle	:	Stainless steel Gr. ASTM A276 Type 410 / 303
Spindle Nut	:	Cast Iron Gr. FG 200 as per IS 210 with bronze lined
Stuffing plate	:	Cast Steel ASTM A216 Gr. WCB
Stuffing seal	:	Synthetic yarn with PTFE
Support channel	:	Steel, epoxy painted

PAINTING:

The valve will be provided with following painting specification.

Surface preparation	:	Blast clean to near white metal finish.
Priming	:	2 coats of Epoxy primer.
Finish painting	:	2 coat of epoxy paint. Minimum DFT inclusive of priming 200 Microns.

ITEM NO.29 B KNIFE GATE VALVES (MOTOR OPERATED)

The specification of valve shall be as per item no 20 , However operation of valve shall be electrically operated with manual override. The specification of actuator shall be as indicated in the technical specification.

ITEM NO. : 30 : GENERAL OVERHAULING AND SERVICING OF THE OPEN CHANNEL / WALL THIMBLE MOUNTED SLUICE / GATES

Overhauling of Open Channel / Wall thimble mounted gates installed at various locations within STP. The tenderer shall have to dismantle existing gates and overhaul it. Tenderer shall have to scrap, clean and repaint the entire gate and its sub assembly. The contractor shall have to supply and erected the new stem nut, pin, pedestal and wall bracket, s.s. stud etc. While re-erection of open channel gate, proper alignment of gates, stem, brackets, head stock shall be done so that the undue working of bracket, etc. avoided. All the related civil work, breaking of wall, RCC and repairing shall be done by tenderer. The leakage from the gates after re-erection shall be within limit specified in IS.

Apply two coat of Zinc base primer after completion of cleaning, brushing, & scraping of gates unit and finally it shall be coated with Epilux Coaltar base epoxy paint. After re-erect gates contractor shall give the test in the presence of Enginner-in-charge.

ITEM 31: TROLLEY AND CHAIN PULLEY BLOCK

- a. The chin pulley block shall be operated on the lower flange of the bridge girder.
- b. The load chain shall be made of alloy steel as per IS: 3109. It shall be heat treated to give ductility and toughness so that it will stretch before breaking. IT shall be of welded construction with a factor of safety not less than 5.
- c. The hand chains for the hoisting and traverse mechanism shall hang well clear of the hook and both the chains shall be on the same side. The hand chain wheel shall be made from pressed sheet and shall be provided with roller type guarding to prevent snagging and fouling of the chain.
- d All the gearing shall be totally encased. Proper lubricating arrangements shall be provided for bearings and pinions. Gears shall be cut form gorges steel Blanks. Pinions shall be of heat treated alloy steel. Gears shall be as per BS: 436/IS: 4460.
- e. The trolley track wheel shall be rim toughened, heat treated carbon steel or low alloy steel or CI and shall be single flanged and shall have antifriction ball bearings. The wheels shall be machined on their treads to match the flanges of the track joints.
- f. The traveling trolley frame shall be made of rolled sell conforming to IS: 2062. the side plated of trolley frame shall extend beyond wheel flanges, thus providing bumper protection for the wheels. The two side plates shall be connected by means of an equalizing pin.
- g. Axles and shafts shall be made of carbon steel and shall be accurately machined and properly supported.
- h. The lifting hooks shall be forged, heat treated alloy or carbon steel of rugged construction. They shall be of single hook type provided with a standard depressed type safety latch. They shall swivel and operate on antifriction bearings with hardened races. Locks to prevent hooks from swiveling shall be provided. Hook shall be as per BS: 2903/IS: 3815.
- i. The brake for the lifting gear shall be automatic and always in action. It shall be of screw and friction disc type self – actuating load pressure brake. Brakes shall offer no resistance during hoisting.
- j. If the offered pumpset weight is more than the craned capacity specified, the contractor shall offer the crane capacity 2.0 times higher than the weight of the pumpset.

DAMAGED PRODUCTS

- A. The Contractor shall notify the Engineer-in-charge in the event of any equipment or material being damaged.
- B. Repairs to damaged products shall not be made without prior approval of the Engineer-in-charge.

ITEM NO.32: AIR COMPRESSOR:

- Design and construction requirements :
- The Air Compressor should be two stage single acting air cooled compressor.
- The air compressor should be self contained, fit to install on bare foundation, receiver

mounted, automatically regulated.

- The air compressor shall be base plate mounted.
- The entire unit shall be complete with inter cooling system, squirrel cage induction motors, tarters etc.
- It should be complete with low oil level switch, silencer. This units shall be complete with reflux, top and safety valves, auxiliary valves, drain valves, shut off valves, pressure switches, etc.
- The pressure transmitter shall be provided as front line control and pressure switches shall act as secondary control.
- In order to reduce discharge temperature of compressed air and to facilitate removal of water vapor and oil vapor, air compressor should be complete with air dryer, automatic drain trap etc. Auto drain trap shall be with manual isolation valve also.
- Air compressor as a system is required. System Arrangement shall be as this: Compressor-Vortex separator-Dryer-Micro Filter- Zero oil Filter
- Each stage mentioned above should have by pass arrangement so that repairing/failure of any stage does not effect the normal working.
- The capacity of ancillaries shall be decided at the time of detailed engineering.
- Vortex separator should be designed to have effective separation of water and oil and should be maintenance free. It should have aluminum body construction. It should have auto drain valve.
- Micro filter and Zero oil filter should be designed for air quality as per ISO 8573-1. It should carry warranty for elements also. Pressure drop caused should be low.
- A properly designed base plate should be provided for mounting of driver and load equipment.
- An inlet filter and silencer of adequate capacity should be fitted to the intake of equipment. The
- filter should be designed to have easy cleaning so that excessive overheating is avoided.
- Since demand of air is small and intermittent, automatic start and stop control system should be provided.
- TESTING:

Performance test	:	YES to be witnessed
Visual inspection check	:	Required

DRAWINGS:

- The manufacturer shall submit the following drawings.
- Preliminary outline dimensional drawings.
- Performance curves
- Data Sheet
- Typical cross sectional drawing showing constructional details with the complete bill of material and relevant standards along with two years normal working spares.
- Drawing showing Network, piping lay out plan, MOC, size, capacity etc.

ITEM NO.33: STRAINERS, UF AND RO SYSTEM

The specification provided herewith are tentative and for smooth operation of TTP units. However, the contractor may design system to achieve the desired parameters and

characteristics of tertiary treated water - industrial grade water as specified in relevant Chapter in the tender.

1. STRAINERS

The Contractor shall provide a set of manual backwashing, in-line strainers to remove particles and debris, such as drill shavings, present in the secondary effluent that could be expected to score, scratch or otherwise damage the membranes used in the UF process. The screening properties of the strainer shall be based on the requirements of the UF membrane process. The Contractor shall ensure that strainers provided can accommodate the total flow required for continuous operation of the downstream UF system with one strainer out of service for cleaning in backwash mode or off-line for maintenance. The layout proposed by the Contractor shall clearly identify all units and associated equipment, including all pipework.

The strainers supplied by the Contractor shall be an in-line type and contain a stationary basket. The strainer baskets shall be fitted with a stainless steel micro-screen configured as a low fouling slotted, wedge wire type. The screen openings shall be shaped to allow even flow and low pressure drop. The screen size will be selected to match the requirements of the UF membrane system. If the manufacture of the UF membrane does not have a requirement for screen size, then the Contractor shall provide a screen with maximum perforations of 0.5 mm. The micro-screen shall be able to be inspected and changed without removing the strainer drum or wheel assembly.

The Strainer casing shall be made from a high grade stainless steel, which shall be suitably passivated to minimise corrosion and pitting.

2. ULTRAFILTRATION SYSTEM

The primary purpose of the UF system is to remove sub-micron particles including bacteria, large colloids and other suspended solids from the secondary effluent to improve the performance of the downstream RO process by reducing fouling and minimising the chemical cleaning requirements. The secondary purpose of the UF System is to serve as one of the “multiple barriers” to the micro-organisms regulated.

Scope of Supply

The scope of supply for the UF system shall consist of, but not limited, to the following:

Features of the Ultrafiltration System

The Contractor shall provide a complete UF system, which includes, as a minimum, the following components:

a) Microporous membrane

The UF system shall use a pressurised microporous, hollow fibre membrane from an organic polymer as ultrafiltration membrane made of Modified / Reinforced PES.

b) Membrane elements

Multiple hollow fibre membranes shall be packaged as elements. The nomenclature adopted by the UF manufacturer for the elements may include sub-modules, modules, or cassettes. The Contractor shall supply hollow fibre elements that are specifically designed for municipal wastewater applications.

c) System Configurations

The UF System shall consist of multiple process units. Each process unit shall contain multiple hollow fibre elements. The process units shall be configured as an array of pressure vessels housing the membrane elements. For the UF system, the Contractor shall be fully responsible for the detailed design and layout, and provide all associated equipment, tanks and controls to provide a fully functional, operating system which meets the specified performance requirements. Each array system shall be capable of operation independent from the other arrays. These independent operations shall include filtering, backwashing and membrane chemical cleaning. Each array shall have a local control interface with control from the control panel, or from fully integrated local PLC's, inlet and outlet connections, stop valves, control valves, actuators, instrumentation, membrane integrity checking systems, process and filtrate quality monitoring systems, to provide an independent operating unit which is fully functional. Each array shall have its own membrane integrity monitoring system, for example, an off-line pressure test system.

d) Access to Modules

The Contractor shall provide clear space around the arrays that allows for unobstructed access to the membrane elements as required for installation inspection, integrity profiling, in-situ maintenance and removal of the elements. The Contractor shall supply all tools and devices required to safely and efficiently remove the membrane elements. The Contractor shall submit all catalogues and operation and maintenance details associated with the tools and devices for review and approval to the SMC prior to installation of the membrane elements. The Contractor is responsible for the design, certification, supply and installation of the crange required to remove membrane from a array. The Contractor shall submit all calculations, detailed drawings, certifications which indicate that the crange is structurally sound and safe to operate for review and approval to the SMC prior to installation.

Each array, shall have its own on-board process performance monitoring instrumentation, including, as a minimum, the following:

- a) Inlet (Feed): pressure, flow, turbidity(one common for entire ystem), temperature;
- b) Recirculation Loop (where utilised): pressure, flow, turbidity(one common for entire system);
- c) Outlet (Filtrate): pressure, flow, membrane flux rate (calculated), turbidity;
- d) Transmembrane pressure (TMP);
- e) Backwash Water Inlet: pressure;
- f) Backwash Water Outlet: pressure, flow;
- g) Chemical Cleaning Solution Inlet/Outlet: pH;
- h) Total unit run (elapsed) time;
- i) Elapsed Time: since last backwash;

- j) Filtered Water Volume: since last backwash;
- k) Elapsed Time: since last membrane chemical cleaning; and
- l) Filtered Water Volume: since last membrane chemical cleaning.

The Operator shall be able to adjust process setpoints from the control system operational stations in the Control Room.

Adjustable setpoints shall be provided for each of the membrane filtration systems and shall include, but not be limited to, the following:

- a) Number of process units on-line and off-line;
- b) Equalisation tank operating water level range;
- c) Filtrate tank water level settings;
- d) UF feed pumps start and stop based on flow equalisation tank levels, slow start and slow stop operation, adjustable pump/motor speed based on UF array flow.
- e) Control setpoints for the dosing of sodium hypochlorite to the feedwater and residual chlorine level
- f) Filtrate water quality limits, such as turbidity, particle counts, to initiate backwash or alarm on poor water quality
- g) All setpoints relating to UF backwash initiation, duration, and frequency
- h) Backwash water flowrates, including slow start and slow stop modes.
- i) Feed water inlet flowrate through each train or flow stream
- j) Filtrate tank water levels, and start and stop, and speed of RO Membrane Pressure Pumps/Motors.
- k) Alarm settings

Tools and Devices

The Contractor shall provide handheld/portable instruments for the monitoring of membrane module integrity, and the checking of individual membrane elements for integrity such as 'sonic sensing' equipment. The Contractor shall supply any special tools required for removing membrane elements.

Membrane Element Life

The Contractor shall define the guaranteed membrane element life in the pro-rated membrane warranty. The Contractor is advised that the following criteria shall be used for the purposes of defining membrane module life:

- a) Failure to meet the specified filtrate quality criteria;
- b) Failure to meet specified integrity test requirements; and,
- c) Failure to restore the permeability of the membrane to allow the system to achieve the specified MC and RC CIP frequency requirements at the design flow using only the duty membranes.

The Contractor shall provide all details of membrane life and pro-rata warranty life as required in the Technical Particulars required for Process Equipment and the Technical Particulars required for Equipment Performance Guarantees.

3. REVERSE OSMOSIS (RO) SYSTEM

General

The selection, detailed design, installation, testing and commissioning of the Reverse Osmosis System (RO System) shall be the responsibility of the Contractor. The Contractor shall ensure that the complete RO System The layout proposed by the Contractor shall clearly identify all units and associated equipment, including all pipework. The contractor may provide low pressure / high pressure RO membranes per his own design.

The primary purpose of the RO system is to remove dissolved solids, minerals and soluble organics from the filtered effluent to produce permeate that can be disinfected using ultraviolet light and chemically adjusted using sodium hydroxide to meet the product water quality requirements specified in this tender document.

The Contractor shall be responsible for providing an RO System consisting of four (4) identical, two (2) stage RO trains with design net permeate capacity with maximum recovery of 75%. The bidder is allowed to blend maximum 25% of UF permeate as a part of total product water as 40 MLD, to RO permeate to ensure the desired quality final product water. The Contractor shall provide all process-related equipment, piping, appurtenances including but not limited to the following;

- a) RO Feed chemical conditioning systems consisting of chemical storage, mixing, dosing, instrumentation and control systems;
- b) RO high pressure feed pumps and in-line strainers; c) Membrane elements as specified in this Specifications, with permeate interconnectors and brine seals;
- d) Pressure vessel support frame;
- e) Piping and valves for feed, interstage and final concentrate, permeate, permeate to waste, and membrane cleaning;
- f) Membrane Clean-In-Place system;
- g) Membrane Flushing system;
- h) Sample valves, tubing and sample panel;
- i) All required components for installation, including but not limited to, appropriate anchor bolts, piping supports, hardware, surface preparation, and shop and field painting; and, j) All required process control and monitoring instrumentation including all on-line analysers for performance monitoring and verification.

Reverse Osmosis System

General Features

- a) The process and instrument diagram for the RO systems shall be submitted by the bidder.
- b) The feed water to the RO shall be ultrafiltered secondary sewage from proposed STP at Dindoli. The Contractor shall make provisions for the addition of an

anti-scalant to condition the RO feed water upstream of the RO high pressure feed pumps.

- c) The chemically adjusted feed water shall be conveyed to the RO trains by high pressure feed pumps. The Contractor shall supply a dedicated pump for each train and a redundant feed pump that can be shared between trains. The pumps shall be fitted with variable speed drive units to permit the control system to maintain a constant flow to each membrane train regardless of the feed pressure required. The pumps shall be sized based on the pressure requirements for a five year old membrane and have sufficient head under these conditions to convey the permeate to the top of the product water storage tank.
- d) The Contractor shall provide Four (4) RO Trains. Each train shall have a permeate capacity of design flow.
- e) Permeate from stage one and two of each train will flow into a common header that feeds the product water tank after pH correction. The Contractor shall make allowances for the total permeate flow from any train to be diverted from the product water tank feed header and returned to the UF filtrate tank. The Contractor will also make allowances to segregate the permeate from stage one and stage two of each train so that under any given set of circumstances the permeate from stage two can be returned to the filtrate tank. The concentrate water rejected by the membrane trains shall be taken to RO reject treatment units.
- f) The reverse osmosis trains will be automatically controlled from the Control System. The permeate and concentrate flow rates (and thus, recovery) of each train will be controlled primarily by automatic adjustment of the appropriate feed pump VFD and concentrate control valve. The concentrate valve shall be a globe control valve. In each train, a manually-adjusted permeate backpressure throttling valve shall be installed for Stage 1 for “flux balancing.” The back pressure throttling valve shall be a globe valve or segmented ball valve designed for throttling/balancing the flow and designed to prevent cavitation under all design operating conditions.
- f) The reverse osmosis trains shall be designed to be cleaned in place by a dedicated automatic membrane cleaning system, which is sized to clean stage one and stage two separately. The RO membranes will be flushed using product water immediately after cleaning to remove residual surfactants.
- g) The reverse osmosis trains shall be designed to incorporate an automatic product water flush upon train shutdown to prevent inorganic scaling from stagnant concentrate. The pressure required to effect the product water flush will be supplied by both a dedicated flush pump and the head of the product water storage tank. The Contractor shall provide one (1) RO flush water pump, taking suction from the Product Water Tank and including all controls, instruments, electrical, pipework, manifolding, valves, actuators, fittings and mountings.
- h) The flushing sequence shall be automatically initiated and controlled if an individual RO train is off- line for a period in excess of 30 minutes without being restarted. The system shall be configured to flush each train in sequence, if more than one train is off-line for the predetermined time interval. The Contractor shall design and install an RO system that incorporates features to eliminate the potential for damaging the membranes by positive permeate pressure generated during the cleaning or flush stage. The Contractor shall design the flush system so that all trains can be flushed within 30 minutes of initiating the flush sequence.

a) RO Membrane Elements including following;

The Contractor shall provide low pressure, high rejection, thin film composite, spiral wound type RO membranes that have reduced fouling tendencies when operated on a pretreated feedwater produced by the ultrafiltration of clarified secondary sewage from existing STP at Bhatar. The spiral wound membrane shall have the feed and concentrate (reject) flow through the element parallel to the longitudinal axis of the permeate collection tube of the element. The Contractor shall provide all interconnecting tubes fitted with grooves to accommodate o-ring seals or double gasket seals.

RO membranes cast from cellulose acetate or derivatives of cellulose acetate are not acceptable under the terms of this contract and will not be considered for this application.

The Contractor shall provide RO membrane elements that are of standard RO industry dimensions and suitable for installation inside standard RO pressure vessels (pressure housings).

The Contractor shall furnish complete manufacture's catalogue information, descriptive literature and specifications for the RO membrane elements, including projections developed for the two stage system to the SMC

b) Factory Testing of RO Membrane Elements

The Contractor shall provide RO membranes and elements which have been individually factory tested, at their point of manufacture, and achieved satisfactory results including the requirements below. The individual RO elements shall be factory tested, as a minimum for:

- (1) Vacuum hold test (using the 'San Diego Protocol', as outlined below);
- (2) Sodium chloride solution rejection; and
- (3) Element permeate productivity at standard pressure, temperature and salt load.

The 'San Diego Protocol' for the vacuum hold test (VHT) is as follows:

- (1) Fully wet the individual membrane elements by soaking completely in water;
- (2) Drain the water from the element;
- (3) Plug and seal the permeate tube on one end;
- (4) Attach vacuum pump to the other end of the permeate tube;
- (5) Draw a vacuum of at least 20 kPa absolute or 5.9 inches Hg absolute pressure which corresponds to 24 inch Hg vacuum gauge pressure;
- (6) Measure vacuum decay over a one (1) minute period and repeat until two equal results are obtained.

The vacuum decay in all RO membrane elements shall be less than 10 kPa/minute (2.95 Hg). The salt (Sodium rejection) and the permeate productivity shall as a minimum comply with the figures stated on the Membrane Data Sheet for the membrane tendered.

These factory tested membranes and elements shall be certified, in accordance with the industry approved quality control and quality assurance procedures, prior to shipment to the Dindoli STP site. The Contractor shall provide certified test data, indicating the factory test results, for each RO membrane element, by serial number, prior to

shipment.

After delivery to the Dindoli TTP, and before installation in the RO trains, at least ten (10) percent of the RO elements shall be randomly selected by the SMC and tested by the Contractor but witnessed by the SMC using the ‘San Diego’ vacuum hold test procedure, at the site with equipment provided by the Contractor. RO membrane elements which pass the factory and site tests shall then be acceptable for installation in the RO trains.

Membranes elements which do not meet the quality control and quality assurance procedures, including factory, and/or site tests, shall be replaced with membranes which meet all the procedures and subsequent repeats of the site tests using another random selection for the 10% sample size. The batches of membrane elements for which any membrane fails from which the 10% sample were randomly selected for the field tests shall be replaced in totality.

Membrane Element Identification

Each membrane element shall have a unique serial number, which shall be used for identifying the element’s materials, manufacturing history, quality assurance and performance test results.

The Contractor shall install membrane elements described in positions determined after review of factory test data (by element serial numbers). The permeate conductivity from each pressure vessel shall be within plus or minus 20 percent of the average conductivity of the combined permeate for the stage of the train in which it is installed. In the event that individual pressure vessel conductivities exceed the average conductivity of a stage by more than 20% the contractor shall probe each pressure vessels to detect leaks, repair rolled o-rings or, if necessary, replace leaky membrane elements.

Ancillary Fixtures and Fitting

The membrane elements provided under this Specification shall be complete and operable in all respects including, but not limited to, accessories such as permeate interconnectors and brine seals suitable for installation in the nominal 200 mm (8-inch) diameter pressure vessels.

c) Reverse Osmosis Feed Pumps

The Contractor shall supply a dedicated high pressure feed pump for each RO train and a common stand-by feed pump for RO trains. Suitable pumps include horizontal, multi-stage, split case pumps. The RO feed pumps shall be equipped with variable speed drives for constant feed at variable pressures.

The Contractor shall ensure that each feed pump is sized to deliver the required feed flow to an individual RO train rated to produce designed net permeate. In sizing the pump the Contractor shall make allowances for the feed pressures projected for five year old membrane elements. The Contractor shall make allowances for the additional

feed pressure requirements resulting from the stage one permeate throttling valve. Finally, the Contractor shall also ensure that the pump is sized to convey the RO permeate into the top of the Product Water Storage Tank.

d) Membrane Pressure Vessels

The Contractor shall provide RO membrane pressure vessels (pressure vessel) manufactured from non-corroding materials with side entry ports and connections to house the RO membrane

elements. The Contractor may supply the pressure vessels as either single ported side entry

pressure vessels or multi-ported, side entry pressure vessels.

The Contractor shall supply the vessels complete with end closures, hardware and membrane element end adapters. All seals in the shell or head of the vessel shall be visible so as to be directly accessible for replacement without the removal of any other components.

The shell of the vessel shall be the side port entry type and shall be fabricated of filament wound fibreglass reinforced plastic using continuous glass roving impregnated with an elevated temperature cure epoxy resin system. Materials of construction shall be lot traceable to vessel serial number. All wetted components in continuous contact with the pressurized process water shall be made from plastic or metal proven to have long-term resistance to corrosion in the service intended. All other materials of construction shall be of appropriate strength and corrosion resistance for the operating conditions.

The vessels shall be designed to allow industry-standard sized membrane elements to be easily accommodated by changing end connectors (outboard adapters) and spacers (to prevent movement of the elements within the vessels). The Contractor shall furnish the appropriate end connectors (outboard adapters) for the membrane elements.

Vessels shall be so designed as to allow membrane elements to be connected to the permeate port at either end of the vessel so that permeate can be taken from either end.

End closures shall incorporate an approved quick-opening locking mechanism and shall be so designed as to minimise the force required to install and remove the head. The locking mechanism shall be so designed that the failure of any one component of the mechanism will not allow the mechanism to release. The locking mechanism shall incorporate a safety interlock, which secures the primary locking components and provides a measure of tamper resistance. The locking mechanism shall be so designed as to allow easy visual assurance that all components are in serviceable condition, in place, and fully engaged.

Each vessel shall be fitted with a dedicated permeate sampling valve. The valve shall provide a direct connection to the permeate stream. The sampling valve shall allow access for probing to determine the permeate quality at different points down the length of the pressure vessel. A seal on the permeate sampling valve will stop any permeate

from flowing around the probing tube to the outside of the vessel.

e) **Pressure Vessel Racks**

Each train frame shall be designed and constructed to support all loads, including, but not limited to, full-rack quantity of membrane elements and pressure vessel, valves and piping when filled with water, and panels. The centreline of the bottom pressure vessels in the framework shall be 750 mm above the platform supporting the vessel racks.

The Contractor shall fabricate the frames, racks, or skids which hold membrane assemblies, valves, piping, from welded steel. The fabricated racks shall not be used for supporting of pipes except where specifically allowed for in the design calculations.

The pressure vessel rack will be furnished from structural steel finished to the following specifications

Surface Preparation:

Remove all weld spatter.

Grind all welds smooth.

Bolt holes, mounting holes, etc., shall be drilled prior to painting.

Shop Prime Painting:

Thoroughly clean all ferrous metal items and give a shop coat of primer and finish coating Allow paint to dry before shipment of material. Protect painted surfaces during installation.

Prepare and touchup marred surfaces per paint manufacturer's instructions.

Frame weldments shall be designed to be supported from two bearing points. Frame weldments shall support each pressure vessel at three locations per pressure vessel manufacturer's requirements.

The membrane skid framework will be anchored to the vessel rack support and platform using levelling nuts so that the base is 12.5 mm (1/2-inch) minimum above the finished floor. Non-shrink grout and shims shall be packed beneath the skid frame.

f) **Feed/Concentrate And Permeate Manifolds**

The Contractor shall provide all piping and tubing associated with the feed/concentrate and permeate manifolds. The Contractor is responsible for the design and fabrication of the feed/concentrate and permeate manifolds. The Contractor shall submit all necessary shop drawings associated with these manifolds to the SMC prior to the delivery of this equipment to site. Manifolds supplied by the Contractor shall be inspected by the SMC upon delivery to site. The SMC will reject any manifolds that do not meet the following specifications and the Contractor shall be required to replace those manifolds rejected with new pieces.

Rejected
manifolds may not be repaired and resubmitted.

The feed/concentrate manifolds shall be manufactured from fittings utilising Grade 316L stainless steel reducers, elbows and tees manufactured to ASTM A774 with dimensions conforming to ANSI B16.9. The Contractor shall ensure that the welds on the manifolds meets the requirements for welding of Austenitic Stainless Steel Tube and Pipe Systems in Sanitary Applications as specified by the American Welding Society AWS D18.1. The Contractor shall arrange for the SMC or a nominated representative to inspect and approve the welding work prior to acceptance.

Manifolds shall be designed with inlets/outlets for each pressure vessel. Individual feed/concentrate manifolds shall consist of a continuous central pipe modified with a series of smaller diameter branch connections that are aligned with side entry ports on the pressure vessels. The Contractor shall ensure that these branch connections are extruded from the central pipe. The direct welding of a smaller diameter pipe to the central pipe shall not be accepted. The Contractor shall ensure that all welding shall be full penetration and continuous, and all gaps shall be fully sealed. The completed work shall be free from distortions and true to dimensions. All connections shall be welded in a manner such that the finished connections are neat, smooth in appearance, and all sharp edges ground and all projections ground smooth suitable for provision of corrosion protection and aesthetic finishes.

The Contractor shall ensure that all welds and the adjacent plate shall be fully cleaned, pickled and passivated both internally and externally. Passivation shall be carried out in the fabricator's works. All welds in contact with water shall be ground and polished smooth to achieve a smooth surface, free of pits and voids prior to passivating.

After the manifolds have been accepted the Contractor shall arrange for the manifolds to be electropolished to achieve a highly polished uniform finish. The Contractor shall ensure that all care is taken when handling the stainless steel before, during and after fabrication to prevent contamination with mild steel materials, dust, shavings, weld splatter and the like. Such care is particularly important after passivation and during transport to site, storage and installation as these small particles rust quickly and discolour the surface of the stainless steel. This can destroy the protective oxide film and render it liable to pitting corrosion.

Manifolds will be connected to the pressure vessel ports with 316 stainless steel pipe spools, each using unpainted galvanized ductile iron 7 connectors with 316 stainless steel bolts and washers and silicon-bronze nuts. The “unused” manifold parts will be plugged with removable 316 stainless steel Victaulic caps.

The Contractor shall ensure that all membrane train piping, with the exception of interconnection piping between adjacent pressure vessels, shall be sized to keep flow velocities less than 2 meters per second at the maximum design flow rates and maximum membrane cleaning solution flow rates of 2.5 litres per second per pressure vessel. The Contractor shall supply three (3) sets of permeate orifice plugs, sized to simulate the hydraulic design of the membranes (one set for each membrane train).

If multi-ported, side entry pressure vessels are supplied, then the Contractor shall ensure that the feed manifold and concentrate manifold are located on opposite sides of the of the set of pressure vessels to ensure correct flow balancing. RO Systems configured using multi-ported, side entry pressure vessels with the feed and concentrate manifolds connected to the same side of the group of pressure vessels will not be acceptable.

The Contractor shall ensure that the permeate manifolds are designed with inlets for each pressure vessel. Acceptable materials for the fabrication of the membrane train permeate manifolds and piping include 316L stainless steel, cPVC and ABS.

The permeate manifold shall be connected to the pressure vessel permeate port using PVC U-bends fitted to accommodate either unpainted galvanized ductile iron quick release connectors or PVC unions. Unused manifold parts shall be plugged with removable 316 stainless steel plugs or caps.

RO Membrane Cleaning System

The contractor shall supply and install separate automatic membrane cleaning sequence to chemically clean the RO membranes in situ when they become fouled and suffer a loss of product flow and/or salt rejection greater than a pre-determined value. The system will allow for membrane cleaning using a variety of chemicals, including acids, bases, biocides, surfactants, and detergents.

The Contractor shall provide a complete RO Membrane Cleaning System, including all tanks, pumps, valves, actuators, pipework, fittings, mixers, heaters, control from the CONTROL PANEL, electrical, supplies, instrumentation and mountings.

The Contractor shall provide a RO Membrane Cleaning System which is easy to use and shall minimise operator labour requirements.

The Contractor shall provide spent cleaning chemical solution holding tank(s) to accommodate storage of the used cleaning chemicals for subsequent transfer to a tanker truck for hauling away.

Each train shall have “hard-piped” cPVC cleaning lines, with stainless steel and cPVC valves and victaulic-type (removable) cPVC piping spools, as specified herein and/or shown on the Drawings. The design shall allow cleaning without the need for operation’s staff to insert blind flanges, manually turn valves, or manually operate other devices above 1.5 meters from floor level.

All membrane train piping and CIP piping shall be sized to keep flow velocities less than 2.5 meters per second during the CIP process.

ITEM NO. 34 Disc/Cloth Media Fine Filtration System

The Disc Filters shall be capable of filtering secondary treated sewage with daily flow of 60 MLD and achieve the desired treated effluent quality. Each filter shall be installed in a concrete basin and each filter basin shall be provided with a butterfly drain valve. Each filter basin shall be fitted with 304 stainless steel mounting brackets to accommodate attachment of the filter components to inside of the basin. All mounting brackets shall be attached to the inside of basin wall with 304 stainless steel wedge anchors and hardware. All piping including external & puddle piping shall be provided by the Contractor. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the center tube, without special tools, to allow for removal and replacement of the cloth at the point of installation. Disc with polynet / Cloths shall have a nominal filtration rating of 5-10 microns. Each filter shall be provided with isolation valve at upstream. The cloth / polynet depth shall provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. The filter system shall provide for the collection of filtered solids on the outside of the cloth media. Filtered effluent shall be used for backwashing. The effective filtration area will be considered the actual media area which will be submerged and available for filtration 100% of the time. Hence framework and glued surfaces of filter will be considered while calculating the effective filtration area. Contractor shall submit calculation and sufficient evidences for verifying the effective filtration surface area. The filtration system shall be complete with the effective backwash system and minimum usage of backwash water will be preferred.

Design flow, MLD 60 MLD

Wastewater Characteristics

Parameters	Influent	Desired Quality Effluent
TSS daily average, mg/L	10	
TSS maximum, mg/L	15	5 mg/l

Total available effective filtration area- submerged in the water	100% of the time
Maximum effective filter loading rate at average design flow	8 m ³ /m ² /hr,
Maximum effective filter loading rate at peak design flow	16 m ³ /m ² /hr,
Maximum solid loading rate at the maximum design flow and TSS concentration	10 kg TSS/day/m ²
Filter basin	Concrete
Filter media rating	Nominal 5 microns
Filter media submergence	Fully submerged 100% of the time / as per technology provider
Filtration mode	Outside – in / as per technology provider
Backwash mode	Inside - out / as per technology provider

The filtration system shall be complete with PLC controlled operation and backwash system as per the recommendation of technology vendor. Access walkways, handrails and stair case etc shall be provided as per the tender specifications mentioned elsewhere.

FILTER DISC BASIN

Each filter shall be installed in a concrete basin. Determination of the overall footprint will be dependent on the configuration of the valve and pump room, effluent chamber, influent, effluent, and overflow channels. Each filter shall be provided with a 3” (75 mm) manually operated butterfly drain valve. Valve shall be provided with ductile iron body, aluminum bronze disk, stainless steel shaft and EPDM seat.

BASIN MOUNTING BRACKETS AND HARDWARE

Each filter basin shall be fitted with 304 stainless steel mounting brackets to accommodate attachment of the filter components to inside of the basin. All mounting brackets shall be attached to the inside of basin wall with 304 stainless steel wedge anchors and hardware. Each filter basin shall be furnished with 304 stainless steel influent weir boxes and the 304 stainless steel effluent weir plate. Manual influent valve, influent weir box, effluent weir plate, through the wall spool piping, and all filter external piping shall be provided by the Installing Contractor. The Installing Contractor shall furnish the means (the flow splitter box or alternatively the modulating influent valve and the flow meter) to regulate the flow to each filter unit if the filter doesn't have its own influent weir when multiple filter units are required.

DRIVE ASSEMBLY

Each filter shall include an adjustable drive assembly with a gearbox, nylon drive sprocket, acetal drive chain with 304 stainless steel link pins, and a 304 stainless steel chain guard. To reduce energy demand, the drive assembly shall rotate the disks only during backwash. Systems requiring constantly rotating disks during filtration will not be acceptable. Belt drive systems or systems with multiple drive units per filter will not be acceptable.

CENTERTUBE ASSEMBLY

Each centertube assembly shall include a minimum 3/16” (4.76 mm) thick 304 stainless steel centertube weldment, driven sprocket, wheel assemblies, 304 stainless steel disk segment rods, and frame and cloth assemblies. Each centertube assembly shall also include a Viton v-ring effluent port seal. The driven sprocket shall be multi segment made of UHMW polyethylene. All fasteners shall be stainless steel.

FILTER CLOTH ASSEMBLIES (in case of Cloth Media)

Vertically Mounted Cloth Media Discs featuring automatically operated vacuum backwash. Each cloth disk assembly shall be comprised of a cloth media sock supported by an injection molded polypropylene co-polymer frame with corrosion resistant assembly hardware. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the centertube, without special tools, to allow for removal and replacement of the cloth at the point of installation. Systems requiring special tools and/or the return of media segments to the factory for replacement will not be considered.

Cloths shall be of pile construction having a nominal filtration rating of 5-10 microns. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. Granular media and screens having structured identical openings shall not be allowed. Woven mesh or microscreen type media with no filtration depth are not acceptable.

During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the disk to the inside. Systems with flow paths from the inside to the outside of the disk that collect filtered solids and debris on the interior surfaces of the disk will not be acceptable.

Only media area below the effluent weir elevation will be considered in the effective filtration area calculation since this is the only area that is submerged and available for filtration 100% of the time.

Submittal information shall include calculations that verify the effective filtration surface area. Media surface fused directly to support structure such that water cannot pass through the media shall not be included in these calculations

BACKWASH SYSTEM

The filtration system shall be complete with the effective backwash system and minimum usage of backwash water will be preferred.

The backwash function shall incorporate a pump that draws filter effluent through the cloth as the media rotates past the fixed backwash shoe/system, thereby removing accumulated solids from the cloth surface. Each disk shall be cleaned by a minimum of two backwash shoes/system, one on each side.

The backwash shoes/system shall remain in a fixed position. Springs shall be used to maintain the proper tensioning of the backwash shoe/system against the media surface. Neither the cloth / support assemblies nor the backwash shoes/system shall include any gridwork overlays or other interferences that would prevent direct contact of the backwash shoes/system with the cloth fibers. The backwash system shall include 304 stainless steel backwash shoe/system supports with 316 stainless steel springs, UHMW backwash shoes/system, reinforced PVC flexible hose with stainless steel hose clamps. The backwash shoe shall be in direct contact with the cloth to ensure effective media cleaning. Systems utilizing media cleaning mechanisms that do not contact the filter media will not be acceptable.

BACKWASH/WASTE PUMP ASSEMBLIES

Each backwash/waste pump assembly shall include backwash/waste pumps, valves and gauges. In the external piping shall be backwash and solids waste valves, recirculation ball valves, for each pump, vacuum gauges, and pressure gauges.

Filtering shall not be interrupted during normal backwashing and solids waste discharge.

VALVES

Each filter shall include electrical backwash valve(s) and solids waste valve. Necessary manual valves shall be furnished for normal operation of the filter system.

Each filter shall include a solids waste removal system consisting of perforated manifold. The manifold shall be designed to siphon settled solids for waste discharge through the backwash/waste pump. The operation of the solids waste removal system shall be automatic with user adjustable intervals and duration through the operator interface. Filters that are designed without a solids waste removal system will not be acceptable.

INSTRUMENTATION

Each filter unit shall include necessary instruments such as pressure transducer with a mounting bracket and hardware, a float switch, a vacuum transmitter for proper operation of the filter unit.

CONTROL

The automatic and manual controls for operation of the filtration system shall be furnished fully assembled, wired and pre-programmed in a control enclosure with PLC controlled operation and backwash system. The automatic controls shall be provided in a UL listed, NEMA Type 4X wall mounted enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors.

Automatic operation of the Filter shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a base unit, expansion I/O modules, and memory module. All input and output points supplied (including unused) shall be wired to terminal blocks. The PLC user memory shall consist of a minimum of 20K words of program and data. All PLC hardware shall be UL listed and operate at an ambient temperature of -4° to 140° F (-20° to 60° C).

The control system shall be equipped with a UL listed operator interface that provides control display screens. These screens shall be used by the operator to monitor and control filter status, setpoint and alarm information. The Interface shall allow the Operator access to adjust the following operating parameters:

- Backwash interval, Backwash duration, Sludge waste interval, Sludge waste duration, Number of backwashes between sludge wasting

The operator interface shall provide information to assist the Operator in assessing the status of the filter system. The interface screen shall display, at minimum, the following parameters:

- Water level in the filter, Time since last Backwash, Time since last Sludge withdrawal, Elapsed time on the Drive Motor, Elapsed time on the Backwash Pump(s), Total backwash time and cycles, Total sludge withdrawal time and cycles.

The interface shall display the alarm history. The alarm history shall include the time and date of the most recent 25 alarms along with the description of the alarm. The interface shall also display current alarms, including the date, time and a description of the alarm. As a diagnostic aid to the Operator, the interface shall display the time between backwashes for the most recent 40 backwashes.

The operator interface shall be a NEMA Type 12, 13, 4X rated, 6.5” diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution. The rated operating temperature shall be 32° to 131° F (0° to 55° C).

WARRANTY

The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of one (1) year from the date the goods are put into service, or eighteen (18) months from shipment of equipment, whichever first shall occur. This warranty shall not apply to any goods or parts which have been altered, applied, operated or installed contrary to the Manufacturer's instructions or subject to misuse, chemical attack/degradation, negligence or accident.

The above mentioned specifications are general guideline purpose only. However, the design and specifications of fine filtration system may vary and shall be considered as per manufacturer standard / technology provider.

ITEM NO. 35 : VERTICAL TURBINE PUMP

DETAILS/SPECIFICATIONS FOR V.T. PUMPSETS

V.T. Pump sets.

This specification covers the design, performance, manufacturing, construction features, testing, delivery, installation and commissioning of vertical turbine pumps.

The design, manufacturing, performance of vertical turbine pumps shall comply to all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall confirm to **IS 1710 or its latest edition (if any)**.

1. DESIGN FEATURES :-

01. The turbine pump shall be capable of developing the required total head at rated capacity for its continuous operation. Pump shall be designed for continuous full load duty and indoor installation.
02. Pumps of a particular category shall be identical and shall be suitable for parallel operation. All parts of pump within a single similar service group are to be similar and interchangeable with different pumps
03. The head capacity curve shall be continuously rising towards shut off with the highest at shut off. The shut off head shall be at least 120 % of the head at the specified capacity.
04. Pump family curve for the VT Pumps should be selected such that impeller of above pumps has operating range (therefore, impeller diameter) selectable to +10% and - 20 % head variations. Discharge of pump and all other performance parameters shall remain un-changed, firm and guaranteed. The exacting of the head shall be done at the time of detailed engineering. The evaluation of the tender shall be done at the head mentioned in the data sheet.
05. **The characteristic curves, for head, efficiency and power input, for the pumps at motor rated speed offered must be enclosed with the technical bid without which the tender shall be liable for rejection. The curve should be from shut off head to zero delivery head. The pumps shall be suitable for running at shut off condition for at least 5 minutes.**

06. The performance curves for head, efficiency, and power input must be drawn for all the three (max., rated, and min.) sizes of the impeller. Further, the duty point shall be clearly marked for all the items in respective curves. Also, the scale selected for drawing must appropriately selected such that efficiency can be read with smallest unit of 1 %.
07. The duty point shall not lie on the maximum or minimum impeller diameter curve for the selected model of the pump. Diameter of impeller should have minimum margin of 5 % on maximum and minimum impeller size. It is preferred that the working point should fall on the left side of the maximum efficiency point.
08. **The performance curve selected shall be according to number of pumps running in parallel, indicated in data sheet. Bidder shall submit the relevant performance curves, for head, efficiency and power input, with technical bid, otherwise tender shall not be evaluated and accepted.**
09. The impeller adjustment shall be such that the impeller runs free in any installed condition, despite of extension of line shaft (caused by hydraulic down thrust), the weight of shafting and weight of impellers.
10. The operating speed of the pump shall not be closer to critical speed to have vibration free running at operating condition. The margin shall be as per relevant pump standard.
11. The velocity of vibration shall be limited to 4.5 mm/sec. At the thrust bearing. The noise level shall be limited to 85 dB at a distance of 1 meter. Noise level and amplitude /frequency of vibration of pump from No Load to Full Load condition shall be within acceptable limit of the related standard during testing at manufacturer's works as well as after permanent installation of the pump at site.
12. The corrosion allowance for all Carbon steel/Cast Iron part should be maximum 3 mm.
13. All column pipes (outside and inside) shall be painted with anti-corrosive food grade paint. Details/specifications shall be got approved before applying the paint.
14. Slow speed testing will not be accepted. Further, pumps must be tested on job motor.
15. It is clarified that efficiencies/losses mentioned in the tender are ceiling on efficiencies/losses. In case claimed efficiencies are less than the ceiling efficiencies and losses claimed are more than ceiling on losses, cost loading as elaborated in the tender shall be levied and no advantage shall be given in case claimed efficiencies are more than the ceiling efficiency and similarly, no advantage shall be given in case claimed losses are less than the ceiling on losses.
16. The total head from all causes mentioned in the tender is likely to be varying by +10% and - 20 % of total head specified. The pump and driving motor should be able to meet this situation without any trouble. The H-Q curve for the pump offered should not be flat but steep so that with the variation of head, the discharge does not vary during low head operation (less than - 20% head) pump should not create problem of 'cavitations' / excess vibration during operation.
17. In case, pumps are offered with coating, testing at manufacturer's works shall be carried out "without coating". No advantage shall be given against rise of efficiency for coating.
18. Lubrication is required; the same shall be fabricated and provided by the contractor free of cost. An arrangement of pre-lubrication is must, hence appropriate size water tank,

plumbing work etc. with each pump must be considered. The lubrication/Pre-Lubrication must be done as per bearing manufacturer's recommendations.

DRAWINGS:

The manufacturer shall submit the following drawings.

01. Preliminary outline dimensional drawings showing details of pump, motor, civil foundation, clearances, minimum submergence etc.
02. Performance curves, with parallel running pumps considered, for capacity V/s head, efficiency; power input KW requirement shall be furnished. The capacity range shall be zero flow to shut off flow.
03. Typical cross sectional drawing showing constructional details with the complete bill of material and relevant standards.

NAME PLATE:

Each pump shall be preferably provided with a name plate, indicating manufacturer's standard detail including following details:

1. Rated capacity in M³/ Hr.
2. Total Head in meter.
3. Speed in RPM.
4. Model Number.
5. Serial Number of the machine.
6. Manufacturer's special number.
7. Weight of equipment.
8. Year of manufacturing.
9. Type of lubricant.
10. Bearing nos.

OPERATION AND MAINTENANCE MANUAL:

Operation and maintenance manual In TRIPLICATE shall be submitted for each pump sets.

DETAILS / SPECIFICATIONS FOR AFFIRMATION OF HEAD BEFORE MANUFACTURING & AFFIRMATION OF PERFORMANCE OF PUMP & SYSTEM AT SITE THROUGH ENERGY AUDIT:

- a. Once tender is finalized, successful tenderer, at the time of drawing approval, shall call the pump designer (manufacturer) before the department and re-assess the system resistance (total Head) requirement. He shall initiate pump designing only after having re-assessment done at site. So that, pump performs on required efficiency even at site.
- b. Also, once pumps are supplied, erected and commissioned, performance testing must be carried-out by the government authorized energy auditor deployed by contractor to evaluate the performance at site and ensure that pumps performs as per design criteria and confirms results of testing done in manufacturer's test lab set-up. Any deviation must be

strictly attended /prevented and ensured that performance testing is also observed satisfactory and as called for in tender.

REAFFIRMATION OF HEAD REQUIRED AS PER ACTUAL SITE CONDITION.

The Surat Smart City Development Limited is very keen and conscious for energy saving activities. One of the effort is to have design of pumps actually suiting to site conditions so that efficiency loss do not occur at site due to differed site conditions. Therefore, it is very important to pay attention towards selection of duty point right at the design stage.

The head mentioned in the tender is derived from the available data and is “near to require”. However, it needs to be reaffirmed. Contractor may derive the required head by asking all system data at his own.

Keeping this view, the job involves the re affirmation of the head required actually at site. The SITC job involves, therefore, followings (not compulsory but preferred):

1. Pump manufacturer shall depute their experienced R & D personal at site and shall measure the actual head physically or otherwise.
2. The point of suction and point of delivery are fixed at both end. The bidder is required to study the site condition and should reassure these points and reach to the physical head measurement.
3. The manufacturer is expected to study the normal running condition of the pump house, number of parallel pumps being run in normal condition and other system parameters that affect the duty point condition directly.
4. Based on this study, he will create the system resistance curve and select the family curve to derive the Actual head conditions. The discharge need not to vary.
5. The contractor/manufacturer shall communicate this “actual” duty point conditions in writing to SMC and shall be considered as “actual” guaranteed parameters.
6. The “actual” guaranteed parameters shall be considered as base for the design of manufacturing pump.
7. Please note that since the head mentioned is “near to” the site requirement, hence abrupt and unexpected variation than the mentioned head will not occur. Hence, no commercial implication shall take place. Hence, it is clarified that no commercial implication shall be considered after award of contract and with “actual” new duty point conditions.
8. The pump manufacturer shall co-ordinate for all further drawing approvals keeping in view “actual” head conditions.
- 9. Please note that, besides pump performance, the system performance is expected. Hence, evaluation/audit shall be done for complete system performance. The bidder is expected to suggest the system changes, if any, for improving system energy performance, right at initial stage and correct/ modify it (if any) during the execution stage so that system efficiency can be maintained as guaranteed.**

TO AFFIRM PERFORMANCE OF PUMP AT SITE THROUGH ENERGY AUDIT:

- (i) It is preferred that, the bidder/manufacturer guarantee this “actual” duty point parameters and therefore, the testing at works shall be carried out in relation to the “actual” duty point conditions.
- (ii) **The “actual” duty point parameters must be guaranteed at site also. For this, bidder/ manufacturer shall appoint ENERGY AUDITOR APPROVED BY GOVERNMENT OF GUJARAT. The energy auditor shall be got approved from SMC also. He shall be entrusted the job after approval at SMC end.**
- (iii) Energy auditor shall measure the actual energy consumption and actual site condition parameter, which must match the “actual” guaranteed parameters (System as well as individual pump). The result declared by Energy Auditor shall be binding to both SMC and contractor/manufacturer. The actual duty condition may vary, as the pump is meant to supply water in network. So, guaranteed parameter considered is on any point of defined range (+10% and - 20 % to duty point Head) on characteristic curve.
- (iv) If results are not found to be matching the “actual” guaranteed parameters on defined range, it will be considered as defect in commissioning as mentioned in the tender and may be liable to charge necessary penalty/compensation for additional energy consumption as per the ENERGY LOADING CONDITIONS mentioned in the tender shall be levied from the bills of the contractor OR SMC may reject the defective pump (in case of more than 10% less efficiency).
- (v) The penalty against the Non fulfilling the guaranteed “actual” Duty Point parameters shall be maximum 10 % of work done value (will be treated separately from other penalties)
- (vi) **If the pump head is not in defined range i.e. +10% and - 20 % of duty point, the contractor shall modify any part of Bowl assembly or complete replacement of Bowl assembly as per the required system head to get maximum efficiency without any extra cost to SMC.**
- (vii) Other condition(s) regarding delay penalty etc. will separately be dealt with.
- (viii) At the time of Pre-Dispatch inspections of Pumps at manufacturing works, in addition to representatives of SMC and TPI (If Any), the Government Authorized Energy Auditor shall be arranged by successful contractor to carryout Energy Audit of Pumps under test before dispatch. For this the Energy Auditor must use his own measuring instruments and the results shall be binding on the part of manufacturer. These results must match the designed parameters as detailed in the tender and finalized during drawing approval. Here, Energy Auditor must not be affiliated to manufacturing company.
- (ix) Also, once pumps are supplied, erected and commissioned, performance testing must be carried-out by the government authorized energy auditor deployed by contractor to evaluate the performance at site and ensure that pumps perform as per design criteria and confirms results of testing done in manufacturer’s test lab set-up.
- (x) Any deviation from original parameters of Head, Discharge and Efficiencies at various load etc. must be strictly attended /prevented and ensured that performance testing is also observed satisfactory results as called for in the tender. If after all possible efforts the removal of the deviation in parameters is not becoming practical, possible or attainable due to site condition or any other uncontrollable reason, the results of Energy Audit at the time of Inspection at manufacturing works may be termed as final. And decision of tender

signing authority in this regards shall stand final, however technical reason/proofs for the site /system constraints shall be furnished by contractor/Manufacturing Co. to consider the deviation in the matter.

The bidder/manufacture is requested to understand the gist that “right selection of guaranteed parameter” and system performance thereby energy saving. Hence, due care/attention right at tendering stage and during the actual implementation is expected.

GENERAL DATA SHEET FOR VERTICAL TURBINE PUMPS,

****	General Data	
1	Pump type	Vertical Turbine pump
2	Design Capacity of each pump	Min.-----M ³ /hr.
3	Total Bowl Head at design capacity	----- Mtr.
4	Number of pumps running in parallel	As per Design
5	Total duration of operation	Continuous
6	Liquid to be pumped	Treated and chlorinated drinking water.
7	Sp. gravity of liquid	1.0
8	Place of installation	At floor level of pump house
9	Type of pump required	Vertical Turbine, single stage.
10	Speed of the pump	Max. 1000 RPM
****	FEATURE OF CONSTRUCTION	
1	Type of lubrication	Self-water lubricated
2	Internal element	To be designed as per requirement
3	Type of coupling	Direct-pin bush type
4	Number of stage preferable	Single/ As per mfg. design
5	Installation	Vertical, directly coupled
6	Pump setting Length	As per manufacturer's design (Refer G.A. Drawing)
7	Column pipe	
**	Wall Thickness	Minimum 8 mm
**	Diameter	As Per Design
**	Qty per pump	As per Actual site requirement
**	Length of each column pipe	1.50 Mtr. (Max.)
**	Head Shaft	Must be less than 2.2 Mtr.
8	Column Assembly (Pump setting length)	SL=LC+OTH Pump setting length (SL)= Total Length of Column pipes (LC) plus Pump, bowl assembly, distance piece/spool piece/taper piece, strainer, etc. as per manufacturer's standard (OTH). Exact dimensions can be decided at the time of detailed engineering.
9	Type of impeller	Close
10	Spiders	Spider Must be detachable from the column pipe. (Fabricated spider in column pipe strictly not

		allowed.)
11	Type of drive	415 V +/- 10 %, 50 Hz +/- 5% AC, solid shaft, and squirrel cage motor as per data sheet.
****	Material of construction:	
1	Base Plate	M.S. IS 226 (M)
2	Discharge Elbow	C.I IS 210 FG 260 or MS fabricated with suitable corrocoat in the internal passage in Fluid glide coating
3	Column pipe	ERW
4	Suction bell	C.I 1.5 % to 2.0 Nickel (M) or as indicated by the manufacture
5	Impeller Bowl	C.I 1.5 % to 2.0 Nickel (M) or as indicated by the manufacturer
6	Impeller	CF 8 M
7	Impeller Seal Ring	S.S AISI 304
8	Line Shaft	S.S. 410
9	Impeller Shaft	S.S. 410
10	Head Shaft	S.S. 410
11	Shaft Coupling	S.S -410
12	Line Shaft Bearing	Neo Rubber LND BR-2 shell.
13	Suction Strainer with stiffeners	S.S AISI – 410 Round Bar Type only.
14	Shaft Sleeves	S.S AISI – 410 (M)
15	Stuffing Box	C.I IS 210 Gr FG 260
16	Gland	Bronze
17	Gland Packing	PTFE with synthetic fiber or any advanced material causing least maintenance and least energy consumption.
18	All Hardware	Stainless Steel.
19	Companion flanges	MS as per IS 1538 (Chapter No. 5 & 6)
****	ACCESSORIES & SERVICES REQUIRED:	
1	Base Plate (Sole Plate)	YES
2	Taper Pieces for leveling of pump	YES
3	Air valve with isolation valve	YES
4	Foundation Bolts (S.S.)	YES
5	Suction Strainer (S.S.)	YES
6	Companion Flanges	YES
7	Specific Maintenance Tools (if any)	YES
****	TESTING:	
1	Hydrostatic test	YES to be witnessed
2	Performance test	YES to be witnessed
3	Static balancing test	Test certificate required
4	Dynamic balancing test	Test certificate required

5	Visual inspection check	Required
---	-------------------------	----------

Note:

1. **No Advantage shall be given if efficiency is quoted more than ceiling efficiency and less than ceiling on losses**
2. **Change in MOC should not be allowed.**
3. **Expander/Reducer will not be allowed in suction Column/delivery line.**
4. **For Component (marked-M) material certificates should be furnished**

MOC generally employed is indicated. However, various manufacturers may offer better MOC of particular item as per their standard practice and if so, it must be clearly indicated in Necessary Documents.

Details of Pump set	Ceiling on bowl efficiency	Ceiling on motor efficiency	Ceiling on total sThrust bearing loss, line shaft loss etc.) losses.
----- Mtr ³ /Hr., ---- Mtr. Head	Max. 87 %	Max. 96 %	Min. 0.6 KW

Please note that characteristic curve of pumps and motors must invariably and efficiency indicated in curves by manufacturer will only be considered. Pump & motor rpm shall be same & overall efficiency will be considered according to motor rpm only.

- All the pump sets must be designed to run either alone or in parallel with one or more unit depending upon the required discharge.
- Rotating assembly should be dynamically balanced as per manufacture's standard.
- Characteristics curves from shut off head to full open (i.e. zero deliver head), NPSHr curve must be enclosed along with detail technical literature for each type of the pump sets. The operating head range of this pump set shall be same as mentioned above and tenderer has to submit the detail of safe operating head range of the pump set with cavitations zone on performance curve.
- The pump shall run smooth without undue noise and vibration at any point of operating condition.
- Direction of the rotation of all pump set shall be as per site requirement. It must be checked prior to quote the tender.
- Performance curve of pump Q v/s H, Q v/s NPSHr, Q v/s Power, Q v/s Speed, torque at variable speed of 50 % of rated speed to + 110 % of rated speed shall be submitted along with tender. The pump should have non-overloading type characteristics. Family curve of the pump sets should be submitted for Approval.
- Pump shall be suitable to variable speed application. Curve of speed v/s head, power consumption, and flow shall be provided.
- Type test of the pump set will be carried out at full load as well as low load condition of the pump sets.

DATA SHEET FOR V.T PUMPS TO BE FURNISHED BY THE BIDDER AFTER AWARD OF JOB:

☞ For: ----- Mtr.³/Hr., ----- Mtr. Head pump

No other calculation for deriving Overall efficiency will be considered.

No	Description	Details
***	GENERAL	
a)	V.T. Manufacturer's name/ maker's name	
b)	Type of pump	Vertical Turbine
c)	Length and size of column assembly flanged ended	
d)	No. of stage preferable	Single/As per mfg. design
e)	Actual speed of pump in RPM	
f)	Size of Suction column and delivery branch (mm)	As per mfg. design
g)	Shut off head	
h)	Max. Power input on performance curve (with full column length)	
i)	Maximum power requirement of pump at any point of characteristic curve.	
j)	H.P of motor recommended.	
k)	Bowl Head (Mtr) H	
l)	Bowl Discharge (m ³ /Hr) Q	
m)	Bowl Output (Po= HXQ/367.2) KW	
n)	Guaranteed Bowl Efficiency (Eb)% (at Motor RPM)	
o)	Bowl Input (Pi=HXQ/367.2*Eb)	
p)	Thrust bearing loss (TT) KW	
q)	Line shaft loss (TL) KW	
r)	Motor Output (Mo=Pi+TT+TL)	
s)	Guaranteed Motor Efficiency at duty point (Em)	
t)	Motor Input power at Terminal on duty point. (M i)	
u)	Overall Efficiency of pump derived from above (Eo=Po/Mi) % (at Motor RPM)	
	DIMENSIONS	
v)	Pump setting length.	
w)	Minimum clearance required from the lowest part of the pump to the bottom of the sump.	
x)	Minimum submergence required.	
y)	Centerline of pump discharge pipe above floor.	
z)	Minimum clearance required for removal of pump parts and motor (including height of sling of lifting tackle used).	

ITEM NO. 36 : E.O.T. CRANE WITH ELECTRICALLY OPERATED CHAIN HOIST

SCOPE :

This specification covers the design requirements, features of construction, inspection, testing, painting, delivery, installation and commissioning of E.O.T. crane with electrical chain pulley block with hardware etc.

CODES AND STANDARDS :

The design and manufacture of the crane shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall relieve the vendor of this responsibility.

GENERAL:

E.O.T. gantry crane with hoisting equipment shall be provided in the pump house of required capacity for installation, maintenance, repairing works of the pumping machinery, particularly for handling of pump & motors located in the pump house. The span, lift & other parameters of the crane shall be closely matching with the requirement and layout of the pump house. The crane will be required to operate in local climatic condition. All the parts of the crane, hoist and trolley shall be designed to withstand such atmospheric condition without any deterioration.

DESIGN REQUIREMENTS:

1. The crane shall be single or double girder medium duty class – II horizontal E.O.T. have a long travel motion. The crane shall complete with chain wheels, guards, base plate with fixing bolts, end stoppers, swiveling hooks, and cables for Electrical motor of the Crane.
2. The gantry shall be of single / double girder construction and traveling track (if required) of the crane shall be of 40 mm MS sq. bar supported on MS base plate of 8 mm. thick at an interval of 500 mm OR on the RCC bracket provided in the pump house, as applicable.
3. Traveling trolley will run on the lower flange of gantry /span girder and electrically operated chain pulley block shall be suspended on the trolley,
4. The chain pulley block shall be electrically operated, triple spur gear type with an automatic load brake switch to prevent self lowering of load.
5. The complete crane shall be scraped, cleaned and painted with one coat of red oxide primer and two coat of the epoxy paint as directed by Engineer-In-Charge.
6. Joint for gantry girder shall be on bracket only.
7. No Joint shall be allowed in Bridge Girder.
8. The crane shall be tested at site after erection in the presence of the Surat Smart City Development Limited's representative. Test certificate should be supplied along with the invoices without which no payment for the crane will be made. Tested quality Steel should be used for the crane and test certificates thereof should be provided.
9. Chain electric hoist with hand operated geared trolley should be simple, robust, reliable and capable to give trouble free service for long time. Electric hoist should have capacity of as mentioned with load chain as per site requirement. The lifting speed of the chain hoist shall be as per data sheet.
10. Provision should be made to hold an extra manually operated chain pulley block, whenever required.
11. EOT crane linked End Carriage assembly, Cable carrying system, Shaft, bearing pedestal – hand chain assembly etc. included in this item.
12. **Gantry /span girder trolley are not included in this item. Price of MS Steel like Gantry/span girder, Square bar should not consider in this item as same is included in separate item.**

13. Crane is required to lift the non clog submersible pump set from the bottom of the wet well. It should lift rated weight from the well bottom (as mentioned in data sheet) in single stroke to the upper lift of the crane without changing the load chain. Length of the load chain shall be calculated accordingly. Whatever necessary, required additional length of chain shall provided as per site requirement.
14. The girders shall be leveled and aligned before grouting. If required, necessary packing shall be inserted / welded.
15. The availed head room and clearances are as per site requirement.

CONSTRUCTIONAL FEATURES:

Electric hoist should be incorporated as following.

Load Chain:

Load chain wheel should have correct grip of the hoisting chain without undue wear. Shafts and axles shall have ample strength and rigidity and adequate bearing surfaces for their duties. Axle and shaft shall be made of carbon steel and accurately machined and properly supported.

All anti-friction bearings are to be of SKF/FAG make only. Bearings shall have a minimum life expectancy of 8000 hours and may be ball, roller, or removable bronze- bushing type except that motor bearings shall be of the ball or roller type.

Wheels:

The long travel bridge wheels shall be rim toughened, heat treated carbon or alloy steel. They shall be double flanged. The wheels shall have anti friction bearings. The wheels shall be machined on their treads to match the runway rail section.

Gears

Spur and helical gears (case hardened) should with stand impact loads and high resistance to wear, provided with construct lubrication.

Alloy steel Spur and helical gears should be totally enclosed and running in oil bath along with bearing for constant lubrication.

Electric Motor:

Hoist electric motor should be squirrel cage induction motor with high starting torque, with insulation class- H, TEFC fan cooled, continuously rated for 415 + 10% volts, 3 Phase, 50 + 5% Hz. Motor size and H.P. shall be established by contractor. It should be suitable for frequent reverse ring and breaking / with overload protection. Hoist motor should not be loaded beyond 80% of its capacity. Motor should be capable for variable frequency speed drive operation and should not get heated during continuous operation.

Breaks:

Brake should be disk type spring loaded, fan cooled, for heavy duty operations and should automatically act when electric supply fails. Breaks should be easily accessible.

Hooks:

Swiveling hook should be of heavy duty steel forged.

Limit Switches:

To prevent over lowering and over hoisting limit switches are provided as a safety device.

Electric Control Panel:

It should be as per manufacturer's standard having overload and short circuit protection for speed control etc. It shall be suitable to move & control Hoist in all positions. MCB will be provided for protection.

Pendent Push Button:

The speed variation should be achieved through pendent push button station. Heavy duty Pendent push button should preferably suitable for operation at 24 Volts. Wire rope should be provided to prevent pull on cable and it should be suspended from the hoist with the cable length as per the site requirement.

CLEANING :

Prior to factory inspection, all manufacturing waste such as metal chips, debris and all other foreign material shall be removed from the interior of the crane. All mill scale, rust, oil, grease, chalk and all other material shall be removed from the interior and exterior surfaces.

PAINTING :

Crane shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint. The resulting coating shall be uniform and smooth and adhere perfectly to the surface.

HAND WHEEL:

A hand wheel shall be provided for normal operation.

DRAWINGS:

The following documents are to be furnished by the contractor after award of the work: -

- i) G.A. Drawing of crane with all details from the manufacturer.
- ii) Note on erection and testing by the manufacturer.
- iii) Test certificate for hook, chain and chain pulley block assembly including overload test report of the crane as per standard proforma etc. (to be furnished prior to supply of the crane).

TESTS AND INSPECTION:

Overload test with 150% of rated load shall be carried out for the chain pulley block and trolley and overload test with 125% of rated load shall be carried out for the entire crane assembly.

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

23. SPECIFICATION OF ELECTRICAL WORKS – ELECTRICAL DESIGN CRITERIA

PART - 1

1.0 GENERAL

1.1 Provisions

1.1.1 Other applicable sections including the General and part of electrical requirements as if repeated in this Section.

1.2 Work included

1.2.1 The Contractor shall provide all the required labour, project equipment and materials, tools, construction equipment, safety equipment, transportation, test equipment and satisfactorily complete all the electrical work included in these Specifications. Provide and install wiring for equipment that will be furnished and installed by other Sections of these Specifications.

1.2.2 All works shall be executed strictly in accordance with the latest National Electrical Code.

1.3 Regulations

1.3.1 All the electrical equipments and materials including their installation shall conform to the following applicable latest codes and standards.

- i Indian Electricity Rules 1956.
- ii The Indian Electricity Act 1910.
- iii Fire Insurance Regulations.
- iv Regulations laid down by the Electrical Inspector of the Government of Gujarat,
- v Regulations laid down by Factory Inspector of Gujarat.
- vi Indian Standards Institution's Specifications.
- vii Factory Act.
- viii Any other Rules & regulations and Condition of Supply laid down by the Local Electric Supply Company viz. Dakshin Gujarat Vij Company Limited (DGVCL) or Torrent Power-Surat Electricity Co. (TPSECo.)

1.4 Variances

1.4.1 In instances where two codes are at variance, the more restrictive requirements shall apply.

1.5 Contractor's Expense

1.5.1 The contractors shall obtain and pay for the required bonds, insurance, licenses, permits and inspections, and pay all taxes, fees and utility charges that shall be required for the electrical construction work. The contractor shall obtain at his own expenses the necessary certificate for the approval of the total work carried out from the Electrical Inspector. S.M.C. will pay all the legal fees for obtaining the power from DGVCL / T.P.S.E.Co. No any penalty shall be paid by SMC.

1.6 Extra work

1.6.1 Work that is not included in the tender documents shall not be performed, except when

approved in writing by S.M.C.

1.7 Rates for additions or extras

1.7.1 Any additional item of work over and above those schedules in the tender are to be carried out at the same basic rates as quoted in the tender for the same type of work.

1.8 Contractor responsible for supply of Equipment and Materials

1.8.1 If during the period of erection, the contractor or his workmen damage or destroy any part of the building structure or materials, the Contractor shall be completely responsible for the damages and he will have to make rectification / replacement at his own cost. The decision of the Engineer-in-charge will be final.

1.8.2 Final options to select any particular make shall rest with S.M.C. No disputes in this regards shall be entertained at later date.

1.9 Project Drawings

1.9.1 Locations of equipment, inserts, anchors, motors, panels, pull boxes, manholes, conduits, stub-ups, fittings, lighting fixtures, power and convenience outlets, exterior lighting units and ground wells are approximate, and the Contractor shall be responsible for field verification of scaled dimensions on Drawings. No extra charges will be allowed for field adjustments, wiring changes, conduit rerouting, or additions needed to complete the installation and produce satisfactory operation of all equipment.

1.9.2 The contractor shall review the Drawings and Specifications of other trades and shall include the electrical work that shall be required for the installations.

1.9.3 If there shall be a need to deviate from the Electrical Drawings and Specifications, the Contractor shall submit written details and reasons for all changes to S.M.C. / Consultants for approval.

1.9.4 In the event of varying interpretation of the tender Documents, the Engineer-in-Charge's interpretation shall govern.

1.10 Shop Drawings

1.10.1 After the award of the contract, the contractor shall submit, for the Engineer-in-charge's approval, the required manufacturer's Shop Drawings including complete schematic wiring diagrams for the electrical equipment as indicated in this Section and on the Drawings, a complete descriptive materials list that includes all other products intended or required for the installation, detailed installation drawings for all materials and equipment.

1.10.2 The contractor shall check the Shop Drawings for equipment requirements, dimensions, weight, and conduit locations. On the drawings, mark any corrections, if required, for approval before submitting to the Engineer-in-charge.

1.10.3 Submit Shop Drawings and materials lists for approval in 3 copies. It shall be understood that this requirement specifically requires the submission of Shop Drawings for conduit location which shall indicate any interferences with other work, should the contract Drawings make such interference unavoidable.

1.11 Record Drawings

- 1.11.1 The contractor shall maintain a complete and accurate record set of drawings for the electrical construction work.
- 1.11.2 Records all work that is installed differently than shown on the Drawings.
- 1.11.3 Upon completion of the work, transfer all marked changes to a clean set of drawings with red ink.

Mark the drawings "Record" and submit them to the Engineer-in-charge when the electrical work is completed in 7 sets.

1.12 Coordination

- 1.12.1 The contractor shall coordinate the electrical work with the other trades, other contractors, code authorities, utilities DGVCL / Torrent Power-Surat Electricity Co. and the Engineer-in-charge.
- 1.12.2 Where connections shall be made to existing installation, the Contractor shall properly schedule all the required work, including the power shutdown periods.
- 1.12.3 When two trades join together in an area, the Contractor shall be certain that no electrical work is omitted.

1.13 Public Utility

- 1.13.1 The contractor shall provide the electrical work for power and telephones as indicated in the tender documents, and according to the service requirements.

1.14 Site Investigations

- 1.14.1 The Contractor shall visit the project site prior to submitting his bid, carefully inspect all areas, and become acquainted with the existing conditions.

1.15 Contract Bid

- 1.15.1 The contractor shall evaluate all job condition that affect the construction work for the project.
- 1.15.2 The best bid shall include the total cost for all the electrical work required by the tender documents, site investigations and all other contract expenses.

1.16 Service Manuals

- 1.16.1 Service manuals shall be furnished with the equipment. One (1) shall be given with the equipment, and a minimum of seven (7) copies given to the Engineer separately.

Additional copies shall be provided where so stated in the purchases order. Service manuals shall contain all necessary data for operation and maintenance of the equipment. A recommended spare parts list shall be furnished with the manual. A complete set of shop drawings shall be folded and inserted in each manual.

PART -2

2.0 EQUIPMENT & MATERIALS

- 2.1 Contractor shall provide the equipments and materials that are required to complete all the electrical work outlined in this Section.
- 2.2 Incidental items, not included in the tender drawings and Specifications, that can legitimately and reasonably be inferred to belong to the electrical work shall be provided by the Contractor at no additional cost to the S.M.C. The decision of the Engineer-in-charge in this matter shall be final.
- 2.3 All equipments and materials shall be new, of latest design and standard products of established manufacturers. For uniformity, only one manufacturer shall be accepted for each type of product.
- 2.4 Contractor shall provide adequate and protective storage for all equipments and materials during the construction work. The contractor is responsible for its safe custody for his materials at site.
- 2.5 All equipments shall be procured from reputed manufacturers and shall bear ISI Certification mark wherever applicable. The equipment shall conform to the latest I.S. Standard Specification. A list of the Preferable Manufacturers is attached along with the Tender.
- 2.6 The following site tests are to be conducted (over and above the equipment to be tested at manufacturer's work) on equipment complete job in presence of Surat Smart City Development Limited's representative prior to commissioning.
 - A. LT Switch Board:

All site tests as per Indian Standards and high voltage test of busbars after erection and as per detail specification including site test for relay etc.
 - B. Earth Resistant test.
- 2.7 The materials supplied and installed shall be genuine only and as per the specifications. If the same are not found satisfactory the same shall have to be replaced "Free of Cost". Manufacturer's certificate towards genuineness of material shall have to be supplied (if required by the department) otherwise the material shall be rejected. In case of doubt/dispute the Surat Smart City Development Limited shall ask the contractor to send the material/equipment to the manufacturer's work for testing genuineness. The decision/report received from the manufacturer shall be conclusive and binding on both the parties i.e. the Surat Smart City Development Limited and the contractor. If the material / equipment sent for testing is not found to be genuine then the whole expenses for testing shall be borne by the contractor and the contractor shall replace the whole lot of materials/ equipments supplied by him free of cost.
- 2.8 The entire installation shall be got approved by the Government Electrical Inspector prior to commissioning. All formalities including preparation and submission of all drawings, getting approval, arranging visits of Electrical Inspector and obtaining permission to energize the installation, etc. shall be done by the Contractor for which no extra payment shall be claimed by the contractor.
- 2.9 The responsible authorised person of the contractor should be available at site daily when work is in progress. The Surat Smart City Development Limited shall not be responsible for any accident or damage done to the workman/staff of the contractor. No compensation of any kind shall be paid by the Surat Smart City Development Limited. The contractor shall observe Govt. Rules regarding labour, etc.

2.10 L.T. switch gear shall be painted with final coat of paint using spray machine at site before commissioning without any extra cost, if required.

2.11 All the equipments shall be tested for tests as per latest relevant IS in presence of Surat Smart City Development Limited's representative prior to dispatch and certificate thereof shall be supplied.

If required by the Surat Smart City Development Limited, the equipment shall be sent to recognized test lab for ascertaining the guaranteed parameters. The Contractor should agree to the same. The test results so obtained shall be binding to the Surat Smart City Development Limited and to the Contractor.

2.12 All motors should be with duty S1, Totally Enclosed Fan Cooled type only. Unless otherwise specified, motors shall be provided with class 'F' insulation as a minimum. In case of motors with class 'F' insulation the permissible temperature rise above the specified ambient temperature shall be limited to class 'B'.

However, for motors operating with Variable Frequency Drive, winding shall be vacuum impregnated and Class H insulation only and with forced cooling arrangement.

2.13 Efficiency of equipment and energy saving is one of the important aspect of consideration of tender. Hence, SMC hereby reserves its right to decide final selection of make upon the energy saving aspect. In this regard the decision of SSCDL will be final and no dispute of the contractors will be entertained at a later date for the same.

2.14 The successful bidder shall have to submit CPRI test certificate for minimum 2000 Amp. busbar with 50 KA short circuit capacity for 1 sec. from the L.T. panel vendor selected by him. Otherwise L.T. panel shall not be accepted.

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

Signature & Seal of Contractor

24. SPECIFICATION OF ELECTRICAL EQUIPMENTS

DETAIL SPECIFICATION OF ELECTRICAL ITEMS FOR DINDOLI SPS:

SR NO	DESCRIPTION	RATING/ CAPACITY
1	General Overhauling, Servicing and change of CT with all required Accessories of Existing HT Panel from 66 MLD STP shall be for Dindoli SPS	11 KV
2a	TRANSFORMER 'Supply, erection, testing & commissioning of plinth mounted ONAN outdoor type step-down transformer as per tender Specifications, Data sheet, IS 1180 and relevant and as per given description etc.	11 KV / 0.433 KV, 500 KVA
2b	Fixed Capacitor For 630 KVA Transformers	As per Req.
3	H.T. CABLE & TERMINATION	
3a	Supply, erection, testing & commissioning of 11 KV, XLPE armoured cable	As per Req.
3b	Supply, erection, testing & commissioning of the Heat shrinkable type outdoor H.T. cable end terminations suitable for 11 KV, XLPE armoured cable.	As per Req.
4	MOTOR CONTROL CENTRE	
4a	Supply, erection, testing & commissioning of MCC panel as per tender Specifications, Data sheet, IS and as per given description etc.	
4b	Supply, erection, testing & commissioning of 100 KW Star delta Starter with 70 kVAR Fixed Capacitor as per IS, specifications and technical specification & data sheet	100 KW
4c	Supply, erection, testing & commissioning of 100 kVAR APFC Panel as per IS, specifications and technical specification & data sheet	100 KVAR
5	L.T. CABLES	
	Supply, laying, connection, testing and commissioning of heavy duty, 1.1 KV, PVC insulated, inner & outer PVC sheathed, stranded AL / Cu. conductor cables as per Specification and IS 7098 Part I. The cable shall be laid underground in excavated trench when laid outside the building in the method as specified and shall be laid in prepared trench or cable tray when laid inside the building.	
5.1	XLPE AL conductor armoured-Transformer to SPS PMCC Panel	As per Req.
5.2	XLPE AL conductor armoured-for LT Panel to APFC Panel	As per Req.

5.3	XLPE AL conductor armordered-for LT Panel to Pump	As per Req.
5.4	XLPE AL conductor armoured-for industrial socket, External LDB, Instrument panel	As per Req.
6	CABLE TERMINATION	
	Supply of connection, testing and commissioning of double compression brass/steel cable glands and crimping type bimatic lugs / sockets with necessary tools and equipments as specified in specifications and IS.	
6.1	XLPE AL conductor armordered-NEW STP PLANT PCC to SPS PMCC Panel	As per Req.
6.2	XLPE AL conductor armordered-for LT Panel to APFC Panel	As per Req.
6.3	XLPE AL conductor armordered-for LT Panel to Pump	As per Req.
6.4	XLPE AL conductor armoured-for industrial socket, External LDB, Instrument panel	As per Req.
7	MAINS WIRING	
	Mains with 1.1 KV grade FRLS PVC insulated ISI marked stranded Copper conductor wire in following type of pipe to be erected concealed in /flushed on wall/ceiling, with 1.5 sq. mm copper conductor FRLS PVC insulated stranded wire of green colour for earth continuity of following size	
	Mains with 1.1 KV grade FRLS PVC insulated ISI marked stranded Copper conductor wire in following type of pipe to be erected in / on wall / ceiling with 2.5 sq. mm copper conductor FRLS PVC insulated stranded wire of green colour for earth continuity of following size	
8	POINT WIRING	
8.1	Point wiring for Light / Bell with 2-1.5 sq.mm & earthwire of 1.5 sq.mm (Green) both are of ISI marked 1.1 KV grade FRLS PVC insulated multistrand copper wires, in following type of pipe to be erected concealed in/ on surface on wall/ceiling complete with 6A Modular type switch / bell push & accessories and earth continuity of following type, erected on PVC / Metallic box, single mounting base frame covered with textured/metallic front plate modules erected on / in wall / ceiling as per pipe erected, with necessary Lamp holder/ceiling rose / H.D.Connector as directed.	

8.2	Point wiring for Individual Plug with & earthwire of 1.5 sq.mm (Green) both are of ISI marked 1.1 KV grade FRLS PVC insulated multistrand copper wires, in following type of to be erected concealed in / on surface of wall / ceiling complete with Modular type switch & 5 pin Plug erected on PVC / Metallic box covered with appropriate front plate modules erected on / in wall / ceiling as per pipe erected with following type of accessories.	
8.3	Point wiring for Looped Plug with 6A Modular type switch & 5 pin socket erected on PVC / Metallic box, single mounting base frame covered with textured / metallic front plate modules erected on / in wall / ceiling with following type accessories	
8.4	Point wiring for secondary light point with 2-1.5 sq.mm & earthwire of 1.5 sq.mm (green) both are of ISI marked 1.1 KV grade FRLS PVC insulated multistrand copper wires, in following type of pipe to be erected concealed in / flushed on wall/ceiling, complete with earth continuity and necessary connection with primary light with accessories erected on Metal / PVC box covered with 3 mm thick PC(Polycarbonet) / Acrylic sheet for open / concealed wiring. with necessary Lamp holder / ceiling rose / H.D.Connector as directed.	
8.5	Point wiring for Two Way Controlled Light Point with 2-1.5 sq.mm & earthwire of 1.5 sq.mm (green) both are of .ISI marked 1.1 KV grade FRLS PVC insulated multistrand copper wires, in following type of pipe to be erected concealed in / flushed on wall/ceiling ,complete with 6A Modular type switches and following type of accessories erected on PVC / Metallic box, single mounting base frame covered with textured / metallic front plate modules erected on / in wall / ceiling as per pipe erected. with necessary batten/angle holder or ceiling rose or H.D.Connector as directed.	
8.6	One industrial metal clad switched socket outlet point controlled with MCB with powder coated enclosure & related accessories to complete the work.	As per Req.
8.7	UPVC or better material made switch boards with required switches	---
9	LIGHT & FAN FIXTURES	
	Supply, installation, connection, testing & commissioning of light fixture complete with ballast, starters, lamps and other necessary accessories and mounting down rod / bracket, steel wire, hook.	

9.1	Supplying and erecting LED Type indoor Tube Light Fitting	1 x 22 W
9.2	Supply, installation ,testing & Commissioning of Ceiling Fan	1200 mm Dia
9.3	Supplying and erecting approved make Cabin fan of 230V. A.C. 50 Cy/s. oscillating type complete erected with lead wires as directed.	400 mm. sweep
9.4	Supplying and erecting approved make Pedestal Air-Circulator fan A.C. 230 V. 50 Cy/s. and adjustable height complete with guard, & standard lead flexible wires and plug top.	600 mm sweep
9.5	SETC of 45 W LED street light fittings	45 W LED
9.6	SETC of 60 W LED Heavy duty flood light	60 W LED
10	LIGHTING DISTRIBUTION BOARD	
10.1	Supply,Installation,Testing and Commissioning of 4 Way (Row) TPN Lighting Distribution Board	4 Way TPN
10.1.1	Incomer: 64 A TP MCB (C Curve)	
10.1.2	Outgoing: 16 A TP MCB (C Curve)	
10.2	Supply,Installation,Testing and Commissioning of 12 Way (Row) SPN Lighting Distribution Board.	10Way SPN
10.2.1	Incomer: 32 A TP MCB (C Curve)	
10.2.2	Outgoing: 10 A SP MCB (C Curve)	
10.3	Supply,Installation,Testing and Commissioning of 12 Way (Row) SPN Lighting Distribution Board With ELCB	4 Way TPN
10.3.1	Incomer: 64 A TP MCB (C Curve)	
10.3.2	ELCB : 30 mA	
10.3.3	Outgoing: 16 A SP MCB (C Curve)	
11	G.I. POLES AND ACCESSORIES	
	Providing and fixing approved make Octagonal poles. Made from CR sheet steel. The pole should be made as per IS. and shall be coated with hot dip galvanizing as per IS 2629/4759. with required base plate suitable suspend local wind speed to be erected on existing foundation.	
11.1	6 Mtr. Long 70 mm Top X 135 mm bottom dia, 3 mm thickness	

11.2	SETC of cement concrete foundation or for concrete filling in 1:3:6 ratio with 20 to 25 mm stone metal duly plastered with necessary curing for pole muffing or any other purpose and with necessary J Bolts. Size:500x500 & 1200 mm deep	
11.3	Spike Type earthing for poles with 1 meter long G.I. wire of 3 mm thickness	
11.4	Supply,Installation,Testing and Commissioning of Street Light pole Single Arm Bucket Size : 2 Mtr	2 Mtr. Long
11.5	Supply,Installation,Testing and Commissioning of coil type counter poise earthing station for external lighting pole and junction box.	2.5 mtr long 8 SWG, Cu wire
11.6	Providing & erecting approved make street light / wall mounting junction box compression moulded from DMC (thermoset plastic) vertical sliding cover having locking with square head stud loop in / loop out in built terminal suitable for four core cable, waterproof of I.P. 54 protected with clamp or bolt nut & earth bolt of following size.	
11.7	Providing & laying approved make 50 mm dia Double walled corrugated pipes (DWC) of polyethylene(conforming to IS 14930 II)with necessary connecting accessories of same material at required depth for laying of cable. below ground / road surface for enclosing cable and back filling the same to make ground as per original.	As per Requirement
12	EARTHING	
12.1	Pipe in Pipe Earthing For Electrical Installation up to 440V in normal soil Length of pipe - 1 Mtr Back filling compound - 1 Nos Bag of 15 Kg	
12.2	A) Supplying & erecting Pipe in pipe earthing for Transformer and various Equipments of Sewage Pumping Station (For Transformer Neutral only Copper Earthing Shall be Used)	
12.3	Supply & labour charges for interconnecting the earthing stations and various equipments in built up trenches, walls/ceiling, buried in ground.	
12.3.1	Cu Strip	
12.3.2	GI strip	50 x 6 mm.
12.3.3	GI strip (motors)	25 x 3 mm.
12.3.4	G.I. wire	12 SWG
13	CABLE TRAY	
	Supply, Installation, laying and connection of G.I. Perforated type cable tray fabricated from required sheet thk to sustain the weight of cable with bands, tees and clamps for fixing and with cover and all the hardwares & accessories as required.	
13.1	450 mm. wide.	450 x 35 x 2 mm

13.2	300 mm. wide.	300 x 35 x 2 mm
13.3	150 mm. wide.	150 x 35 x 2 mm
13.4	50 mm. wide.	50 x 35 x 2 mm
14	FABRICATION WORK	
14.1	Supply of necessary materials and M.S. fabrication work (For ISMB, Squarebar, flats,Chequered plates,For C channels, angles etc for ladder , grills etc.) with oil paint as per details specification.	---
15	SAFETY ACCESSORIES	
	Supply, fixing, testing and commissioning of following substation accessories complete with fixing brackets etc. which shall be supplied by the tenderers with all necessary accessories, tools etc.	
15.1	Supply, fixing of portable fire extinguisher with necessary clamps, supports and trolley.	4.5 Kg. Co2 type
15.2	Supply of ISI marked hand gloves pair suitable to LT.	1.1 KV
15.3	Supply & laying of Rubber insulating mat ISI marked.	25 mm. thick 1000 mm. wide
15.4	Supply & laying of Warning signs	11 KV & 415 V.
15.5	Supply & fixing of First Aid box	---
15.6	Supply & laying of First Aid Chart laminated on wooden frame (1 SET has 2 nos. 1 in Gujarati and 1 in English)	---
15.7	Supply and fixing of fire buckets with floor / wall mounting stand and first filling of sand in SPS.	---
15.8	Supply and fixing of self contained emergency light with dry type maintenance free battery.	10 W LED
16	LIASONING CHARGES	
	Liaison fees for preparing necessary documents and drawings for getting N.O.C from supply co and Electrical Inspector for charging the installation.(All statutory fees will be paid by SMC).	----
17	FURNITURE	
17.1	Cup Board	----
17.2	Table	----
17.3	Heavy Duty Office Chair	----
17.4	Safety Helmet	----
17.5	Safety Belt	----
17.6	Safety Shoes Pair	----

18	AUTOMATION WORK FOR DINDOLI SPS	----
19	CCTV CAMERA	----

Note:-

Above details is for guidance purpose only and tenderer must make site visit and obtain details of all units/machineries/plant equipments & accessories before giving his offer. Existing all units/machineries/plant equipments & accessories are covered under the scope of work. No dispute of any kind regarding quantity/capacity of equipment/unit at later date shall be entertained.

DETAIL SPECIFICATION OF ELECTRICAL ITEMS FOR DINDOLI STP:

Sr. No.	Item Description	
1.	SUPPLY OF NEW HT Panel (1 I/C + 2 O/G)	As per Req.
2.	HT CABLES, From Existing HT Panel to New HT Panel Room	As per Req.
3.	TRANSFORMER -3500 KVA approx	As per Req.
4.	MAIN PCC PANEL FOR NEW INSTALLATION	1 No.
5.	250 KVAR FIXED CAPACITOR FOR X'MER	1 No.
6.	MCC PANEL FOR INLET AREA	1 No.
7.	APFC PANEL FOR INLET)	1 No.
8.	MCC PANEL FOR AIR BLOWER ROOM	1 No.
9.	APFC PANEL FOR BLOWER ROOM	1 No.
10.	MCC PANEL FOR SBR ROOM	1 No.
11.	APFC PANEL FOR SBR ROOM	1 No.
12.	MCC PANEL FOR CHLORINATION ROOM	1 No.
13.	APFC PANEL FOR CHLORINATION ROOM	1 No.
14.	MCC PANEL FOR CENTRIFUGE HOUSE	1 No.
15.	APFC PANEL FOR CENTRIFUGE ROOM	1 No.
16.	5000 A or As per Requirement , EC Grade, Tinned Copper bus duct - For 2 Transformers	As per Req.
17.	PCC - Air Blower Panel, AL. XLPE Armoured Cable	As per Req.
18.	PCC - Inlet Room, AL. XLPE Armoured Cable	As per Req.
19.	PCC - Centrifuge House AL. XLPE Armoured Cable	As per Req.
20.	PCC - SBR PANEL ROOM AL. XLPE Armoured Cable	As per Req.
21.	PCC - Chlorination Room AL. XLPE Armoured Cable	As per Req.
22.	PCC - GAS ENGINE AL. XLPE Armoured Cable	As per Req.
23.	PCC - Existing STP Blower Room AL. XLPE Armoured Cable	As per Req.
24.	4C X 2.5 sq.mm Copper	As per Req.
25.	4C X 4 sq.mm Copper	As per Req.
26.	HT Terminations - 11 KV	As per Req.
27.	LT Terminations (DC Gland, Lugs, etc)	As per Req.
28.	Aluminum Die Cast Push button stations	As per Req.
29.	Transformer Neutral Earthing - Copper	As per Req.
30.	Copper strip for neutral earthing	As per Req.
31.	GI Strip for equipment earthing	As per Req.
32.	Indoor Lighting -36 W LED with Reflector & Elec. Choke	As per Req.
33.	Exhaust Fan	As per Req.

34.	High Eff. Ceiling Fan	As per Req.
35.	Junction Boxes - Polycarbonate IP 66	As per Req.
36.	Lighting Distribution Boards - Double Door TPN type	As per Req.
37.	Point wiring including wires, plug points	As per Req.
38.	Conduit for Lighting	As per Req.
39.	Outdoor lighting including all accessories (45 W LED)	As per Req.
40.	Flood Lighting (120 W LED)	As per Req.
41.	36 W LED For Street Light Fixture	As per Req.
42.	6 Mtr Long Street Light Pole	As per Req.
43.	7 Mtr Long Flood Light Pole	As per Req.
44.	Street Light Single Arm Bracket - 2 Mtr.	As per Req.
45.	Street Light Double Arm Bracket - 2 Mtr.	As per Req.
46.	Street Light Triple Arm Bracket - 2 Mtr.	As per Req.
47.	PCC - Street Light Pole Power Cable	As per Req.
48.	SITC of of CCTV camera system in entire plant with capacity of 1 TB storage	Lot
49.	Exisitng DG Set Panel - New STP PCC Room , as per Load Requirement AL. XLPE Armoured Cable	Lot
50.	Exisitng DG Set Panel - Dindoli PMCC Room , as per Load Requirement AL. XLPE Armoured Cable	Lot
51.	Exisitng DG Set Panel - New 40 MLD TSTP PCC Room , as per Load Requirement AL. XLPE Armoured Cable	Lot
52.	Split Air Condition (2 tonne) capacity for Office , Scada Room , Laboratory etc.	Lot
53.	MS Fabrication work for Cable Tray , Panel Base frame etc.	Lot
54	PLC & SCADA SYSTEM FOR SBR PROCESS	Lot
	Pressure Gauge	
	Dissolved Oxygen Meter	
	Level Transmitter	
	VFD for Air Blower	
	Level Sensor For Decantaer System	
	Position Sensor for decanter	

Note:-

Above details is for guidance purpose only and tenderer must make site visit and obtain details of all units/machineries/plant equipments & accessories before giving his offer. Existing all units/machineries/plant equipments & accessories are covered under the scope of work. No dispute of any kind regarding quantity/capacity of equipment/unit at later date shall be entertained.

DETAIL SPECIFICATION OF ELECTRICAL ITEMS FOR UPGRADATION OF EXISTING 66 MLD DINDOLI STP:

Sr. No.	Item Description	Unit
1	SUPPLY OF NEW HT Panel (1 I/C + 5 O/G)(2 - Existing STP,1 - New STP , 1- 40 MLD TSTP , 1 – Dindoli SPS)	1
2	MCC Panel for New Blower Room (Supply From New STP PCC Panel)	1
3	MCC PANEL For Pump Room	1
4	APFC panel for New Blower room	As per Req.
5	AL. XLPE Armoured Cable for New PCC - Existing STP Blower Room	As per Req.
6	AL. XLPE Armoured Cable for MCC - Blower	As per Req.
7	Modification of Existing Bio Gas Panel including Power Cable up to each PCC/PMCC panel (Addition of New Feeder For New Stp + Dindoli SPS + New TTP etc. with Individual MFM on Each Feeder)	As per Req.

Note:-

The Tenderer must make site visit and obtain details of all units/machineries/plant equipments & accessories before giving his offer. Existing all units/machineries/plant equipments & accessories are covered under the scope of work. No dispute of any kind regarding quantity/capacity of equipment/unit at later date shall be entertained.

DETAIL SPECIFICATION OF ELECTRICAL ITEMS FOR 40 MLD TTP:

SR. NO.	ITEMS	QTY.
1	HT Panel (1 I/C + 2 O/G)	1 No.
2	Transformer - 4000 KVA approx	2 Nos.
3	Fixed Capacitor for 4000 KVA Transformer	LOT
4	Main PCC Panel for new installation	1 No.
5	MCC - 1 Panel For RO System	1 No.
6	APFC panel for MCC - 1	1 No.
7	MCC - 2 Panel UF System	1 No.
8	APFC panel for MCC - 2	1 No.
9	MCC - 3 Panel Backwash , Dosing Pump , Transfer Pump	1 No.
10	APFC panel for MCC - 3	1 No.
11	MCC - 4 Panel RO Feed Pump	1 No.
12	APFC panel for MCC - 4	1 No.
13	MCC - 5 Panel RO Feed Pump	1 No.
14	APFC panel for MCC - 5	1 No.
15	6300 A or As per requirement, EC Grade, Tinned Copper bus duct - For 2 Transformers	As per req.
16	HT Cable - Existing STP to New TTP XLPE 11 KV	As per req.
17	PCC - MCC 1 AL XLPE Armoured Cable	As per req.
18	PCC - MCC 2 AL XLPE Armoured Cable	As per req.
19	PCC - MCC 3 AL XLPE Armoured Cable	As per req.
20	PCC - MCC 4 AL XLPE Armoured Cable	As per req.
21	PCC - MCC 5 AL XLPE Armoured Cable	As per req.
22	MCC 1 to APFC AL XLPE Armoured Cable	As per req.
23	MCC 2 to APFC AL XLPE Armoured Cable	As per req.
24	MCC 3 to APFC AL XLPE Armoured Cable	As per req.
25	MCC 4 to APFC AL XLPE Armoured Cable	As per req.
26	MCC 5 to APFC AL XLPE Armoured Cable	As per req.
32	Control Cables 4C X 2.5 sq.mm Copper	As per req.
33	Control Cables 4C X 4 sq.mm Copper	As per req.
34	HT Terminations - 11 KV	As per req.
35	LT Terminations (DC Gland, Lugs, etc)	As per req.
36	Aluminum Die Cast Push button stations	As per req.
37	Transformer Neutral Earthing - Copper	As per req.
38	Equipment Earthing	As per req.
39	Copper strip for neutral earthing	As per req.

40	GI Strip for equipment earthing	As per req.
41	Indoor Lighting -Panel Light 36 W	As per req.
42	Indoor Lighting - 90 W LED Fitting for shed	As per req.
43	Exhaust Fan	As per req.
44	High Eff. Ceiling Fan	As per req.
45	Junction Boxes - Polycarbonate IP 66	As per req.
46	Lighting Distribution Boards - Double Door TPN type	As per req.
47	Point wiring including wires, plug points	As per req.
48	Conduit for Lighting	As per req.
49	Outdoor lighting including all accessories (45 W LED)	As per req.
50	Flood Lighting (120 W LED)	As per req.
51	Split Air condition unit of 2 Tonn Capacity for Laboratory , Admin Building and Scada Room Etc.	As per req.

Note:-

The Tenderer must make site visit and obtain details of all units/machineries/plant equipments & accessories before giving his offer. Existing all units/machineries/plant equipments & accessories are covered under the scope of work. No dispute of any kind regarding quantity/capacity of equipment/unit at later date shall be entertained.

The general requirements include design, manufacture, testing at works, supply and delivery at site, unloading and storing the equipment at site of installation, erection, testing and commissioning of the equipment at site, etc. as required for complete electrical system for smooth operation of treatment plant as per the scope under this tender.

ITEM NO.: 1: EXPANSION OF EXISTING H.T. SWITCHGEAR AS WELL AS SUPPLY OF NEW H.T. SWITCHGEAR

(A) SUPPLY OF NEW H.T. VCB SWITCHGEAR PANEL FOR

- (i) 101 MLD NEW STP ,**
- (ii) 40 MLD TSTP PLANT**
- (iii) DINDOLI SPS:**

Supply, installation, testing and commissioning of cubicle pattern compartmentalized, 11 KV, 350 MVA, panel, extensible, indoor type, floor mounted, manual as well as electrical operated, dust damp and vermin proof, 11 KV switchgear comprising of :

1 No. : 11 KV, 350 MVA symmetrical at 11000 Volts three phase, symmetrical breaking capacity shall be breaking capacity shall be 25 KA and making capacity of 46.25 KA at 11000 volts, 800 Amp. Horizontal draw out type vacuum circuit breaker as a incommer complete with microprocessor based overload and earth protection relays with RS 485/232 communication port, mechanical interlock, On-Off indicator, 96 mm Sq. dial flush mounted, Digital Multifunction meter with RS 485/232 communication port, emergency trip, Healthy trip Push button, mechanical operation counter, red, green and amber LED lamps for On-off and auto trip indication with heat shrinkable colored sleeve type, insulated 800 Amp. Rated copper busbars and inter connections, single gland cable box to receiver cable ,as per required size of aluminum conductor, 11 KV, XLPE (E) Cable, earthing terminals and other required accessories as per required rating for incommer.

2 No. : 11 KV, 350 MVA symmetrical at 11000 Volts three phase, symmetrical breaking capacity shall be 25 KA and making capacity of 46.25 KA at 11000 volts, 800 Amp. Horizontal draw out type vacuum circuit breaker as a outgoing complete with microprocessor based overload and earth protection relays with RS 485/232 communication port, mechanical interlock, On-Off indicator, 96 mm Sq. dial flush mounted, Digital Multifunction meter with RS 485/232 communication port, emergency trip, Healthy trip Push button, mechanical operation counter, red, green and amber LED lamps for On-off and auto trip indication with heat shrinkable colored sleeve type, insulated 800 Amp. Rated copper busbars and inter connections, single gland cable box to receiver , 11 KV, XLPE (E) Cable, earthing terminals and other required accessories as out going feeders to control Distribution transformers as per required rating.

(B) FOR EXPANSION OF EXISTING H. T. VCB PANEL OF EXISTING PLANT:

This scope of work include change of Existing Incommer VCB as per new Load Requirement and Addition of Following Outgoing Feeders in Existing H.T VCB Panel.

1 No. : 11 KV, 350 MVA symmetrical at 11000 Volts three phase, symmetrical breaking capacity shall be 25 KA and making capacity of 46.25 KA at 11000 volts, 800 Amp. Horizontal

draw out type vacuum circuit breaker as a outgoing complete with microprocessor based overload and earth protection relays with RS 485/232 communication port, mechanical interlock, On-Off indicator, 96 mm Sq. dial flush mounted, Digital Multifunction meter with RS 485/232 communication port, emergency trip, Healthy trip Push button, mechanical operation counter, red, green and amber LED lamps for On-off and auto trip indication with heat shrinkable colored sleeve type, insulated 800 Amp. Rated copper busbars and inter connections, single gland cable box to receiver , 11 KV, XLPE (E) Cable, earthing terminals and other required accessories as out going feeders to control HT Side of min 4000 KVA or as per Requirement for **40 MLD TTP**.

1 No. : 11 KV, 350 MVA symmetrical at 11000 Volts three phase, symmetrical breaking capacity shall be 25 KA and making capacity of 46.25 KA at 11000 volts, 800 Amp. Horizontal draw out type vacuum circuit breaker as a outgoing complete with microprocessor based overload and earth protection relays with RS 485/232 communication port, mechanical interlock, On-Off indicator, 96 mm Sq. dial flush mounted, Digital Multifunction meter with RS 485/232 communication port, emergency trip, Healthy trip Push button, mechanical operation counter, red, green and amber LED lamps for On-off and auto trip indication with heat shrinkable colored sleeve type, insulated 800 Amp. Rated copper busbars and inter connections, single gland cable box to receiver , 11 KV, XLPE (E) Cable, earthing terminals and other required accessories as out going feeders to control HT Side of min 3500 KVA or as per Requirement for **101 MLD NEW STP**.

1 No. : 11 KV, 350 MVA symmetrical at 11000 Volts three phase, symmetrical breaking capacity shall be 25 KA and making capacity of 46.25 KA at 11000 volts, 800 Amp. Horizontal draw out type vacuum circuit breaker as a outgoing complete with microprocessor based overload and earth protection relays with RS 485/232 communication port, mechanical interlock, On-Off indicator, 96 mm Sq. dial flush mounted, Digital Multifunction meter with RS 485/232 communication port, emergency trip, Healthy trip Push button, mechanical operation counter, red, green and amber LED lamps for On-off and auto trip indication with heat shrinkable colored sleeve type, insulated 800 Amp. Rated copper busbars and inter connections, single gland cable box to receiver , 11 KV, XLPE (E) Cable, earthing terminals and other required accessories as out going feeders to control HT Side of min 500 KVA or as per Requirement for **DINDOLI SPS**.

It should be complete with insulated copper busbars with inter connections. The supporting insulators, insulated sleeves for bus bar and insulated partitions shall be strictly weather proof and non-hygroscopic. The alarm & tripping for buchholz and high temperature of transformer winding & transformer oil etc. should also be provided including control cables. D.C. supply, it required for relays etc. must be included providing power pack units, if required.

The above panel should incorporate the following accessories/items:

Panel Board:

The cubicle pattern board should be complete with foundations bolts, nuts flush type meters as specified, indicator lamps, operating handle, trolley for drawing out VCB's and other required accessories.

Current transformer:

The ratio of the CTs shall be suitable for controlling Suitable size of transformers. The VA burden of the CTs shall be sufficient to supply the energy required by the relay for normal operation and tripping of the circuit breaker.

Protection system:

Microprocessor based H.T. relay for 2 O/C and 1 E/F protection scheme.

Specification of the relay:

2 Over current + 1 Earth fault Protection with highest
1A/5A in same relay.

Low burden

Relay should be provided with RS 485 / 232 Computer compatibility Port.

Over current protection relay:

Pick up setting: 20% to 200% in step of 5%

High set: 20% to 2000%

Time setting: Min 0.05 to 1.0 Sec. in step of 0.05 Sec.

Earth fault current protection relay:

Pick up setting: 20% to 200% in step of 5%

High set: 20% to 2000%

Time setting: Min 0.05 to 1.0 Sec. in step of 0.05 Sec.

Original test certificate of the manufacture's Co. of the new relay must be submitted along with deliver. After the commissioning work, relay should be calibrated & tested by the manufacture's representative/Engineer at site in presence of the Site Engineer.

In any case of the Fault, S.M.C.'s feeder should be tripped first and contractor should set the relays accordingly.

The secondary wiring supplied for the equipment shall consist of non deteriorating fire proof superior grade stranded copper PVC wires suitably colored and fitted with numbered ferrules at both ends. The cross section of the wires shall be 2.5 Sq. mm. for others. Following color codes shall be used for wiring

C.T.: Red, Yellow, Blue, Black

An operating mimic diagram shall be provided on the front side.

On-off operation of breaker must be done by closing the main door of breaker, for that necessary arrangement must be done by manufacture.

Breaking and Making Capacity:

The vacuum breaker shall be capable of having rupturing capacity of 350 MVA symmetrical at 11000 Volts three phase. Symmetrical breaking capacity shall be 25 KA and making capacity of 46.25 KA at 11000 volts.

Space Heater:

Space heater for heating the panel for removal of the moisture should be provided. Each panel should have individual heater.

Mechanical Indication LED Type:
Breaker On, Off, Trip.

Front Panel Indications LED Type:
Breaker On, Off, Trip

General Finish:
Totally enclosed, metal clad, vermin and dust proof suitable for tropical climate.

Treatment & Painting:
All metal parts of panels should be treated with shot blasting and zinc spray before final color coat.
The panel shall be furnished with powder coating of light admiralty Grey paint.
The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. All Nut Bolts used in the construction shall be of mild steel hot deep galvanized only.
The manufacturer shall have facilities for assembling vacuum, time and speed measurement facilities in India. This is to ensure adequate service support for future.

Cable Box:
The breakers shall be provided with suitable and identical cable boxes for connection of 11 KV XLPE (E) aluminum conductor armoured cable approaching vertical from below at rear side. The cable boxes shall be so located at convenient height to facilitate easy cable jointing work. The design of the cable box shall be such that any type of jointing methods such as heat shrinkable/push on type/cold shrinkable type termination's can be adopted.

Earthing:
The Breaker Panel shall have special earth bar with a sectional area of not less than 100 Sq. mm run along the whole of metal enclosed switch structure, each end being connected to the main earthing system where metal cased are used on instruments these shall be connected to this bar by conductors of not less than 16 Sq. mm section.

Foundations:
All Foundations bolts, nuts and washer necessary for installation shall be of stainless steel and supplied by the contractor.

Labels & Name/Rating Plate:
Breaker panels shall be clearly labeled as required indicating where necessary their purpose and "ON" and "OFF" letters on brass, ivory, enamel iron or other suitable materials. The complete operating instructions & diagrammatic explanation shall be described on the name plate, affixed on the panel from the front side with fluorescent color alphabets.
The Marking / Labeling shall include but not limited to following:
The front shall include clear mimic diagram which indicates the different functions.

The Position indicator shall give true reflection of position of the main contacts; they shall be clearly visible to Operator.

The lever operating directions shall be clearly indicated in the mimic diagram.

The manufacturer plate shall include the switchboard's main electrical characteristics and operating instructions with diagrammatic explanation.

The manufacturer plate shall include serial number and year of manufacturing of the switchgear.

11 KV Danger Board as per relevant IS in English and Gujarati shall be provided on all side of panel. The board shall be glass enameled white red background and white letterings.

Testing of the Panel:

Complete panel should be tested as per relevant IS, at manufacturer's workshop in the presence of Engineer – In – Charge of the S.M.C / TPI.

NOTE :

1. The installation, testing and commissioning of H.T. panel must be done in the presence of manufacturer's representative(s).
2. All related work including preparing and approval of drawing, getting permission to energies the equipment from Govt. Electrical Inspector and Supply Company shall have to be done by the contractor. The Surat Smart City Development Limited shall pay all statutory fees but not any penalties directly to the concern authority.

ITEM NO. 2: DISTRIBUTION TRANSFORMER

1. **3500 KVA** for 101 MLD NEW STP (2 Nos. - 1W + 1 S)
2. **4000 KVA** for 40 MLD TTP (2 Nos. - 1W + 1 S)
3. **500 KVA** for Dindoli SPS (2 Nos. - 1W + 1 S)

Supply, installation, testing and commissioning as per necessary rating (1 Working + 1 Standby) , 11000/433 volts, 3 ph, 50 c/s., copper wound, oil immersed, naturally cooled (ONAN), delta/star connected, low losses, percentage impedance as per 1180 & 2026 standard and it's latest amendment (with mentioned losses), core type out door, plinth mounting, step-down continuously rated, distribution transformers suitable for parallel operation with each other. Each transformer must be complete with oil conservator with drain valve, dehydrating breather, bidirectional rollers, explosion vent, buchholz relay, filter valve, drain valve, sampling valve, two nos. tank earthing terminals, rating and diagram plates, thermometer pocket with 100 mm dial type thermometer with Control contacts, MRP & RSD complete with capillary tube, lifting lugs, air release and oil filling plug, magnetic oil level gauge with minimum and maximum level marking, marshalling box, suitable cable box on H.V. side, multi gland cable box to receive required No. of 3 ½ core Aluminum conductor XLPE insulated & sheathed armored cable on L.T. side / Suitable Bus Duct Arrangement if Transformer is above 2000 KVA. Additional externally brought out neutral bushing for earthing should be provided. +5%, +2 ½%, -2 ½%, -5%, -7 ½%, -10% tapping on H.T. side with Seven position OFF load tap changing switch with position indicator, locking device with lock and keys must be included. The transformers should be complete with first filling of transformer oil. All accessories as per relevant IS standards shall be provided as a minimum and additional as mentioned in this specifications.

The material of constructions should be such that it should give lower core losses, higher efficiency, better regulation and long years of trouble-free service. The transformer shall have detachable cable boxes with disconnecting chamber on H.V. and L.V. side if required. The L.V. cable box if provided should be suitable to receive the required runs of aluminum conductor, armored, XLPE insulated cable as per the L.V current rating of transformer. The cable box should have ample space for connecting these cables. The H.V. cable box should have ample space for terminating the required 11 KV (E) XLPE cable. The transformer shall be suitable to run in parallel with each other. The temp. rise shall not exceed 45°C in oil over an ambient temp. of 50°C. The contractor shall be required to ascertain the condition along with approval of drawing and the Surat Smart City Development Limited will confirm the same with manufacturer prior to approval of drawing.

Oil Temperature Indicator (OTI) with 4 to 20 mA output signal and Winding Temperature Indicator (WTI) with 4 to 20 mA output signal same shall be connected with SCADA system with RS 485 Compatibility.

Each of the transformers must be tested for routine tests and one transformer shall be tested for type tests as per latest Indian Standards including heat run test considering overload condition in presence of Engineer/representative of Surat Smart City Development Limited at manufacturer's works prior to dispatch and manufacturer's certificates thereof must be supplied. The efficiency and losses of transformers at various loads must be specified.

Item also includes transformer foundation and necessary civil work like chain link, beam, column, slab, brick wall, etc. as per site requirements.

ITEM NO. 3: 11 KV HT CABLE:

Supplying, laying, testing and commissioning of 11 KV, XLPE (E), as per load requirement aluminum conductor armoured cable for 101 MLD STP H.T. Panel , 40 MLD TTP H.T. Panel , Dindoli SPS in open trench / duct or underground. The item includes excavation and refilling using bricks, sand etc. as per standard practices, breaking of wall and restating the same after completing the work for which the Surat Smart City Development Limited shall not supply any material or labor. The cable length may vary depending on site condition and contractor should take measurement and supply the cable accordingly with prior approval. No straight joint shall be allowed under any circumstances. Hypo test shall be carried out after lay and before and after jointing.

ITEM NO. 4: HT CABLE TERMINATION:

The item includes supply, installation, termination, testing and commissioning of heat shrinkable termination kit for above mention cables. These terminations will be made on transformer's H.T. Side, and 11 KV V.C.B. panel. The termination at outgoing of supply company with incoming of breaker is also in the scope of tenderer. The cable boxes are included in the items of transformers and HT Switchgear. All HT termination shall be heat

shrinkable type only. This item also includes supplying and fixing of Min 06 (Six) Sets or As per requirement Reusable Flexible bushing for covering the H.T. Terminations for each panel.

All material and labour required for termination shall be in the scope of contractor's work. Hypot test shall be carried out before and after end termination /Jointing.

GENERAL ELECTRICAL SPECIFICATION

SCOPE :

This part of design criteria defines the minimum basic requirement for electrical engineering, design basis for selection of various electrical equipment, equipment specifications and scope of work for electrical system.

SCOPE OF WORK :

The contractor's scope of work covered in this package shall include the complete design, system studies, details engineering, testing at manufacturer's work procurement, transportation to site, supply, storage at site, installation, testing and commissioning and handing over the entire plant including the electrical system and equipment.

DESIGN BASIS:

Introduction :

This specification, together with the applicable project specification shall govern the design and engineering of electrical facilities

- (i) The design shall be based on the following : - Safety to personnel and equipment during operation and maintenance.
 - Reliability of service
 - Ease of maintenance
 - Adequate scope for future expansion and modification
 - Convenience of operation
 - Electrical supply to electrical equipment and machinery within the design operating limits
 - Maximum interchangeability of equipment – Automatic protection of all electrical equipment through selective relaying system
 - Minimum fire risk
 - A fail safe system
- (ii) The design basis detailed in this specification shall be followed in accordance with sound engineering practices.

Codes & Standards :

- (i) The design, engineering, supply of equipment, installation, testing and commissioning shall be in accordance with established codes, sound engineering practices, and must conform the statutory regulations applicable in India. Other standards may be allowed in particular cases where appropriate IS/IEC standards are not available subject to SMCs approval. However, contractor will not be allowed to form a basis for deviation from IS/IEC just due to country of origin of any equipment.

Voltage drop - in supply cable feeding lighting distribution board/panel on maximum design load shall be limited to 1% and in supply cables feeding, lighting points with all lighting points connected to a circuit switched on, it shall be limited to 2%.

C. Power Distribution :

Tenderer shall do necessary arrangement for provide 3 phase 4 wire 410 +/- 10% volts power through 1.1 KV grade 3.5 core cable feeder of suitable rating upto MCC to be supplied and installed by contractor. All the utilization voltages required shall be driven from the above supply voltage. All transformers, switchgears and distribution boards, etc. required for, shall be supplied by the contractor. The transformers are not in the bidders scope of the work.

ELECTRICAL EQUIPMENT/SYSTEM SPECIFICATION :

The equipment shall conform to corresponding IS standard, specifications and particular specification attached with this document and to Indian/IEC standards and shall be suitable for installation and satisfactory operation in the service conditions mentioned in specifications. All equipments shall be tropicalised. All equipment shall also be withstanding the maximum short circuit fault current at the point of installation for a time greater than the maximum fault clearing time.

Motors :

Motors upto and including 250 KW shall be suitable for 415 V and motors of rating above 250 KW shall be suitable for 3.3 KV. For heavy duty drives such as compressor fan/agitator/crusher etc. high starting torque motors (Min. 150% of rates torque) shall be provided. Motors above 30 KW rating shall have anti-condensation heaters and a seperate terminal box shall be provided.

Cables and Wires :

All HV and MV cables shall conform to IS Spec. High voltage cables shall be XLPE insulated, armoured with PVC overall sheathed aluminium conductor cables. The power cable shall be 3 core armoured cables for motors. Each motor shall have two seperate earthings.

1.1 KV Grade cables shall be XLPE / PVC insulated sheathed, armoured cable with aluminium conductor. The control cables shall be PVC insulated PVC sheathed armoured cable with copper conductors. The power and control cables shall have the following minimum cross-sectional areas :

- | | |
|----------------------|--|
| a. Medium voltage | 4 mm ² (Aluminium)/2.5 mm ² copper |
| b. MV control cables | 2.5 mm ² (Copper).(See note) |
| c. Lighting | 2.5 mm ² (Copper) |

Note : Minimum one spare core shall be provided in each control cable.

The cables shall be sized based on the maximum continuous load current it carries, the voltage drop, system voltage, system earthing and short circuit withstand criteria. Besides the derating due to ambient air temperature, ground temperature, grouping and proximity of

cables with each other, thermal resistivity of soil etc. shall have to be taken into account. A derating factor of minimum 0.6 shall be considered for sizing all cables. Contractor shall consider a lower derating factor, if required.

Control Stations :

Each motor shall be provided with a local control station in the field, and remote control in control room.

The enclosure shall have suitable protection for site conditions. All control stations shall have minimum enclosure protection of IP-55.

The control station shall include the following equipment as per individual requirement :

- Start/Stop push button with LED type indicating lamp and cable glands,
- Digital Ammeter for all motors.
- Suitable cable glands.

Stop push button shall be lockable and have stay put feature. Ammeter is not required in local push button station but the same shall be provided with remote/local selector switch in M.C.C.

Lighting System :

Plant lighting inside plant & outer surfaces of walls of plant, outdoor lighting for clarifier, filter house and sludge drain chambers House within the battery limits is in contractor's scope. Street lighting also in the scope of this contract. Lighting system shall include normal lighting. Normal lighting shall be on 230 V AC +/- 10%.

Work shall be carried out in accordance with attached Erection specification for Lighting. Lighting system shall be designed with illumination levels as per good engineering practices. However, minimum illumination level shall be maintained as listed below. This system consists of lighting transformers to reduce fault levels, main distribution board, lighting and power panels, fixtures, junction boxes, 3 pin 5A/15A convenience socket outlets, cable glands etc. Lighting transformer feeders shall be sized for full transformer capacity.

All outdoor lighting shall be manually controlled only. Taller structures shall have aviation obstruction lighting as per statutory regulations.

Lighting and power panels shall be provided with miniature circuit breakers for the control and protection of circuits. Wherever felt necessary 3-way junction boxes can also be used for tapping of lighting circuits. A minimum of 25% of the miniature circuit breaker of each board shall be left as spares. MCBS shall not be loaded more than 80% of rated capacity. The maximum load on any individual lighting circuit shall not exceed 1000 W.

Wiring for lighting and convenience outlets shall be carried out with PVC armoured cables run along the column/platform and structures. The armoured cable will enter lighting fixture/JB through single compression gland. Minimum illumination level required shall be as per detailed lighting specifications. The maintenance factor shall not be more than 0.7.

Sizing of earth rods and conductors :

This shall be designed to cope with the conditions imposed. The earth conductor shall be adequately sized to carry the maximum earth fault current resulting in the network, without undue temperature rise. All joints shall be protected to prevent corrosion.

The following are the guide lines for carrying out the earthing work.

All the electrical equipment operating at the above 250 volts shall have two separate and distinct connections to earth grids.

GI disconnecting plates shall be installed at various places in the plant. Alternatively, aluminium disconnecting plates may be used in corrosive areas.

Connections between GI earth electrodes, disconnecting plates and various equipments shall be done by GI earthing strips/G.I. stranded wire rope.

GI strips shall be used for main earthing grid. Following is the minimum sizes of earthing conductors to be used for various connections.

Equipment	Size of GI Earth Conductor
- Main Earth Grid	40 x 5 mm GI strip
- 3.7 KW motor	GI wire No. 8 SWG
- 5.5 to 30 KW	3/8" GI wire rope
- Above 30 KW	5/8" GI wire rope
or alternatively suitable G.I. strip shall be provided instead of wire.	
- Steel structural columns,	40 x 5 mm strip tanks, loading racks.
- Pipe racks, vessels and	35 mm ² wire rope heat exchangers.
- Lighting, power and	35 mm ² wire rope instrument panels.
- Receptacles and local	8 SWG solid control stations.
- Lighting poles	35 mm ² wire rope

ERECTION INSTALLATION, TESTING & COMMISSIONING :

Works shall be carried out in accordance with attached :

- Electrical installation equipment-specification for erection, testing and commissioning specification.
- Electrical installation cabling - General specification for cabling specification.
- Electrical installation lighting - General specification for lighting specifications.
- Electrical installation grounding - General specification for Grounding Specifications.
- Other specifications of this tender documents.

SPECIFICATION FOR ELECTRICAL EQUIPMENTS

8.0 PMCC / MCC PANELS:

Following Minimum new PMCC / MCC Panels shall be provided by the tenderer, if additional MCC panels required as per design, same shall be provided by the tenderer.

This details given only for guidance to tenderer, actual quantity shall be decided during detailed engineering.

- 8.1 PCC for New 101 MLD STP with Double busbar type which incorporate necessary rating 2 nos. of in coming, 1 no. of bus coupler , 1 No of D.G incomer and required nos. of outgoing feeders with ATS for various MCC Panels along with fix type capacitor for transformer. PCC will receive power from new transformers.
- 8.2 PCC for New 40 MLD TTP with Double busbar type which incorporate necessary rating 2 nos. of in coming, 1 no. of bus coupler , 1 No of D.G incomer and required nos. of outgoing feeders with ATS for various MCC Panels along with fix type capacitor for transformer. PCC will receive power from new transformers.
- 8.2 PMCC for Dindoli SPS with Double busbar type which incorporate necessary rating 2 nos. of in coming, 1 no. of bus coupler , 1 No of D.G incomer and required nos. of outgoing feeders with ATS for various MCC Panels along with fix type capacitor for transformer. PMCC will receive power from new transformers.
- 8.3 Addition / Modification in Existing PCC for Dindoli STP as per new Load requirement require for Upgradation Process.

MCC FOR UPGRADATION OF EXISTING 66 MLD STP :

MCC - Panel for Air Blower units like Air Blower for IFAS System and other spare feeders etc. which incorporate 1 no. of in coming and required nos. of outgoing feeders with APFC Panel to maintain Power Factor 1.0.
(Location :- Existing Air Blower Room)

MCC - Panel for Pump Room for units like Pumps , Lighting System , E.O.T and other spare feeders etc. which incorporate 1 no. of in coming From New 101 MLD PCC Panel and required nos. of outgoing feeders with APFC Panel to maintain power factor 1.0.
(Location :- Pump Room)

MCC – Modification / Addition of Outgoing Feeder in Existing Bio Gas Power Generation panel with all required Accessories.
(Location :- BGPP Room)

MCC FOR PROPOSED 101 MLD STP :

MCC-1 - Panel - 1 No. for Inlet Area for units like Multirake Type Fine Screen , Belt Conveyer , Classifier System , Actuator panel for Various Inlet Gates etc. and Others which incorporate 1 no. of in coming and required nos. of outgoing feeders with APFC Panel to maintain Power Factor 1.0.
(Location :- New Primary Panel Room)

MCC-2 - Panel - 1 No. for New Air Blower Room for units like Air Blower for New STP and Other spare Feeders etc. which incorporate 1 no. of in coming and required nos. of outgoing feeders with APFC Panel to maintain Power Factor 1.0.
(Location :- New Air Blower Room)

MCC-3 - Panel - 1 No. for SBR System for units like Returns Actiated Sludge Pumps, Surplus Activated Sluge Pump Sets , Decanter Assembly and Other spare Feeders etc. which incorporate 1 no. of in coming and required nos. of outgoing feeders with APFC Panel to maintain Power Factor 1.0.

(Location :- New Pump House for SBR System)

MCC-4 - Panel - 1 No. for Chlorination System for units like Chlorinator , Chlorine Booster pumps and Other spare Feeders etc. which incorporate 1 no. of in coming and required nos. of outgoing feeders with APFC Panel to maintain Power Factor 1.0.

(Location :- Chlorination Room)

MCC-5 - Panel - 1 No. for Centrifuge System for units like Centrifuge , Poly Dosing Pump ,Centrifuge Feed Pump , Poly Tank Mixers , Screw Thickner and Other spare Feeders etc. which incorporate 1 no. of in coming and required nos. of outgoing feeders with APFC Panel to maintain Power Factor 1.0.

(Location :- Centrifuge Room)

MCC FOR DINDOLI SPS

MCC- - Panel - 1 No. for Dindoli Sewage Pumping Station for units like Cubical Starter Panel Non Clog Sewage Submersible Pump Sets , Mechcnial Screen , EOT, Actuator For Inlet Gates , Lighting System of Sewage Pumping Station and Other spare Feeders etc. which incorporate 2 no. of in coming from Trasnformers , 1 No. From DG Sets and required nos. of outgoing feeders with APFC Panel to maintain Power Factor 1.0.

(Location :- SPS Panel Room)

The MCC shall have degree of protection of the enclosure IP-54. The M.C.C. shall be of drawout and extensible type. The lighting boards shall not be draw-out type. Main PMCC Panel for STP shall be singalbusbar type.

The MCC shall be free standing,extensible, metal enclosed fixed comparten-talised, modular type, dust and vermin proof suitable for indoor installation. The switchgear shall be assembled out of vertical panels of uniform height not exceeding 2450 mm. The maximum height of the operating handle/switches shall not exceed 1800 mm and the minimum not below 300 mm.

The switchgear shall be designed to ensure max. safety during operation, inspection, connection of cables relocation of outgoing circuits and maintenance with the energised bus system and without taking any special precautions. The switchgear shall permit max. interchangeability and shall be extensible on either side

The switchboard / MCC shall be sheet steel clad with the frame fabricated out of 14 SWG cold rolled sheet steel and doors/ covers also of 14 SWG cold rolled sheet steel having integral base frame for each vertical panel. All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made of galvanised and passivated or cadmium plated high quality steel bolts, nuts and washers secured against loosening.

The switchgear shall be suitable for bottom cable entry. Each MCC panel shall have a separate cable alley of 150 mm minimum width. Motor starter and switchfuse units shall be in Multitier arrangement in single fixed execution. All auxiliary devices for control,

indication, measurement and protection such as push buttons, control and selector switches, LED type indicating lamps, Digital metering instruments shall be mounted on the front side of the respective compartment. Components requiring frequent inspection during operation shall be provided with an anti-corrosive heater rated for 240 AC +/-10% supply with a switch, fuse and a thermostat.

MCC must incorporate all the feeders required for above mention capacity including spare feeders as mentioned elsewhere in this tender. All the busbars including main busbars must be designed as per the rating of conserend/associated switchgear.

Main bus bars shall be of high conductivity having uniform current rating throughout the length. Horizontal and vertical bus bars shall be sized depending upon the max. expected current and to limit the max. operating temperature at specified design ambient temperature to 85 deg. C for normal operating condition and the 200 deg. C for short circuit condition considering installation in poorly ventilated area.

Adequately sized (taking current density 1.5 Amp/Sq.mm.) Electrolytic Tinned Copper (Cu.) busbars with heat shrinkable coloured sleeve running horizontal in a separate enclosure shall be provided for space heaters, control supply and meter requirements. Necessary tee-off connections shall be used for distributing auxiliary supply to each vertical panel. All busbars shall be colour coded and designed to withstand specified short circuit current for one second. Copper used must be electrolytic tinned copper only.

Copper earth bus shall be adequately sized and provided throughout the length of the switchboard with provision for interconnection to earthing grid. All non-current carrying metal parts of the mounted equipment shall be earthed. Doors and moveable parts shall be earthed using flexible copper connections. All feeders must be seperated using metal partitions

Inside the switchboard, the wiring for power control, protection and instruments circuits shall be done with PVC insulated copper conductors having 660/1100 V grade insulation. Min. size of control wire shall be 1.5 mm² copper for circuits having MCB'S rating of 10 Amps. or less. For higher MCB'S rating control circuits, min. 2.5 mm² copper conductor shall be used.

'Elemex' type terminals shall be acceptable for wires upto 10 mm² size and for conductors larger than 10 mm² bolted type terminal with crimping lugs shall be provided. Each wire shall be terminated at a separate terminal.

All motor starter shall be D.O.L. type and upto 7.5 H. P. and star-delta type above 7.5 H.P. unless otherwise specified as per process reequirement. All the cast resin C.T.'s and energy meter must be of accurcacy class 0.5.

Switches/MCCB shall be load break, heavy duty, air lock type with 2NO + 2NC the operating handle mounted on the compartment door complete with necessary interlock and defeat mechanism. All fuses shall be non-deteriorating HRC cartridge pressure filter, link type the connector shall be air lock type having AC-3 duty rating.

Micro processor Based Motor protection relays with RS 485 and having over load, short circuit, singal phasing, earth fault, Reverse rotation protection shall be used for motor rating above 7.5 H.P.

All Digital indicating instrument shall be moving iron flush mounting type of 96 x 96 mm sq. pattern. However 72 x 72 mm instruments may be acceptable for out going feeders in the MCC. All control/selector switches shall be rotary back connected type having a cam operated contact mechanism with pistol grip handle for circuit breaker control and knob type handle for other applications. All motor starter feeders shall have stop push buttons and trip indication lamps. Incomer to MCC shall have a 415 V MCCB / TPN with primary fuse, secondary MCB alongwith a voltmeter and a selector switch. The incomer to MCC shall have Digital KWH meter with protection MCB's etc. to record energy consumed in the plant including lighting for the plant. A separate Digital KWH meter may be used the lighting consumption. Accuracy class of Digital KWH meter and CT's must be 1.0. All CTS used in pannel must be resin cast type.

All metal parts shall be thoroughly cleaned degreased and made free from rust. After application of the primer, the switchboard shall be spray painted with two coats of final paint colour shade.

Micro processor Based Motor protection relays with over load, short circuit, singal phasing, earth fault, Reverse rotation protection shall be used with all motor starters above 7.5 HP motors.

For all the out going feeder from MCC , MCCB shall be used up to current rating 400 A and current rating equal to or more than 630 A ACB shall be used as a outgoing feeder.

All MCC panel Shall be consist of atleast following Spare feeders :
2 Nos. of 63 A FP MCCB , 2 Nos. 32 A FP MCCB, 04 Nos. 32 A FP MCB , 06 Nos. of 16 A FP MCB , 10 Nos. of 10 A DP MCB

A centrally located engraved nameplate shall be provi-ded for the switchboard. Each module shall have engraved nameplate bearing data as per approved drawings. Nameplate or polyester adhesive stickers shall be provided for each equipment mounted on the switchboard. One feeder of each rating must be provided in the switchboard as a spare feeder. The contractor shall have to submit the G.A.Drawing/and/or single line diagram of MCC showing the feeder arrangements along with the tecncial bid.

SOFT STARTER:

General:

This specification describes the requirements for a solid-state torque controlled starter (Controller) used to provide linear ramp starting and stopping of three-phase AC induction motors. The requirement is for a stand-alone unit that negates the need for further equipment in terms of protection, viewing and controlling.

A. Electrical ratings

a) 200 – 525 +/- 10% 200-690 +5%/- 10% Volts AC mains

- b) 50-60 Hz +/- 10%
- c) 100-240/380-500 +/- 10% Volts control voltage

B. The Controller shall provide as standard, the following “starting” modes:

- a) Linear Torque control for Start
- b) Quadratic Torque control for Start
- c) Pump Control
- d) Current Limit Start
- e) Voltage ramp Start
- f) Voltage ramp with current limit Start
- g) Full Voltage DOL Start
- h) Remote analogue control
- i) Soft Start with Selectable Torque Boost
- j) Slow Speed time controlled
- k) Slow Speed external controlled
- l) Dual Ramp Start
- m) Bypass control

C. The Controller shall provide as standard, the following “stopping” modes:

- a) Linear Torque control for Stop
- b) Quadratic Torque control for Stop
- c) Pump Control
- d) Voltage ramp Stop
- e) DOL/Coast to stop
- f) Remote analogue control Stop
- g) Dynamic DC-Brake and Soft brake (reverse brake)
- h) Slow Speed time controlled
- i) Slow Speed external controlled
- j) DC-Brake at slow speed
- k) Dual Ramp Stop
- l) Accurate positional stop control
- m) Bypass control

D. The Controller shall provide as standard, the following “Additional” features

- a) Jogging forward and reverse
- b) 4 parameter sets
- c) Analog output
- d) Built in Display

E. The Controller shall provide as standard, the following “Operation” features

- a) Keyboard
- b) Remote

F. The Controller shall provide as standard, the following “Protection” features:

- a) Motor Thermal Overload
- b) Soft Start thermal overload
- c) PTC input
- d) Motor Shaft Torque (Max) machine process protection.
- e) Motor Shaft Torque (Min) machine process protection.
- f) Phase imbalance
- g) Phase reversal
- h) Over voltage
- i) Under voltage
- j) Locked Rotor
- k) Excessive Starts per hour for application
- l) Phase loss input / output
- m) Motor output loss

G. The Controller shall provide as standard, the following “Viewing” functions:

- a) Three Phase Current
- b) Three Phase Voltage
- c) Current in L1, L2, L3
- d) Voltage between L1-L2, L1-L3, L2-L3
- e) Shaft Power in kW / HP (selectable)
- f) Motor thermal capacity
- g) Motor Energy consumption (kWh)
- h) Power factor
- i) Run time in hours
- j) Torque in Lbs./ft or Nm (selectable)

H. The Controller shall provide as standard, the following “Fault Indication” functions:

- a) Line failure
- n) Phase imbalance
- b) Over temperature – motor
- c) Over temperature – Soft Starter
- d) Shorted Thyristor
- e) Open Thyristor
- f) Locked Rotor
- g) Motor output loss
- h) Overload - Shaft Torque
- i) Underload – Shaft Torque
- j) Phase imbalance
- k) Over voltage
- l) Under voltage
- m) Excessive Starts
- n) Phase reversal
- o) Event List of 15 latest fault indications/occurrence

CONSTRUCTION:

- a) The Controller shall be of modular construction, consisting of a Power Control Board (PCB) and Power Structure.

- b) The PCB shall be compatible the full range of power structures.
- c) In the sizes from 17-1400 Amps all phases should be controlled during start/stop.
- d) The power structure shall consist of six SCR's mounted on a heatsink for ratings up to and including 1400 Amps.
- e) The Controller shall be DIN Rail mountable up to 250 A.
- f) DIN Rail mountable units should be mountable without space at side.

GENEREAL SPECIFICATIONS FOR PCC / PMCC / MCC PANEL

1 SCOPE: .

This scope shall cover design, manufacturer, check test and supply, installation testing and commissioning of Panel Board as described in bills of quantities. All the Panel Boards will be installed indoor and is connected through the L.T. XLPE cables.

2 SERVICE CONDITIONS AT SMC SITE :

- Ambient Temperature : Max./Min = 50 deg. C./60 deg. C.
- Design temperature : 55 deg. C.
- Relative Humidity : 95% at 35 deg. C.
- Altitude : 20 M above MSL
- Voltage : 415 +/- 10%
- Frequency : 50 Hz +/- 5%
- Neutral : Solidly/ earthed.
- Fault level : As per Design Fault Level, symmetrical at 415 Volt Solidly earthed.

3 DOCUMENTATION:

- 3.1 Vendor shall furnish drawings, data and manuals in three sets along with equipment supplied.
 - General arrangement drawing indicating accessories and dimensions.
 - S.L.D.s, three phase wiring diagram, control wiring
 - Foundation plan and loading
 - Termination arrangement with dimensions.
- 3.2 Documents to be submitted after placement of order
 - As per 3.1 above for approval prior to manufacturing.
 - Schematic and sectional drawing.
 - Bill of quantity as well as make of material with Cat. No. for each item for all the panels.
- 3.3 Final Documents
 - Final as built wiring diagram , Bill of material of the Panel (power and control circuit with ferrule number) in C.D.s & in 3 hard copies
 - Instruction and Maintenance Manuals – three copies.
 - Test certificates – three Copies

4.0 GENERAL SPECIFICATIONS :

- 4.1 All the metal clad totally enclosed, rigid floor(MCC), air insulated, cubical type suitable for operation for three phase/single phase, 415/240 Volt, 50 Hz, Neutral effectively grounded at

transformer. The panel shall be IP54 protection class construction. It should be either “Front operated and maintained” or “Front operated and back maintained”, as per the site conditions. The painting of all the metal part shall be as per the painting specification as defined in the datasheet.

- 4.2 The panel shall be designed to withstand the heaviest condition at site, with maximum ambient temperature of 50 deg C., 95% Humidity.

STANDARDS AND CODES :

The panels shall comply with the latest edition of relevant Indian Standards and Indian Electricity rules and Regulations. The following Indian standards shall be complied with :

IS : 4237	General recruitment for switchgear and control gear for voltages not exceeding 1000 V a.c. or 1200 V d.c..
IS : 5578	Guide for marking of insulated conductor.
IS : 22353	Guide for uniform system of marking and identification of conductors and apparatus Terminals.
IS : 13947	Low voltage switchgear and control gear.
IS : 8197	Terminal marking for electrical measuring instrument and their accessories.
IS : 2551	Danger Notice plates.
IS : 10228	Code of practice for selection, Installation and maintenance of switchgear and control gear.
IS : 8623	Specification for factory built assemblies of switchgear and control gear for voltage upto and including 1000 V A.C. and 1200 V D.C.
IS : 8828	Miniature Circuit Breakers.
IS : 9224	Low Voltage Fuses
IS : 2705	Current Transformers
IS : 3156	Voltage Transformers
IS : 3231	Electrical Relay for protection
IS : 1248	Indicating Instruments
IS : 722	Integrating Instruments
IS : 6875	Control switches and push buttons
IS : 1822	A.C. motor starters of voltage not exceeding 1000 v0lt

Indian Electricity Act and Rules(AS amended up to date) and approval of FIA of India. The panel also requires approval of the department at various stage of manufacturing such as design, selection, construction, testing, shipping etc.

5.0 CONSTRUCTION:

CUBICAL TYPE Panel:

STRUCTURE

The panels shall be of compartmentalized design so that circuit arc/flash products do not create secondary fault and be fabricated out of high quality CRCA sheet, suitable for indoor installation, “Front operated and maintained” or “Front operated and rear maintained” as per site requirement, extensible and floor mounting type.

All CRCA sheet steel used in the construction of panels shall be 14 SWG thick and shall be folded and

braced as necessary to provide a rigid support for all components. The internal partition sheets shall be at least 16 SWG thick. Joint in any kind of sheet steel shall be seam welded, as welding slag grounded off and welding pits wiped smooth with plumber metal.

The panels shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP : 54. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasket with foam rubber and /or rubber strip and shall be lockable. All panels and covers shall be properly fitted and screwed with the frame and holds with the panel correctly positioned. Fixing screw should be entered into holes, taped into an adequate thickness of metal or provided with bolts and nuts. Self threading screws shall not be used in the construction of panels.

A base channel of 75 mm * 50 mm * 6mm thick shall be provided at the bottom of the lower most unit shall be provided.

The main panel shall be preferably arranged in multi-tier formation. The panel shall be of adequate size based on outgoing feeders required as shown in the drawing. The size of the panel shall be designed in such a way that the internal space is sufficient for hot air movement and the electrical components does not attain temperature more than 50 deg. C. Openings shall be provided for natural ventilation, the said openings shall be screened with fined G.I. weld mesh. All the electrical component shall be rated for 50 deg. C.

Alternatively the panel shall be provided with removable sheet steel plates at bottom to drill holes for cable/conduit entry at site. The panel shall be designed to facilitate easy inspection, maintenance and repair. The panel shall be sufficiently rigid to support the equipment without distortion under normal and under short circuit conditions. They should be suitably braced for short circuit duty.

Push button and provision for remote control start – stop arrangement shall be done for all motor starters. Control supply of the each individual feeder shall be taken from the Auxiliary contact of the MCCB, so by switching the MCCB, control supply of the concerned feeder will be controlled. The main object of doing this is to cut-off Power as well as control supply from the feeder at the time of Maintenance / Repairing.

All the individual component shall be with operating handle and panel mounted only. Door mounting of any power component shall not be allowed. Operating handle of switch gear, control unit for panel shall not be above 1.8 Mtr. From operating platform. If required MS fabricated stand shall be provided to ease the bottom entry of cable, The stand shall be fabricated from at least ISMB 75 and shall be remain at the required height from ground which shall not be less than 450mm & 600mm for panel of/below 400Amp. Rating and above 400 Amp. Rating respectively.

GENERAL REQUIREMENTS OF THE PANEL:

The panel manufacturer must have CPRI approval for manufacturing panel for the successful bidder. Contactor has to submit the details of Panel Manufacturer before drawing approval.

PAINTING :

The painting shall be seven-tank process with powder coating and as mentioned in the data sheet.

CIRCUIT COMPARTMENTS:

Each circuit breaker and switch fuse unit shall be housed in separate components and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker/ switch fuse unit in “ON” and “OFF” position. Safety interlocks shall be provided for air circuit breaker to prevent the breaker from being drawn out when the breaker is in “ON” position. The door shall not form an integral part of draw out position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barrier should be provided between the tiers in the vertical section.

INSTRUMENT COMPARTMENTS:

Separate adequate compartment shall be provided for accommodating various instruments. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker/switch fuse unit, bus bar and connections.

BUS BARS:

The bus bar shall be air insulated and made of high quality, high conductivity high strength electrolytic copper only with heat shrinkable sleeve of high dielectric strength in different color. The bus bar shall be of 3 phases and neutral system with separate neutral and earth bar. The bus bar and interconnection between bus bars and various components shall be of electrolytic Copper only. The bus bar shall be of rectangular cross section design to withstand full load current for phase bus bar and half rated current for neutral bus bar in MCC panel and shall be extensible on both the sides. The bus bar size shall be as per current density 1.5 Amp./sq mm.

The bus bar shall have uniform cross section through the length. The bus bar and interconnections shall be insulated with epoxy coated bus sleeves and supported on bus insulators on SMC/DMC type at sufficiently close intervals to prevent busbar sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 50KA RMS symmetrical for 1 second and a peak short circuit withstand of 105 KA minimum. The bus bar shall be housed in a separate compartment. The bus bar shall be isolated to avoid any accidental contact. The bus bar shall be arranged such that minimum clearances between the bus bar are maintained as below.

Between Phases	:	25 mm. minimum
Between Phases and neutral	:	25 mm.
Between Phases and earth	:	25 mm.
Between neutral and earth	:	20 mm. minimum

All bus bar connections shall be done by drilling holes in bus bar and connecting by chromium plate or tinned plated brass bolts and nuts. Additional cross section of bus bar shall be provided in all panels to cover up the holes drilled in the bus bar. All connections between bus bars and circuit breakers/ switches and cable terminal shall be through Copper strips of proper size to carry full rated current. This strips shall be insulated with insulating tapes. Panel to Panel bus bar entry should be effectively sealed by electrical and thermal insulation barriers so that products of flash over should not travel from one panel to another panel creating multiple faults.

ELECTRICAL POWER AND CONTROL WIRING CONNECTION:

Terminal for both incoming and outgoing cable connections shall be suitable for 1100 V grade, aluminum / copper conductor XLPE insulated and PVC sheathed, armored cable and shall be suitable for connection of solder less sockets for the suitable size and type of cable Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance. 10% or 2 nos. whichever is higher, spare terminals shall be provided on each terminal block, so that not

more than one outgoing wire is connected per terminal. Suitable barriers of enclosures shall preferably separate terminal strips for power and control from each other.

Wiring inside the modules for power, control, protections and instruments etc. shall be done with use of 660/1100 V grade FRLS insulated copper conductor wires conforming to IS : 694 and 8130. Power wiring inside the starter module shall be rated for full current rating of respective contactor, but not less than 4.0 sq. mm. cross section area. For current transformer circuit 2.5 sq. mm. copper conductor wire shall be used. Other control wiring shall be done with 1.5 sq. mm. copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solder less socket at the end before connections are made to the terminals.

Control power supply to modules through the control transformers only. Control power wiring shall have control fuses,(HRC fuse type)/2 Amp. MCB for circuit protection.

All indicating lamps shall be protected by HRC fuses. Identification ferrules shall be fitted to all the wiring termination for ease of identification and to facilitate checking and testing. Spring type washer shall be used for all copper and aluminium connections.

TERMINALS:

The outgoing terminals and neutral links shall be brought out to a cable alley suitably lockable and accessible from the panel front. The current transformer for instruments metering shall be mounted on the disconnecting type terminals blocks. No direct connection for incoming or outgoing cables to internal components of the distribution board is permitted; only one conductor may be connected in one terminal.

WIREWAYS

A horizontal/vertical box type PVC channel wire ways shall be provided to take interconnecting control wiring between different vertical sections.

CABLE COMPARTMENT

Cable compartment of minimum 450 mm size shall be provided in the Panel for easy termination of all incoming and outgoing cables entering from top or bottom. Adequate supports shall be provided in the cable compartment to support cables. All outgoing and incoming feeder terminals shall be brought out to terminal blocks in the cable compartment.

For Instrument control cables a separate marshalling cabinet shall be provided in each panel to separate the power and instrument cables. All the feedback and command signals to and from PLC shall be wired in the marshalling cabinet and from there it shall be internally wired to respective feeder.

EARTHING:

Cu earth bars of suitable size (25x3 for < 500 Amp, 50x6 for >500Amp. Panel) shall be provided in the panels for the entire length of the panel Provisions for the connection of this earth bar to the main earthing station/bar. The frame work of the panel as well as each feeder door earthing shall be connected to this earth bar. The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be ultimately bounded with the earth bar. Each door of the panel should be earthed separately by Flexible link

LABELS :

Engraved metallic labels shall be provided on all incoming and outgoing feeders. Single line circuit

diagram showing the arrangement of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

NAME PLATE :

A metallic name plate with the panel's designation with the bold letters shall be fixed at top of the central panel. A separate name plate giving feeder details shall be provided for each feeder module door. Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays, etc. shall suitably be identified by providing stickers.

DANGER NOTICE PLATES:

The metallic danger notice plate shall be affixed in a permanent manner on operating side of the panel indicating danger notice in both Hindi and English and with a sign of skull and bones and shall be of ISI certification mark.

INTERNAL COMPONENTS:

The panel shall be equipped complete with all types of required number of Air Circuit Breakers, switch fuse units, contactors relays, energy meters, fuses, meters, instruments, indicating lamps, push buttons, equipment fittings, bus bars, cable boxes, cable glands etc. and all the necessary internal connections/wiring as required and as indicated elsewhere. All parts of the Panels carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at the parts of the panels. All units of the same ratings and specifications shall be fully interchangeable.

6.0 COMPONENTS :

GENERAL:

The type, size and rating of the components shall be as indicated. While selection of the capacity of the components resulting from the prevailing conditions like ambient temperature shall be allowed for the thermal and magnetic trip rating shall be compensated for the ambient temperature. The ratings indicated on the drawing are ratings anticipated at prevailing site conditions.

SWITCH DISCONNECTOR FUSE UNITS:

The fuse switch units shall be 3 pole, double break type heavy duty suitable for load break duty (AC 3), quick make and break action. Separate neutral link shall be provided in the switch. All switch fuse units shall be duly interlocked with operating mechanism so as to prevent opening of the door when the switch is in ON position and also prevent closing of the switch when the door is not properly secured. All contacts shall be silver plated and all live parts shall be shrouded. The incoming and outgoing terminals of the switch shall be adequately sized to receive proper of the cables. High rupturing capacity(HRC) fuse links shall be provided with switch fuse units and shall be in accordance with IS : 9224-1979 and having rupturing capacity of not less than 35 MVA at 415 V. When switch is in "OFF" position the fuse shall be isolated from both the ends. HRC fuse links shall be provided with visible indicators to show that they have operated. The switch dis-connector fuse unit shall be manufactured in accordance with IS : 13947.

CONTACTORS:

It shall be suitable to star delta/DOL/soft starter ampere rating or motor ampere rating, Continuous duty, 440 V, 50 Hz with 2 NO+ 2NC or more (if required) auxiliary contacts & necessary safety features. Wherever contactors are required for capacitors, it shall be Capacitor Duty contactor and accordingly, rating shall be selected. Exact rating shall be finalized at the time of detailed engineering. All power

contactors shall be AC3 Duty only and as per TYPE – 2 Co-ordination as per the switchgear selection chart.

MOTOR PROTECTION RELAY (μ P BASED)

Motor protection relays (MPR) shall be provided for all motors rated equal to and more than 7.5 HP as per the quantity stated at each Starter. MPR shall be micro computer based with RS 485 and of required range as per motor rating at site, which bidder shall evaluate on his own at site if required before submitting his bid, with necessary selectable CTs and communication port for communication with PLC/SCADA, etc. complete in all respects. Necessary connection with communication network (Provisional) of PLC shall be carried for monitoring the motor status in real time trends and historical data.

It shall be

- Computerized 3 phase protective Device
- Suitable range as per motor rating
- Selectable Scrolling time
- Settable and accurate Overload and Under current protection with Annotation
- Selectable Under current time
- Current based single phase loss protection with Annunciation and selectable protection time
- Locked rotor protection with annulations with settable range 4 to 10 times.
- Earth Fault Protection with Annotation
- Settable earth Fault current
- Current Based phase Reversal protection with Annotation
- It shall be complete man-Machine interface with suitable software calibration facilities and ease of wiring.

AIR CIRCUIT BREAKER:

CONSTRUCTION:

The ACB shall have following features.

- Draw out type Mechanical with suitability of various positions (such as “test” and “maintenance”) and its indicators.
- Safety shutter of Fiber glass/polycarbonate sheet of 2 mm thickness shall be provided.
 1. The ACB shall have trip free mechanism which prevents the operating mechanism from interfering with the tripping or opening action)
 2. ACB shall be provided with mechanical anti-pumping feature.
- Door interlock with defeat features to be provided.
- ACB shall be lockable in isolation position.
- Power circuit breakers shall comply with standards IEC 60947-1&2 or standards derived from the latest amendments.
- The circuit breakers shall have a 55KA breaking capacity or more if not justified by calculations taking into account their installation location.
 - All the vital accessories like Shunt, Motor, and Under Voltage coils shall be accessible from the front and should not need removing of the breaker from its panel for the replacement.
 - There should be a Mechanical Contact wear indicator to assess the life of contacts and which shall be mounted directly on the moving contacts to indicate the degree of erosion of the contacts.

- “OK” signal (on breaker front panel) interlocking to ensure the breaker shall get closed only when vital interlocking are checked & found OK.

SPECIFICATION FOR MICROPROCESSOR BASED OVER CURRENT RELEASES FOR ACB’S:

If anyone phase is loaded to 20% of the rated current of the current transformer installed it should be sufficient for the release to operated. The release should offer the following minimum protection functions:

Overload (L):

Thresholds –Current setting - I_r - 40 % to 100 % of I_n rating, Time delay - 0.5 seconds to 24 seconds @ 6 I_r . It should be True RMS Long time Protection

Selective Short circuit (S):

Pick up Settings –4 to 10 times of I_r . (Min 9 Thresholds) Time delay at 10 I_r . - 50 ms to 500 ms with I2t ON User may facilitated to bypass the protection if required.

Instantaneous short circuit (I):

It should be from 1.5 times to 12 * I_n User may facilitate to bypass the protection if required. Accuracy of Instantaneous tripping ± 10 %

Ground Fault (G):

Since earth-fault is not related to rating of the ACB, therefore the Earth fault protection, if specified, will have adjustable current setting in absolute values and not in terms of percentage of ACB rating. The adjustable time delay setting for tripping on earth fault shall be within 100 – 400ms. Also there should be provision to disable the Earth Fault Protection if required.

Neutral Protection:

Neutral Protection shall be provided for 3P as well as 4P ACB in the release. The Neutral protection shall be dependent on the phase current and typical protection range shall be either 50% or 100%.

Important Parameters

Sr No	Parameters	ACB
1	Rated Operating Voltage	500V
2	Rated Insulation Voltage	1000V
3	Rated Impulse Withstand voltage	8kV
4	Rated ultimate short ckt breaking capacity @ 440 V AC	55kA
5	Rated Short time withstand current for 1sec	35kA
6	Rated short circuit making capacity @ 440VAC (Peak Value)	Min 120kA
7	Utilization category	B
8	Mechanical Life operations without Maintenance (2 operations in one operation cycle considered)	12500
9	Mechanical Life operations with Maintenance (2 operations in one operation cycle considered)	20000

10	Electrical Life operations @ 440V without maintenance	8000
11	Power Loss @rated current for 3/4 pole	

Construction

As per Standard practice

Electrical Auxiliaries

All electrical auxiliaries, shall be installable in a compartment which, under normal operating conditions, shall not contain any conducting parts capable of entering into electrical contact with the circuit-breaker poles. It shall be possible to connect all auxiliary wiring from the front of the circuit breaker.

Mechanical indicators

Mechanical indicators on the front panel of the power circuit breakers shall indicate the following status conditions:

1. "ON" (main contacts closed)	Spring charged
2. "ON" (main contacts closed)	Spring discharged
3. "OFF" (main contacts open)	Spring charged – circuit breaker ready to close
4. "OFF" (main contacts open)	Spring discharged – circuit breaker not ready to close
5. "OFF" (main contacts open)	Spring discharged

MCCB

1. The MCCB shall be microprocessor based having features of indication and protection for overload, short circuit, earth fault. MCCB should be confirming to IS 13947 or IEC-947.
2. MCCBs shall be designed to enable safe on-site installation of auxiliaries such as voltage releases (shunt and under voltage releases) and indication switches as follows:
 - They shall be separated from power circuits,
 - All electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks,
3. The addition of a motor mechanism module or a rotary handle, etc., shall not mask or block device settings
4. For 4P MCCB, the 4th pole should be 100% rated and protected by release.
5. For Thermal Magnetic MCCB, adjustable Overload and Adjustable short circuit required.

Important Parameters

	Parameters	MCCB
1.	Rated Operating Voltage	440 VAC
2.	Rated Insulation Voltage	690 V
3.	Rated Impulse Withstand voltage	8 kV
4.	Rated ultimate short ckt breaking capacity @ 415V	35 kA
5.	Rated Short time withstand current for 1sec	7 kA
6.	Rated Short time withstand current for 3 Seconds	-

7.	Rated short circuit making capacity @ 440V ac	105kA
8.	Protection range for over load and short circuit	from 40% to 100%
9.	Utilization category	A
10.	Mechanical Life operations w/out Maintenance	8000
11.	Mechanical Life operations with Maintenance	20000
12.	Electrical Life operations @ 415VAC without maintenance	6000
13.	Number of poles. (Fully rated fourth pole in 4P MCCB.)	3 or 4 as applicable.

The MCCB shall be with protections and having suitable setting range with 2NO+2NC auxiliary contacts.

DIGITAL ENERGY METER

A separate/external energy meter having class: 1 accuracy local display. It must have RS485 modbus port to enable transmission of minimum following data.

- Current in all phase
- Phase as well as line Voltage
- KW, KVA, KVAR
- Harmonic distortion
- Power Factor
- Frequency It should be installed in the LT Panel's cubical in such a way that all the settings can be done without opening of cubical door.

VAF (Voltmeter &, ammeter& Frequency) Meter

They shall be digital flush mounting type. The 3 line LED display VAF meter with auto scrolling parameter. The meter shall be square in the shape of 96 * 96 mm and suitably ranged.

KWH METER:

KWH meter shall be of suitably ranged, flush mounting, 440 volts 50 c/s, 3 phase 4 cycle, unbalanced load type with metering class and with suitable CTs.

CURRENT TRANSFORMER:

Where ammeter/KWH meter are called for, cast resin type class 1 and 10VA burden C.T.s shall be provided for current/energy measurement. Current transformer shall be in accordance with IS: 2705-1992 as amended up to date.

PUSH BUTTONS:

The push button unit shall be comprised of the contact element, a fixing holder and a push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 amp. continuous current rating. The actuator shall of standard type and colour as per its usage for ON, OFF and TRIP.

INDICATOR LAMPS :

Indicator assembly shall be screw type with built in resistor having non fading color lens. LED type lamps are required with standard color practices. Indication lamp shall be LED type panel mounted, low power consumption, Min.100000 hrs. of Life, O/L and S/C protected with its holders etc. Suitable for specified voltage shall be used.

SOFT STARTER:

Details are given separately.

CAPACITORS

Applicable Standard	IS 13585 (Part- 1), IS 2834
Voltage	415/440 Volt for LT & HT power connection respectively
Phase/connection	3/Delta
Frequency	50 Hz +/- 5 %
Duty	Heavy Duty, Indoor suitable for panel mounting
Ambient Temperature	50 C
Type of cooling	Natural
Dielectric use	High purity, 6 Micron plain Aluminum foil plus 2 layer of P.P (APP) film.
Sealing	Hermetic or Specify, if any other type
Insulation Class	3 KV
Peak Inrush current	Upto 350x Rated current
Over current	Upto 2 x Rated current
Switching Operations per year	20000
Degree of Protection	IP 20
Permissible Losses	Preferably Less then 1.5 W/KVAR
Discharge Device	Resistor must be included

Capacitor banks shall comprise of identical delta connected three phase units with suitably rated discharge resistors. They shall be designed to withstand the Electro dynamic and thermal stresses caused by transient over current during switching.

Capacitor Bank shall be provided with a bus bar chamber.

Besides having above mentioned technical & general specifications, capacitors offered must have following features:

High Inrush Current withstand Capability

High Over current handling Capacity

High Over voltage withstand Capacity

Internal fuse protection

Eco-friendly Design

Rust & Shock proof

Best suited for indoor applications

Test certificates of manufacturer must be supplied with at the time of delivery of capacitors.

7.0 SHOP DRAWINGS :

Prior to fabrication of the panels the supplier / contactor shall submit for consultant's approval the shop/vendor drawing consisting of G.A. drawing, sectional elevation, single line diagram, bill of material etc. and if design calculation indicating type, size, short circuit rating of the electrical components used, bus bar size, internal wiring size, panels dimensions, colour, mounting details etc. in 6 sets. The contractor shall also submit manufacturer's catalogues of the electrical components installed in the panels along with the drawing.

8.0 INSPECTION :

At all reasonable times during production and prior to transport of the panels to site, the supplier/contractor shall arrange and provide all the facilities at their plant for inspection and routine test.

9.0 TEST CERTIFICATES:

Testing of panels shall be carried out at factory and at site as specified in Indian Standards in the presence of engineer incharge /consultant. The test result shall be recorded on a prescribed form. The test certificate for the test carried out at factory and at site shall be submitted in duplicate.

8.2 Local Push Button Station :

Each motor shall be provided with a pedestal mounted control station in the field near the motor. The local control station shall have die-cast Aluminium enclosure of IP-55 protection. The control station shall include START/STOP push buttons cable gland, etc. Stop push button shall have stay put features. All push buttons shall be shrouded type rear connected with 2 NO + 2 NC momentary contact and shall be complete with necessary inscription plates. Outdoor control stations shall have necessary canopies. Local push button station shall include start/stop push button and glands only. Ammeter is not required in local push button station but the same shall be provided with remote/local selector switch in control room. Provision of Ammeter should be made in MCC.

Motor Canopy :

Motor canopies for various size and type of motors for all outdoor motors with necessary thickness for entire STP shall be provided in FRP. Motor covers (canopies) shall be in one piece molded from polyester resin + Glass fiber, having good mechanical properties. It shall have excellent resistance to corrosive atmospheres & aggressive chemicals. The covers shall be provided with louvers & have enough space on all sides for air circulation. Necessary hardware etc. required for fixing shall be supplied by the tenderer. The tenderer will have to get prior approval from Engineer-in-charge prior to supply.

FRP INSULATING MATTING :

For 440 volts grade: 80 Mtr.
For 11000/22000 volts grade: 15 Mtr.

Supplying, erection, testing and commissioning of above mentioned volt grade 1 mtr. width FRP sheet with I.S.I. mark shall be provided for different Panels of approved make. (Make: Sintex)

Power and Control Cables :

Scope :

This specification covers requirements of XLPE / PVC insulated 1.1 KV grade power grade, and control cables.

Codes and Standards :

The design manufacture and performance of cable shall comply with all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed.

The equipment shall conform to the latest applicable Indian standards.

- | | | |
|---------------------------|---|---|
| (a) IS - 1554 (All parts) | : | PVC insulated electric cable (Heavy duty) |
| (b) IS - 694 | : | PVC insulated electric cable (Light duty) |
| (c) IS - 3961 | : | Recommended current rating for cables. |
| (d) IS - 7098 (Part II) | : | XLPE cables. |

Design Requirements of Cables :

Cables shall be capable of satisfactory performance when laid on trays, in trenches, conduits, ducts and when directly buried in the ground.

Cables shall be capable of operating satisfactorily under power supply system voltage variation of +10%, a frequency variation of +5% and a combined voltage and frequency variation of +/-15%.

Cables shall normally be laid under the following conditions :

- | | |
|--------------------------|------------------------------------|
| (i) In air | Ambient temperature of 50 deg.C |
| (ii) In ground | Ground temperature of 40 deg.C |
| (iii) Depth of laying | 900 mm (Approx.) in ground |
| (iv) Thermal resistivity | 120 dec. C cm/watt |
| (v) Conduits | Space factor of not more than 60% |
| (vi) In trays | Single layer, touching each other. |

Cables for control circuit shall incorporate stranded copper conductors with a minimum size of 1.5 sq.mm.

Cable shall be supplied in non-returnable drums made of seasoned wood

For control cables having more than 5 Cores, the method of identification of cores shall be in numerals (1, 2, 3 etc.)

The contractor shall furnish technical data of each type and size of the cable giving the current rating, derating factor, bending radius etc.

Tests :

- (i) All routine tests shall be conducted.
- (ii) Acceptance tests shall be conducted.
- (iii) Test reports shall be furnished.

L.T. CABLE SPLICES AND TERMINATIONS

A Termination

Provide brass or copper indent type connectors or cable lugs crimping/solder type at both ends of the cable. Aluminium or ferrous metal connectors are prohibited. Dowell's make conductivity grease to be used while using crimping type cable lugs/sockets. All motors shall be connected using copper or brass ring-torwue terminals, brass bolts and nuts. The cable lugs, connectors shall fit the conductor to which it shall be connected. The compression tool shall be equipped with attachment, which shall assure proper crimping pressure on the connectors.

Connections shall be made tight and insulated with PVC electrical tape of colour as per I.S.

Termination of cables shall be done by using kits as recommended by the Engineer in Charge taking due care as specified by the manufacturer.

Provide a double compression type cable glands at each end of the cable. Glands should be of nickel-plated brass, with PVC shrouds over it. Before applying a PVC shroud, all bare metal shall be wrapped with pressure-sensitive adhesive PVC tape.

Double compression HW type nickel plated brass cable glands with PVC shroud over it shall be used for termination of cable at flame proof junction boxes or flameproof P.B. Station instead of single compression type cable gland.

B Saddles and Clips

Saddles and clips shall be PVC covered or of G.I. Fixing screws shall be round head brass. Where screws are used nuts shall be of brass, square pressed type.

C. Jointing Sleeves

Jointing sleeves shall be of brass with standard terminations. Solder type cable connectors/cable sleeves shall be used to joint the cable/conductors. The solder used shall comply with B.S. 219 type M.

Non corrosive flux only shall be used.

D. Joints in Cables

Joints in cables shall be kept to a minimum and conductors shall be joined using solder ferrules or siemens make jointing compound. Joints shall be enclosed within standard adaptable boxes. Siemens make Tropolin type or equivalent shall be used. For preference, straight through joints shall be enclosed within brass jointing sleeves where joints are enclosed in other than brass sleeves and are buried in the ground, bitumen base filling compound, complying with B.S. 1858, Class II shall be used to completely fill and seal the joint box after the cover is secured. Where joints are enclosed in brass sleeves and are burries in the ground, the ends of the sleeves shall be plugged with plastic filling compound before the glands are screwed into the sleeve.

Joining of 650 Volt cables shall be done by using recommended make cable jointing kits

taking due care as specified by the manufacturers.

G.I.PIPES:

The G.I. pipe shall be of class 'B' and size of the pipe having length not less than 3 meter.

R.C.C. Pipes:

Supplying and laying of R.C.C. NP3 Class pipe for road crossing and anywhere else as required at site and directed by Engineer-in-charge. The size of pipes shall be selected as per directed by Engineer-in-charge.

M.S. FABRICATION WORKS WITH GALVANIZING COATING :

Providing, fabricating and fixing in position works such as ladders, making suitable cable trays as directed by Engineer-in-charge, screens, etc. as directed by Engineer-in-charge. The detailed drawing or sketch shall be given by the department as and when required depending on the site condition. The final drawing as per fabrication done will be supplied by the contractor. The fabrication shall have to be done using various M.S. steel sections like round, square, flats, angles, channels or M.S. joists as per site requirement. The complete fabricated structure shall be scraped, cleaned and galvanizing coating. This item also includes breaking of R.C.C. slab, beam etc. as per site requirement and make it finish. Sand, cement etc. will be supplied by the tenderer for the same work.

FIRE EXTINGUISHERS:

Each lot shall incorporate following.

Twelve fire extinguishers shall be supplied, each fire extinguisher shall be of the light alloy CO₂ type (for dealing with electric fires) of not less than 4.6 Kg. capacity, fitted with squeeze grip, valve, swivel horn. Extinguishers shall have an effective jet strength of at least 2 m, be suitable for operation in ambient temperatures of C and subject to test pressure of not less than 87 kgs/cm² and complete with wall mounting bracket.

Six sets comprising of four numbers of fire extinguishing sand filled, red coloured M.S. buckets with suitable fabricated stand shall be supplied and placed as directed by the Engineer.

The fire extinguishers shall be supplied at time of commissioning the plant.

They shall be fixed in position designated by the Engineer together with a board giving operating instructions.

All operating instructions shall be of large characters in English and Gujarati Language.

04 sets of first aid kit as per factory act shall be provided.

APFC panel should comprise with following specifications.

(A) APFC Relay :-

The automatic power factor controller should be atleast 12 step microprocessor base and having following features

- Automatic step section depending upon the system power factor and targeted Power Factor. Relay should sense the capacity of each bank automatically and accordingly only required nos. of capacitor should be switched on in any case.
- This controller should take phase sensing current and voltage from both incoming of LT panel. Required Epoxy cast resin C.T.'s for Sensing both L.T. incomer should be supplied by the contractor. Summation C.T. (if required) should be supplied by the contractor. All necessary arrangement required for sensing the NO LOAD current of transformer with amplifying circuit. This APFC panel should operate and maintain the P.F. for load conditions as well as NO LOAD condition of Transformer.
- Automatic selection of C/K ratio (min. capacitor step size/C.T. ratio)
- Indication of real time P.F. with lagging or leading
- Prevent leading P.F. during low load condition
- Audio (Hooter) and Visual alarm with reset Push button for low P.F. below targeted.
- The APFC relay should have RS-485 communication port to communicate PLC/SCADA

The 12 step P.F. controller should operate capacitor in required step depending upon system power factor. The capacitor must be disconnected in the event of power supply failure and should be protected against high inrush current, when power supply restored or at the time of automatic and time delayed switching of capacitor.

The details of all INCOMERS shall be ACB of atleast 1.6 times to the total capacitor current AND OUTGOING FEEDERS shall have Contactor with inductor coil to prevent inrush current of capacitor. Timer for time delay shall be provided in manual mode for each individual feeder. Required control wiring should be taken from control bus bar. Each control circuit should be protected by appropriate capacity of MCB. And all the outgoing shall be protected by thermal MCCBs. Capacitor specification as mention as elsewhere.

Specifications for Medium Voltage Motors :

All medium voltage induction motors shall meet the requirements of enclosed and following specific requirements in addition to requirements as per latest edition of IS:325

Motors shall be squirrel cage type in standard frame sizes rated for continuous duty and designed for direct-on-line/star delta starting across full line voltage. Motor's shall be capable of withstanding occasional bus transfer/reacceleration at a voltage not exceeding 150% of the rated voltage. All motors shall be suitable for starting under specified load conditions with 75% of the rated voltage at the terminals. Motors rated 30 KW and above shall be would using dual coated wire with high temperature index as per I.S. 4800 Part-13 and applying Dr.Beck's Epoxy Gelcoat on overhung portion of the winding.

Motors shall be designed to allow three consecutive starts from cold condition, two consecutive starts from hot condition and four uniformly distributed starts in one hour. Minimum locked rotor thermal withstand time at rated voltage shall be 10 seconds under cold conditions and 8 seconds under hot conditions. Motor starting time shall be less than its hot thermal withstand time.

Starting current shall generally be limited to six times the rated current for all motors. Starting torque, minimum torque and pull out torque shall be compatible with the speed torque curve of the driven equipment with due regard to pulsating loads with minimum acceptable values as 110%, 90% and 175% respectively of the rated torque. For heavy duty motors, high starting torque (min 150%) motors shall be provided with starting time preferably less than ten seconds.

Motors shall be provided with class "F" only insulation and the permissible temperature rise above the specified ambient temperature shall be limited to the values applicable for class "B" insulation. The windings shall be tropicalized and adequately braced. The ends of the windings shall be brought out in a terminal box with six terminals with suitable links to connect them in Delta.

The terminal box shall be capable of withstanding the full internal shortcircuit conditions with the specified system fault level. The fault duration shall be taken as 0.25 secs. for motors rated 55 KW and above. For motors rated below 55 KW, the fault energy to be considered shall depend upon the back up fuse rating. The terminal box shall be located on the right hand side viewed from the driving (coupling) end. It shall be rotatable in steps of 90 deg. to allow cable entry from any direction. The terminal box shall be of sturdy construction and large enough to facilitate easy connection of cables. Following sizes of aluminium conductor, PVC insulated armoured cables shall be applicable for design of terminal box and related accessories.

The power cable shall be 3 core armoured cables for motors. Each motor shall have two separate earthings.

Motor rating	Size of Conductors (mm ²)	Size of Earth conductors (if used) (mm ²)	No. and size of entry ET-IS:1653
3.7 KW	4	4	19 MM
5.5 KW	6	6	25.4 MM
7.5 KW -11 KW	10	10	25.4 MM
15 KW	16	16	31.8 MM
18.5 KW	25	16	31.8 MM
22 KW	35	25	31.8 MM
30 KW	50	25	38 MM
37 KW	70	35	38 MM
* WHERE APPLICABLE AS PER DATA SHEET)			

Motors shall be suitable for either direction of rotation. Bearing shall be chosen to provide a minimum operating life of 40,000 hours and shall preferably be capable of grease injection from outside without removal of covers with motors in running condition. Prelubricated bearings wherever used must provide 4 to 5 years of trouble-free service without any replacement or re-lubrication. Motors vibrations shall be within the limits of IS:4729 unless otherwise required for the driven equipment.

Motors shall be totally enclosed fan cooled (TEFC) type minimum degree of protection for rotor enclosure, terminal box and bearing housing shall IP-55 as per IS : 4691. Vertical motors shall be provided with fully covering plain canopies. In addition to the two earth terminals on the motor body, an earth terminal shall be provided inside the terminal box.

All motors rated above 30 KW shall be provided with 220V +/-10% anti-condensation heater. These heaters leads shall conform to the provisions of applicable standards for motors installed in hazardous areas. The heater shall be brought out to a separate terminal box in IP-55 enclosure suitable for two core 4 sq.mm. aluminiumconductor armoured cable.

Generally 1000 RPM and highly efficiency motors shall be preferred. The min. value for product of efficiency and power factor shall be as per IS:8789. For ratings not covered in IS:8789, product of efficiency and power factor shall be as agreed between the owner and vendor.

Internal and external parts of the casing and all metal parts likely to come in contact with the surrounding air shall be protected with anti-acid paint. All external surface shall be given a coat of epoxy based paint.

Specification for Lighting Fixtures and Accessories :

Scope :

The specification covers the requirements of lighting fixtures for LED lamp and associated accessories. Equipment shall include lighting distribution boards, lighting fixtures, poles, switches, receptacles, conduits wires and miscellaneous hardware necessary for complete lighting work.

Code and Standards :

The design,manufacture and performance of equipment shall comply with all currently applicable statutory regulations and safety codes in the location where these fittings will be installed.

The fittings shall conform to the latest applicable Indian Standards, British Standards or IEC Standards, some of which are listed below :

IS : 1913 General and safety requirements for electric lighting fittings.

IS : 1777 Industrial lighting fittings,with metal reflectors.

IS : 4012 Dust proof electric lighting fittings.

IS : 3528 Water proof electric lighting fittings.

IS : 2149 Luminaries for street lighting.

IS : 1947 Specification for flood light.

IS : 5077 Specification for decorative lighting out-fits.

IS : 1534 Ballasts for use in fluorescent lighting (Part I) fixtures.

IS : 1569 Capacitors for use in fluorescent lighting fixtures.

IS : 1950 Vitreous enamel reflectors for discharge lamps.

IS : 1391 Air-conditioners.

IS : 10332 Specification for luminaries

IEC 62384 DC or AC supplied electronic control gear for LED modules performance requirements

IEC/ PAS 62612 Self-ballasted LED lamps for general lighting services- Performance requirements

IEC 61347-2-13 Lamp controlgear: particular requirements for DC or AC supplied electronic control gear for LED modules.

IEC 61000-3-2 Electro Magnetic compatibility (EMC)- Limits for Harmonic current emission -- (equipment input current ≤ 16 A per phase.

IEC 60598-1 Luminaries - General requirement and tests

Lighting Fixtures : The fixtures shall be suitable for operation on a nominal supply of 220volts, single phase, 50 Hz +/- 5% a-c with a voltage variation of +/-10% (i.e.228 V to 252 V).

All fixtures shall be designed for continuous operation under atmospheric conditions specified without reduction in lamp life or deterioration of materials and internal wiring.

Ballast : Lighting fixture ballasts shall be designed, manufactured and supplied in accordance with the relevant standards and shall function satisfactorily under site conditions specified. The ballasts shall have a long service life and low power loss.

Ballasts shall be mounted using self-locking anti-vibration fixings and shall be easy to remove without removing the fittings.

The ballasts shall be of the inductive and heavy duty type, filled with polyster or equivalent. They shall be free from hum and protected from the atmosphere. Ballasts which produce a humming sound shall be replaced free of cost by the supplier.

For multi lamp fittings, a separate choke shall be provided for each lamp.

Starters : Lighting fixture starters shall be of the safety type (i.e. if the lamps fail to ignite at the first start, no further starting must be possible without attending to the tube light). Starters shall have bimetal electrode and high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamp and without the use of any tool.

Lighting fixture capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.

Each capacitor shall be suitable for operation at 220 volts + 10 % single phase 50 Hz + 5 %

with a suitable value of capacitance so as to correct the power factor of its corresponding lamp circuit to the extent of 0.98 lag. The capacitors shall be hermetically sealed preferably in a metal container to prevent seepage of impregnating materials and ingress of moisture.

Reflectors : Lighting fixture reflectors shall generally be manufactured from sheet steel or aluminium of not less than 20 SWG. They shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be securely mounted to the housing by means of positive fastening devices of a captive type.

General :

- (i) Each fixture shall be complete with a four way terminal block for the connection and looping of incoming and outgoing supply cables. Each terminal shall be able to accept two 6 mm² solid aluminium conductors.
- (ii) Each lighting fixture shall be provided with a grounding terminal suitable for connecting 2.5 mm² stranded tinned copper grounding conductor.
- (iii) All metal or metal enclosed parts of the housing shall be so banded and connected to the ground terminal so as to ensure satisfactory grounding continuity throughout the fixture.
- (iv) On completion of manufacture, all surfaces of the fixtures shall be thoroughly cleaned and degreased. The fixtures shall be free from scale, rust, sharp edges and burrs.
- v) The enamel finish shall have a minimum thickness of 2 Mils for outside surfaces and 1.5 Mils for inside surfaces. The finish shall be non-porous and free from blemishes, blisters and fading.
- (vi) All light reflecting surfaces shall have optimum light reflecting co-efficient such as to ensure the overall light output as specified.
- (vii) All reflectors and louvers shall be furnished to the same standard as the fixture housing.

Tests :

The following routine tests shall be conducted as per the relevant Indian Standards.

- (a) Each fixture shall be tested at 1500 volts r.m.s. 50 Hz for one minute and no flash over or break down shall occur between current carrying parts and ground.
- (b) Insulation resistance of each fixture shall be tested at 500 V d-c and the insulation resistance so measured shall not be less than 2 megohms between all current carrying parts and ground.

- (c) Each fixture complete with its proper lamp/lamps shall be shown to operate satisfactorily at its normal voltage and frequency.
- (d) Each fixture shall be examined visually to ensure that it is complete in all respects and satisfactorily finished.
- (e) Type and routine test certificates shall be submitted for tests conducted as per relevant IS/BS for the fixture and accessories.

Drawings and Data : As part of the proposal, the Bidder shall furnish relevant descriptive and illustrative literature on lighting fixtures and accessories and following drawings/data for the respective lighting fixtures :

- (i) Dimensional drawings
- (ii) Mounting details cable entry facility and weights
- (iii) Light distribution diagrams (zonal & isekandera)
- (iv) Light absorption and utilisation factors
- (v) Lamp output v/s. temp, curves.

Lighting Fixtures and Layout :

General Specification for LED Inddor Lightning :

LED indoor fittings with LEDs of wattage 0.2 Watt to 0.5 Watt assembled on single MCPCB, with housing used as a heat sink shall be made of thick sheet Steel conforming to IS: 13/CRCA polyester powder coated and high U.V. & corrosion resistance with diffuser and/or Polycarbonate optics with company mark/name 120 to 300 V, Power Factor more than 0.9, THD < 10 %, CCT 4000 K to 6500K, Uniformity ratio >0.7, Luminaire efficiency > 85 lumens/watt , LED driver efficiency > 85 % CREE / OSRAM / PHILIPS Lumileds / NICHIA / SEOUL/Bridgelux(U.S.A.) make LED used for luminaire. (Each fitting required LM-80 Certificates)

General Specification for LED Outdoor Lightning :

LED indoor fittings with LEDs of wattage 0.2 Watt to 0.5 Watt assembled on single MCPCB, with housing used as a heat sink shall be made of thick sheet Steel conforming to IS: 13/CRCA polyester powder coated and high U.V. & corrosion resistance with diffuser and/or Polycarbonate optics with company mark/name 120 to 300 V, Power Factor more than 0.9, THD < 10 %, CCT 4000 K to 6500K, Uniformity ratio >0.7, Luminaire efficiency > 85 lumens/watt , LED driver efficiency > 85 % CREE / OSRAM / PHILIPS Lumileds / NICHIA / SEOUL/Bridgelux(U.S.A.) make LED used for luminaire. (Each fitting required LM-80 Certificates)

It shall be the responsibility of the tenderer to workout a detailed layout for the lighting fixtures offered by him, in order to provide the specified levels of illumination. The tenderer shall be responsible for measuring the levels of illumination after installation and establish compliance with the specification. The number and types of fixtures offered by him shall be indicated in

his tender. The final layout of the lighting fixtures shall be furnished for the approval before commencement of installation.

As per Ste requirement 1 x 22 watts LED tube light fixtures (indoor type with reflector) complete in all respect will be required to be provided for lighting of Existing 66 MLD STP, New 101 MLD STP, Dinsoli SPS and 40 MLD TTP. Detailed layout shall be finalised at the time of detailed Engineering.

As per Site Requirement 1 x 45 Watts LED Street light fixtures (outdoor type Street Light Fixture) complete in all respects will be required to be provided for lighting of Existing 66 MLD STP, New 101 MLD STP, Dinsoli SPS and 40 MLD TTP. Detailed layout shall be finalised at the time of detailed Engineering.

As per Site requirement 1 x 120 Watts LED Flood light fixtures (outdoor type) complete in all respects will be required to be provided for lighting of Existing 66 MLD STP, New 101 MLD STP, Dinsoli SPS and 40 MLD TTP. Detailed layout shall be finalised at the time of detailed Engineering.

As per requirement Ceiling Fan comp. in all respects will be required to be provided lighting. Detailed layout shall be finalised at the time of detailed Engineering.

The layout/detailed drawing for the complete plant lighting (inside and outside) must be prepared and got approved from the Surat Mahangar Seva Sadan.

Lighting fixtures for the pump-bay shall be industrial type LED complete with reflector. Street lighting shall be carried out with pole mounted sodium vapour lamp fixtures. All other indoor areas shall be illuminated using fluorescent tube fixtures of the industrial / decorative type, complete with reflectors.

All the luminaries inside the bio gas power plant Building shall be flame proof type only.

All lighting fixtures shall be supplied complete with lamps and all necessary accessories for their satisfactory operation.

All lighting fixtures Outdoor type as well as indoor type shall be as per approved vendor list and LED type only.

Lighting fixtures shall be any of the following makes such as Phillips, Crompton, GEC make and equipped with all components required for their satisfactory performance. All lighting fixtures shall be complete with necessary mounting accessories.

Receptable units - Lighting Systems : Decorative and industrial type receptacle units of approved make of 5A, and 15A rating with switches conforming to IS : 3854 and sockets

confirming to IS : 1293 shall be supplied and installed. Minimum 10 nos. of each rating shall be provided.

Plant Wiring: All plant wiring shall be carried out using casing capping made from exclusively extrusion process using special compounded PVC resin having flat surface of casing with curved arrangement to grip the capping for fitting and holding. Casing can be screwed on surface by screw easily. No screw will be visible from outside. The wiring shall be done using copper conductor PVC wire confirming to IS-1554 with concealed plate type switches and switch boards (Make-M.K./C.P.L./Ellora). The copper conductor PVC insulated earth wire shall run through-out for light and power points.

It shall be the responsibility of the Contractor to work out a detailed layout for the complete plant in order to provide the levels of illumination as indicated in the relevant standards.

Emergency Lighting: Emergency Lighting shall be designed such that at all junctions, exit passages & strategic locations, Lux level shall be maintained above 10 Lux. Emergency light fitting shall be 240 V self contained 10 W LED type with built in Ni-Cd battery having charging facility and six hours back-up time.

Lighting cable from Main lighting DB (MLDB) to Lighting panels shall be Al / CU conductor, XLPE insulated, 1.1KV grade, laid in cable trays otherwise cleated along the wall/ column/ beam.

The provision made under quality control act/order shall be followed.

Each fitting shall be controlled individually.

Critical Lighting shall be designed such that at all junctions, exit passages & strategic locations the Lux level shall be maintained above 10 Lux. Installite fixtures with built in battery backup shall be Considered.

Specific Requirements :

(i) Illumination Levels :

The illumination levels to be considered for the design of lighting system for various areas shall be as following. These are the illumination levels achieved at Work plane.

Area Illumination Level (Lux) - Average values

Office rooms	300 Lux
Switchgear rooms	250 Lux
Control rooms	300 Lux

Chemical and general stores	150 Lux
Chemical plant room	200 Lux
All other indoor areas	150 Lux
Outdoor platforms and walk ways	50 Lux
Outdoor plant areas	20 Lux
Transformer Area	
- General	10 Lux
- On Equipment	30 Lux
Roads	20 Lux
Large tank & reservoir	15 Lux
Process Area	100 Lux

Technical Specification For Energy Efficient Led Based Luminaire: -

This specification is for technical and general requirements design, development, manufacturing, testing and supply of energy efficient LED luminaire complete with all accessories, LED lamps with suitable current control driver circuit and required optics including mounting arrangement for streetlight going to use at the site.

CODES & STANDARDS: -

- IEC 60529 Classification of degree of protections provided by enclosures (IP Codes)
- EN 55015, CISPR15 Limits and methods of measurement of radio disturbance characteristic of electrical lighting and similar equipment.
- IEC 62031 LED modules for general lighting-Safety requirements
- IEC 61547-EMC Immunity requirement
- IEC 60598-2-1 Fixed general purpose luminaries
- IEC 60598-1 Luminaries - General requirement and tests
- IEC 61000-3-2 Electro Magnetic compatibility (EMC)- Limits for Harmonic current emission — (equipment input current ≤ 16 A per phase.
- IEC 60068-2-38 Environmental Testing: Test Z- AD: composite temperature/ humidity cyclic test
- IEC 61347-2-13 Lamp controlgear: particular requirements for DC or AC supplied electronic control gear for LED modules.
- IS 10322 Specification for the luminaries
- IS 4905 Method for random sampling
- LM 79 LED luminaire photometry measurement.

- LM 80 Lumen Maintenance
- IEC 62384 DC or AC supplied electronic control gear for LED modules performance requirements
- IEC/ PAS 62612 Self-ballasted LED lamps for general lighting services- Performance requirements

ENVIRONMENTAL CONDITIONS: -

The LED streetlight is to be used at the in city of Surat. It is located in Southern part of Gujarat. The equipment shall be designed to work in such environmental conditions:

- (xi) Maximum ambient air temperature: **50° C**
- (xii) Minimum ambient air temperature: **5° C**
- (xiii) Max. Relative humidity: **90%**
- (xiv) Average Rainfall: **55 inches**
- (xv) Atmosphere: **Dusty and Heavy chemical smoke at times in certain areas.**
- (xvi) Coastal area: The equipment shall be designed to work in coastal area in humid, salt laden and corrosive atmosphere.

LUMINAIRE SELECTION CRITERIA: -

ILLUMINATION LEVEL:

The detailed calculation with uniform distribution including the lux distribution curve/ graph/ spatial distribution shall be submitted in support of the dimensions selected and variation thereof. The luminaries shall be so designed that the illumination level shall be evenly distributed and shall be free from glare.

CONSTRUCTIONAL FEATURES:

General:

- a) Luminaries shall be made of die cast aluminium/ extruded Aluminium body with powder coated finish having safety.
- b) Heat sink used should be aluminium extrusion having high conductivity. Heat sink should be integrated within luminaries and efforts shall be made to keep the overall outer dimensions optimum such that it permits sufficient heat dissipation through the body itself so as to prevent abnormal temperature inside the luminaries and consequential damage to cover, gasket material, LEDs, lenses and drivers.
- c) LED must be mounted on Metal core PCB with suitable large area surface by means of fins to dissipate the conduct heat. The fins must be exposed to ambient flowing air.
- d) All luminaries shall be provided with toughened glass of min. 0.8 mm thickness of sufficient strength. UV stabilised Poly carbonate material is also acceptable. High efficiency prismatic diffuser/Lens under the LED chamber to protect the LED and luminaries shall be provided.

- e) The minimum IK protection of optic cover shall be IK 05. The test material certificate shall be provided.
- f) Suitable number of LED lamps shall be used in the luminaries. The manufacturer shall submit the proof of procurement of LEDs from OEMs at the time of testing.
- g) Suitable reflector/ lenses may also be provided to increase the illumination uniformity and distribution.
- h) The electrical component of the LED and LED driver must be suitably enclosed in hermetically sealed unit.
- i) The connecting wires used inside the luminaries, shall be low smoke halogen free, fire retardant e-beam cable and fuse protection shall be provided in input side.
- j) Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.
- k) The equipment should be compliant to IEC 60598-1, IEC 62031 and IEC/PAS 62612 depending on the type of luminary.
- l) The LED Module(s), Driver gear, etc. shall be designed in such a way so that temperature of heat sink shall not exceed 70° C.
- m) All the material used in the luminaries shall be halogen free and fire retardant confirming to standard.
- n) The infrastructure for Quality Assurance facilities to verify/ test/ prove above specifications must be available at the manufacturing facility. The compliance shall be indicated clearly in the tender itself.
- o) All fasteners must be of stainless steel.
- p) All glands inside/ outside luminaries must be metallic
- q) Heat sink must be thermally connected to MCPCB/ LED light source.

High power and high lumen efficient LEDs suitable for following features shall be used:

- aa) The working life of the lamp at junction temperature of 85° C (max) at operating current shall be more than 50,000 working hours of accumulative operation and shall be suitable for continuous operation of 24 hours per day. These features shall be supported with datasheet.
- bb) Adequate heat sink with proper thermal management shall be provided.
- cc) Lumen maintenance report as per LM 80 guidelines shall be produced for the power LEDs used.
- dd) Thermal management shall be in such a way that LED soldering point temperature shall not go beyond 75° C.
- ee) The LED luminaries shall be free of glare.

LED DRIVER specification used for streetlight:

- a) Current waveform should meet relevant nation and international standard.
- b) LED Driver shall withstand, withstand voltage up to level mentioned elsewhere in tender and restore once normal working when normal voltage is applied.
- c) The life of the driver should more than 25000 Hrs.
- d) Maximum Temperature rise $\leq 30^{\circ} \text{C} @ 45^{\circ} \text{C } T_{\text{amb}}$. With safety margin of 10°C .
- e) The control gear should be compliant to IEC 61347-2-13, IEC 62031 and IEC 62384 as per the requirements.
- f) The driver of the luminaries should have Short Circuit, Over Voltage, over current, over temperature, Under Voltage, String Open protections.

The electronic components used shall be as follows:-

- a) The protective cum adhesive coating used on PCBs should be cleared and transparent and should not affect colour code of electronic components or the product code of the company.
- b) The construction of PCBs and the assembly for components for PCBs should be as per IS standards.

DATA SHEET

Sr. No.	Parameter	Value/Detail
(1)	Rated Supply Voltage	230 V ~, 50 Hz
(2)	Input supply voltage range	140-270 V
(3)	Expected Input Frequency	50 Hz +/- 3%
(4)	Working Temperature	+5° to +50° C
(5)	Working Humidity	10% - 90% RH
(6)	Usage hours	Dusk to dawn
(7)	Power Factor	≥ 0.90
(8)	Index of Protection Level	Minimum IP 65 as per IEC 60529.
(9)	LED Chip efficacy	$\geq 120 \text{ lm/ W}$
(10)	Driver Efficiency	$> 85\%$
(11)	Junction Temperature of	$< 85^{\circ} \text{C}$
(12)	Rated Life @ L70	50,000 burning hours at 35°C
(13)	Nominal Correlated Colour	5000°K to 6000°K
(14)	Dispersion Angle	Minimum 120°
(15)	Tilting angle	Adjustable / Fixed
(16)	Maintenance factor of	0.85
(17)	Colour Rendering Index	≥ 65

(18)	Total Harmonic Distortion	< 15 % (EMI/ EMC Certification)
(19)	LED MAKE	Cree/ Osram/ Nichia/ Philips

Acceptance Tests: -

These tests are carried out by an inspecting authority at the supplier's premises on sample taken from a lot for the purpose of acceptance of a lot. Acceptance tests shall not be carried out from particular size from the lot on which type tests have already been conducted. Recommended sampling plan is given below.

- A. Marking & Dimensions
- B. Total Power including Driver
- C. Luminaire efficiency & Module efficacy
- D. Colour rendering index (CRI)
- E. Endurance test
- F. Lumen maintenance
- G. Degree of protection test
- H. Chromaticity coordinates and correlated colour temperature

Specification for Earthing and Lightning Protection :

Scope :

This specification covers requirements of earthing and lightning protection system. The specification is intended to cover complete supply, installation, testing and commissioning of the earthing and lightning systems.

General Information :

The design, supply and performance of the system shall comply with all currently applicable statutory regulations and safety codes in the locality where the systems will be erected and commissioned.

The earthing and lightning system shall be installed in conformity with the requirement of Indian Electricity Act 1910 as amended and the Indian Electricity Rules formed thereunder Indian Standard code and practice and other statutory regulations, that may be relevant to the erection.

Unless otherwise specified, the equipments, materials and accessories provided by contractor shall conform to the latest applicable Indian Standards or IEC Standards some of which are listed below :

IS : 3043 Code of Practice of earthing.

IS : 2039 Code of practice for protection of building and allied structures against lightning.

Earthing System :

1. Two separate and distinct earth leads shall be used for earthing each equipment/structures enclosing the power conductor and one earth lead for metallic

- structure adjacent to electrical installation.
2. Metallic frames of all electrical equipment rated above 250 volts, must be earthed by two distinct connections with earth system.
 3. Earthing cables crossing other metallic structures such as conduits pipe lines etc., shall be minimum 300 mm away from such structures.
 4. All underground connections and joints in earthing system shall be brassed/welded. Connections with equipments/structures shall be bolted type.
 5. Conducting petroleum jelly shall be applied to contact surfaces of all bolted joints and joints shall be covered with bituminous compound and taped.
 6. When G.I. conductors are connected to aluminium conductors the contact surfaces of G.I. shall be tinned to prevent bimetallic corrosion.
 7. Neutral connection shall never be used for the equipment earthing.
 9. Earthing conductors shall be protected against mechanical damage.
 10. All motors can be connected to the earth grid by providing pads.
 11. Earthing conductors running along the structures, wall etc. shall be cleated at every 750 mm interval.
 12. Minimum size of earth conductor shall be in accordance with IS:3043. However, sizes of earth conductors for equipment shall be at least half the size of power conductor, limited to maximum of 120 mm of aluminium.
 13. All earth lead connections shall be as short and direct as possible and shall be without link

Indoor Equipment Earthing :

1. Each floor of building shall have its own earth bus embedded in concrete.
2. Earthing grid embedded in the floor slab shall have a minimum concrete cover of 50 mm.
3. Earth buses on different floor and main grid shall be connected by a latest two conductors of main grid conductor size.
4. Every alternate column (steel or RRC) of the building, housing electrical equipments shall be connected to main earthing grid.
5. Earthing conductors shall be welded at intervals of 1000 mm along their run of stye structure and shall be at interval of 750 mm along the wall.

Outdoor Equipment Earthing :

Wherever earthing conductor crosses the trenches, funnels railway, track, etc., it shall be run below the trench etc.

Equipment structures shall be earthed at two diagrammatically opposite points.

Earthing & Lightening Protection System:

1. Sizes and number of earth leads for earthing various items and other technical particulars shall be as specified by the contractor.

2. Earthing conductors shall be shown diagrammatically. Exact location of earthing conductors, earth electrodes test pits, and earthing connections may be changed to suit the site conditions.
3. Earthing conductors in the building, running parallel to walls and columns shall not be less than 150 mm away from the wall/ columns.
4. Suitable earth risers shall be provided if the equipment is not available while carrying out earthing connections.
5. However, earthing conductor passes through walls, galvanized iron sleeves shall be provided for the passage of earthing conductor. Water stop sleeves shall be provided. Water stops shall be provided wherever earthing conductor enters the building from outside.
6. Whenever the Conductors are to be buried, the contractor shall co-ordinate with other civil contractors to ensure that the conductors are installed before concreting.
7. All connections shall be low resistance, so that contact resistance shall be minimum.

OCTAGONAL TYPE STREET LIGHT POLE

Structure:-

The Octagonal Poles shall be designed to withstand the maximum wind speed of 159 Km/hr. The maximum stress at wind speed of 159 Km/Hr shall not exceed 80% of the strength of steel. The detail of top loading i.e. the weight and area of top luminaries are worked out based on this consideration. Maximum deflection of the pole shall meet the requirement of BS 5649: part 6 1982. The pole shall be hot dip galvanized as per IS 2629/IS 2633/IS 4759 standards with minimum coating thickness of 85 micron.

The pole shaft shall have Octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by Submerged Arc Welding process using state of the art know how. All Octagonal Pole shafts shall be provided with the rigid Flange plate of suitable thickness with provision for fixing four bolts. This base plate shall be fillet welded to pole shaft at two locations i.e. from inside and outside.

P.C.D. of Base plate must be suitable to Anchor plate which is already casted on bridge. Item Includes one no of 63 Amp rating terminal plate and 1 No. of SP 2 Amp MCB with DIL rail (B Series) per luminary shall be provided having rupturing capacity ≥ 10 kA. Terminal plate made up of Bakelite with appropriate current rating, SP MCB (B Series) and stud type terminal shall be mounted at the base of the pole. If a particular light fitting has to be manually operated the same can be done by this MCB provided at the base compartment. The provided terminal shall be suitable for loop-in-loop-out of max. 4 Core x 25 sq mm armoured cable. 1 No. of SP 2 Amp MCB (B Series) per luminary shall be provided having rupturing capacity 10 kA.

The cable shall be terminated at connector in the pole using ISI Marked PVC 1.1 KV grade insulating tape roll with appropriate colour code. All items shall be fixed on the Bakelite sheet of suitable size having 12 mm thickness. There shall also be welded a clip of size 40 x 40 x 4 mm for the purpose of earthing.

The pole shall be adequately strengthened at the location of the door to complete for the loss in section.

Material:-

Octagonal Poles: Steel conforming to St 35 or required grade

Foundation Bolts: As per relevant IS

Base Plate : IS 226/IS 2062 steel

The steel used to manufacture steel poles is as per BSEN 10025 grade S355 Jo. Yield strength Min. 355N/mm² and Tensile strength 490 - 630 N/mm².

Please note that among the various standards mentioned, most stringent will apply.

Door Opening:-

An adequate door opening shall be provided at the base of the pole and the opening shall be such that it permits clear access to equipment like termination plate, MCB, cables, etc. The door opening shall be complete with a close fitting, vandal resistant, weather proof hinged type with mechanical internal lock with special paddle key.

The door shall have required width-having height of minimum 250mm at the elevation of 500 mm from the Base Plate. The door shall be vandal resistance and shall be dust proof to ensure safety of inside connections. The door shall be flush with exterior surface and shall have suitable locking arrangement. The door opening shall be carefully designed and reinforced welded steel section, so that undue buckling of the cut section under heavy wind conditions.

Pole Earthing:

Pipe type Earthing having 150 cms long and 2.5 cms. Dia galvanised iron pipe with coupling and buch buried in specially prepared earth pit complete with necessary 25 x 3 mm size GI earthing strip using salt and charcoal / coke as required for pipe type earthing. Earthing pipe will be connected to pole by GI earthing strip through nut-bolt & washers.

ITEM NO 8 : EARTHING STATION

1. GENERAL :

(i) All the non-current carrying metal parts of the electrical installation and mechanical equipment shall be earthed properly. The cables armour and sheath, electric panel boards, lighting fixtures, ceiling and exhaust fan and all other parts made of metal shall be bonded together and connected by means of specific earthing system. An earth continuity conductor shall be installed with all the feeders and circuit shall be connected from the earth bar of the panel boards to the conduit system, earth stud of the switch box, lighting fixtures, earth pin of the socket outlets and to any metallic wall plates used. All the enclousers of the motors shall be also connected to the earthing system.

2. SCOPE OF WORK :

The scope of work shall cover supply, laying, installation, connecting, testing and commissioning of :

Earthing station.

Earthing G.I/Copper strips from earthing station to equipotential bar.

Earthing G.I/Copper strips/ wires from equipotential bar to lay feeder mains and circuit to connect power panels, DBs, switchboards etc.
Bonding of Non-current carrying parts, and metallic parts of the electrical installation.

3. STANDARDS :

The following standards and the rules shall be applicable.

IS; 3043 – 1966 Code of practice for earthing.

Indian Electricity Act and Rules

All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the British Standard Code of Practice in absence of Indian standards.

4. TYPE OF EARTHING STATION :

PIPE / CHEMICAL TYPE EARTHING :

Supply, Erection, Testing and commissioning of earthing station having ‘ Pipe in Pipe ’ / “Flat in pipe” (Chemical Type) technology using Safe Earthing Electrode. The special type back filling compound having inherent moisture absorption characteristics must be used to make the earthing station maintenance free and no periodic water pouring should be required. The work shall include excavation refilling providing manhole cover, chamber etc. the earthing station shall as per IS 3043:1987 requirements.

Earthing station shall be provided for all Electrical system as per above technology. Earthing station shall be provided having G.I. electrode 3000 mm long, outer diameter of minimum 50 mm and inner diameter of minimum 25 mm with GI earthing strip or as per DGVCL/GETCO/Torrent Power Ltd. Standard.

Multiple earth connection shall be taken from suitably located earth plates connected to earth loop. All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections of equipment. Unless otherwise specified, earthing connections to individual equipment shall be done in accordance with standard equipment earthing schedule.

Plant instrument system clean earthing, UPS system clean/safety earth shall be separate from the electrical earthing system.

Earth connections shall be made through compression type cable lugs / by welded lugs.

All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections and all connections adequately locked against loosening.

METHOD OF MEASUREMENT :

Provision of earthing station complete with excavation, electrode, watering pipe, soil treatment. Masonry chamber with cast iron cover etc. shall be treated as one unit of measurement.

TEST :

The entire earthing installation shall be tested as per requirements of Indian standard Specification IS : 3043.

The following earth resistance values shall be measured with an approved earth megger and recorded.

1. 1. Each earthing station.
2. 2. Earthing system as a whole.
3. 3. Earth continuity conductors

Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 ohm in each case.

Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

All tests shall be carried out in presence of the Surat Smart City Development Limited's representative.

Recommended Size of Earthing Conductors

Below are the recommended minimum sizes of earth conductors. However, Earthing Strips/conductors, if required of higher size as per Ground Fault Calculations, should be laid.

Type of Equipment Earth conductor size

Small equipment and instrument 8 SWG GI solid wire Or through min. 1.5 sqmm earth conductor of power cable Lighting, Power and Instrument Panels 10mm dia GI wire rope Or 25 x 3 mm GI Strip Push Button Stations (LCS) 8 SWG GI solid wire

ITEM NO 9 :EARTHINGSTRIPS

- (a) **Copper strip 50 x 6 mm**
- (b) **G.I. strip 25 x 3 mm**
- (c) **12 S.W.G. G.I. Wire**

Supply, erection, testing and commissioning of earthing strips for connection between LT switch gear, motor, starter as well as transformer neutral and earthing stations.

The earthing strips shall be laid underground or in trenches or on the floor of pump house and hence excavation/ refilling, clamps etc shall be included. The strips shall be finally painted with green colour. The joints shall either be brazed or bolted after tin plating the ends and using GI/brass bolt nut and washers as per direction of engineer –In- charge. All equipment earthing joints must be done using nut-bolts and other must be welded. For measurement purpose overlapping of joints shall not be considered and payment shall be made as per actual basis. All necessary excavation, refilling shall be in the scope of the work. Two separate and distinct earth leads shall be used for earthing each equipment/structures enclosing the power conductor

and one earth lead for metallic structure adjacent to electrical installation.

Metalic frames of all electrical equipment rated above 250 volts, must be earthed by two distinct connections with earth system.

Earthing cables crossing other metallic structures such as conduits pipe lines etc., shall be minimum 300 mm away from such structures.

All underground connections and joints in earthing system shall be brassed/welded.

Connections with equipments/structures shall be bolted type.

Conducting petroleum jelly shall be applied to contact surfaces of all bolted joints and joints shall be covered with bituminous compound and taped.

When G.I. conductors are connected to aluminium conductors the contact surfaces of G.I. shall be tinned to prevent bimetallic corrosion.

Neutral connection shall never be used for the equipment earthing.

Earthing conductors shall be protected against mechanical damage.

All motors can be connected to the earth grid by providing pads.

Earthing conductors running along the structures, wall etc. shall be cleated at every 750 mm interval.

Minimum size of earth conductor shall be in accordance with IS:3043. However, sizes of earth conductors for equipment shall be at least half the size of power conductor, limited to maximum of 120 mm of aluminium.

All earth lead connections shall be as short and direct as possible and shall be without link

Earth Pits and Main Grid :

1 Adequate under of earthing pits and electrodes shall be used in conjunction with earthing grid.

The minimum spacing between two adjacent earth pits shall not be less than five (5) meters and shall be kept sufficiently away from structures to clear footings.

2 The main grid loop for a building shall be installed outside foundation of the building, buried in back fill. It shall be installed at a minimum depth of 600 mm outside the building wall. The main earth loops (MEL's) in plant areas shall be generally routed along cables when equipments are located away MEL's suitable sub-loops may be run upto them for deriving connections for individual equipment.

LIGHTENING PROTECTION :

Tall structures shall be protected against lightning strokes by suitable lightning protection system to be fabricated and installed.

Down conductor shall not be taped in between for equipment earthing.

Cable sheaths, metal conduits, casing etc. shall not be connected to lightning protection system.

Down-conductor shall be as short as possible. Each down conductor shall be provided with a testing point located at a height of about 1000 mm from ground level.

A minimum 2 meter separation shall be maintained between any other electric conductor and lightning protection system.

Earthing and lightning protection system shall be blended to each other to prevent side flash over, if adequate clearance between two system cannot be maintained.

Indoor Equipment Earthing :

Each floor of building shall have its own earth bus embedded in concrete.

Earthing grid embedded in the floor slab shall have a minimum concrete cover of 50 mm.

Earth buses on different floor and main grid shall be connected by a latest two conductors of main grid conductor size.

Every alternate column (steel or RRC) of the building, housing electrical equipments shall be connected to main earthing grid.

Earthing conductors shall be welded at intervals of 1000 mm along their run of stye structure and shall be at interval of 750 mm along the wall.

Outdoor Equipment Earthing :

Wherever earthing conductor crosses the trenches, funnels railway, track, etc., it shall be run below the trench etc.

Equipment structures shall be earthed at two diagrammatically opposite points.

Earthing & Lightning Protection System:

1. Sizes and number of earth leads for earthing various items and other technical particulars shall be as specified by the contractor.
2. Earthing conductors shall be shown diagrammatically. Exact location of earthing conductors, earth electrodes test pits, and earthing connections may be changed to suit the site conditions.
3. Earthing conductors in the building, running perrallel to walls and columns shall not be less than 150 mm away from the wall/ columns.
4. Suitable earth risers shall be provided if the equipment is not available while carrying out earthing connections.

5. However, earthing conductor passes through walls, galvanized iron sleeves shall be provided for the passage of earthing conductor. Water stope sleeves shall be provided. water stops shall be provided wherever earthing conductor enters the building from outside.
6. Whenever the Conductors are to be buried, the contractor shall co-ordinate with other civil contractors to ensure that the conductors are installed before concreting.
7. All connections shall be low resistance, so that contact resistance shall be minimum.

Testing of Earthing System :

- Surat Smart City Development Limited may ask to carry out earth continuity tests, earth resistance measurements and other tests in presence of the Engineer-in-charge which in his opinion are necessary to prove that the system is in accordance with design specifications, Indian code of practice and Indian Electricity Rules. Contractor shall have to bear the cost of all such tests. The earth resistance of the sub-station earthing system shall not exceed 1 ohm.
- The lightning protection vertical air terminations and/or horizontal air termination conductors shall remain in their installed position even during severe weather conditions.
- All joints in the down conductors shall be of welded/brazed type. All metallic structures in the vicinity of down conductors shall be bonded to the down conductors.
- The test joint for down conductors shall be directly connected to the earthing systems.
- The earth resistance shall be checked, recorded and the resistance shall be improved in case it is higher than acceptable limits.
- The contractor shall carry out all rectifications repairs or adjustment work found
- necessary during testing and commissioning.

Earthing Conductor :

The complete scope for collection of data, design of the system as per relevant national/international standards, preparation of layout drawings, installation and approval to the satisfaction of electrical inspector, are in scope of works under this tender specification. Earthing conductor sizes as given in electrical design criteria are for the purpose of guidance. Contractor shall satisfy himself for the size of the earth conductor required.

Notes :

- Conductors above ground shall be galvanised Iron to prevent atmospheric corrosion.
- Conductors buried in ground or embeded in concrete shall be mild steel. Fault clearing time for sizing earthing conductor shall be taken as one (1) second and plant earthing system shall be designed such that overall earthing resistance is less than One (1) ohm.
- **Lightening Protection :**
The need for lighting protection for buildings and allied structures shall be assessed as per IS : 2039 and if found necessary, lighting protection shall be provided as per the same standard.

ITEM NO : 10 :CCTV & COMPUTER

Provide the outside and inside, Day and Night DOME colour indoor camera:- 1/3” super HAD CCD image sensor, greater or equal to 600 TVL, 0.3 Lux, DWDR, DNR Technology, Varifocal 3-8 mm lens in built, CE/UL certified with all other accessories and power supply, 16 channel digital video recorder with in built 2 TB hard disc, display and recording at 400 FPS, SATA hard drive support, DVD-RW in built, RG-6 armored video cable, RG-6 video cable (cable as per site requirement), 6 U, 600 x 600 mm depth rch to put DVR with all basic accessories plus 10 socket 5/15 amp power strip + 6 hardware tray, 1 KVA online UPS with battery backup of 1 Hour, with external charger if applicable and laying of cable with necessary accessories & fittings/ laying of HDPE pipe with all required accessories and mounting/laying of cable through hard soil digging and refilling/laying of cable through soft soil digging and refilling/installation, commissioning and testing of all the CCTV system components.

COMPUTER :

The contractor shall provide Desktop computer with following minimum specification

- Processor - dual core 2.4 GHz+ (i5 or i7 series Intel processor)
- RAM - 6 GB
- Hard Drive - 500 GB or larger solid state hard drive
- Graphics Card - any with DisplayPort/HDMI or DVI support - desktop only
- Wireless (for laptops) - 802.11ac (WPA2 support required)
- Monitor - 23" widescreen LCD with DisplayPort/HDMI or DVI support - desktop only
- Operating System - Windows 10 or 7 with Service Pack 1, Home or Professional editions,
- Warranty - 2 year warranty
- Backup Device - External hard drive, USB Flash Drive, and/or DVD+/-RW drive
- USB ports : Front 2x USB3, Rear USB ports: 4x USB 3

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

Signature & Seal of Contractor

25. GENERAL CONDITIONS FOR EQUIPMENT ERECTION AND COMMISSIONING

- 9.1 In accordance with the specific installation instructions, as shown on manufacturer's drawings or as directed by the Surat Smart City Development Limited's Representative, the Contractor shall unload, erect, install, site test and place into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workman like manner so that it is level, plumb, square and properly aligned and oriented. Tolerances shall be as established in manufacturer's drawings or as stipulated by the Surat Smart City Development Limited. No equipment shall be permanently bolted down to the foundation or structure until the alignment has been checked and found acceptable to the Surat Smart City Development Limited.
- 9.2 The Contractor shall furnish all supervision, labour, tools, equipment, rigging materials and incidental materials, such as bolts, wedges, anchors, concrete inserts etc. required to completely install, test and adjust the equipment.
- 9.3 Manufacturer's drawings, instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.
- 9.4 The Engineer may engage the manufacturer's erection Engineers to supervise the erection of the relevant equipment referred to in the Technical Specification. The Contractor shall erect and commission the equipment as per the instructions of the Erection Engineer(s) and shall extend full co-operation to him.
- 9.5 In case of any doubt / misunderstanding as to correct interpretation of a manufacturer's drawings of instruction, necessary clarifications shall be obtained from the Surat Smart City Development Limited. The Contractor shall be held responsible for any damage to the equipment consequent to not following a manufacturer's instructions correctly.
- 9.6 The Contractor shall move all equipment into the respective building through the regular doors or floor opening provided specifically for the equipment. The Contractor shall move the equipment from the storage site to the crane, attach to the crane hook and install in final location. The Contractor shall make his own arrangements for the listing of equipment.
- 9.7 Where assemblies are supplied in more than one section, the Contractor shall make all the necessary mechanical and electrical connections between sections including the connections between busbars/ wires. The Contractor shall also carry out the necessary adjustments /alignments isolators and their operating mechanisms. All insulators and bushings shall be protected against damage during installation. Insulators or bushings chipped, cracked or damaged due to negligence or carelessness shall be replaced by the Contractor at his own expense.

- 9.8 The Contractor shall take utmost care in handling instruments, relays and other delicate machanisms. Wherever the instruments and relays are supplied separately, they shall be mounted only after the associated control panels/desks have been erected and aligned. The blocking materials/mechanism employed for the safe transit of the instruments and relays shall be removed after ensuring that the panels/desks have been completely installed and no further move-ments of the same would be necessary. Any damage to relays and instruments shall be immediately reported to the Surat Smart City Development Limited.

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

Signature & Seal of Contractor

26. SPECIFICATION FOR ERECTION, TESTING & COMMISSIONING OF ELECTRICAL EQUIPMENTS AND ACCESSORIES

10.1.1 Scope :

This specification is intended to cover complete installation, testing and commissioning of electrical equipments i.e. motor control centres, control panels/ switchgears, motors, push button stations out door sub -station etc. complete.

10.1.2 Codes and Standards :

- i. The installation, testing and commissioning of all electrical equipments shall comply with all currently applicable statutory regulations, fire insurance and safety codes in the locality where the work will be carried out. Nothing in this specification shall be construed to relieve the Contractor of his responsibility.
- ii. Unless otherwise specified, the work, material and accessories shall conform to the latest applicable Indian, British or IEC Standards, some of which are listed below :

IS : 3072 Installation and maintenance of switchgear.

IS : 900 Installation and maintenance of Induction motors.

IS : 3106 Selection, installation and maintenance of fuses.

IS : 1886 Installation & maintenance of transformers.

IS : 1180 Distribution Transformers.

IS : 4029 Guide for testing three phase induction motors.

IS : 335 Insulating oil for transformers & Switch-gears.

IS : 5124 Installation & maintenance of A.C. Induction Motor starters upto 1.1 KW.

IS : 226 Specification for structural steel.

IS : 5216 Guide for safety procedure and practices in electric work.

IS : 3202 Climate proofing of electrical equipment.

IS : 2274 Code of practice for electrical wiring installations.

IS : 6665 Code of practice for industrial lighting.

IS : 1866 Code of practice for maintenance of insulating oil.

IS : 1653 Rigid steel conduits for electrical wiring.

IS : 2667 Fittings for rigid steel conduits for electrical wiring.

10.1.3 Good workmanship shall be in accordance with best engineering practice to ensure satisfactory performance and service life.

10.1.4 Detailed Requirement of Installations :

a. Switchgear, Control Panel etc.

All alignment, levelling, grouting, anchoring adjustments shall be carried out in accordance with manufacturers instructions and/or as directed by the purchaser.

All modules shall be taken out and internals shall be cleaned preferably with vacuum cleaner.

All connections and fixing of equipments in switch-gear.

In some cases, minor modifications may have to be carried out at site in the wiring and mounting of the equipment to meet the requirements of the desired control scheme and the contractor shall have to do the same at no extra cost.

b. Motors :

The installation of Motors shall be carried out in accordance with manufacturer's instructions and/or as directed by the purchaser.

Checking and cleaning of bearings and charging/filling of lubricants, wherever necessary.

Cleaning of core the winding, varnishing out the windings and measurement of air gap for motor assembly at site if demanded.

Motors shall be run on un-coupled condition for few hours before coupling them with the drive equipment.

Motors shall be coupled with drive, adjusted and shall be tested on load.

c. Miscellaneous Items :

The contractor shall install miscellaneous items such as motor starters, local start/stop push button stations etc.

The equipment will be generally wall, column or stand mounted.

The exact location will be as shown in the final drawings.

All supports or brackets needed for installation shall be fabricated and painted by the Contractor.

All welding, cutting, chipping and grinding as & when necessary shall be carried out by the Contractor.

d. Installation of Cables :

Cables shall be laid in accordance with layout drawings and cable schedule etc. to be supplied by Contractor and approved by the SMSS High voltage, medium voltage and control cables shall be separated from each other by adequate spacing or running through independent pipes.

and instructions issued by the Surat Smart City Development Limited's representative. Cables shall be laid directly buried in earth, on cable racks, on cable trays, in conduits, on walls etc. as per the requirements.

All cables routes shall be carefully measured and cables cut to required lengths, leaving sufficient length for the final connection of the cable to the terminals of the equipment.

The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables.

Cables shall be laid in trenches at requisite depths. Before cables are placed, the trench bottom shall be filled with a layer of sand. This sand shall be covered with 150 mm of sand, on top of the largest diameter cables, the sand shall be lightly pressed. A protective covering of approved type of brick shall be laid. The remainder of the trench shall then be back filled with soil, rammed and levelled.

As each row of cables is laid in place and before covering with sand every cable shall be given an insulation test in the presence of Engineer-in-charge. Any cable which proves defective shall be marked and replaced with a new cable and the end of defective cable sealed to avoid leakage of water, if it is not feasible to remove the defective cable altogether.

When cable rises from trenches to motor, push button, lighting panels etc. it shall be taken in GI pipes for mechanical protection upto a minimum of 150 mm above grade etc. The top of the pipe shall be filled with PUTTI after pulling of cable for sealing purpose.

Straight through joints if required shall be made by using epoxy resin type torpplain or M-seal.

Cables shall be neatly arranged and dressed in the trenches in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated.

All cables will be identified close to their termination points by cable numbers as per cable schedule. Cable numbers will be punched on AL strips [2 mm thick] securely fastened to the cable wrapped round it.

Each underground cable shall be provided with identifying tags of lead securely fastened every 20 m of its underground length with atleast one tag at each end before the cable enters the ground, at each bend or turning and the road crossing.

In unpaved area, cable trenches shall be identified by means of cable marker. These posts shall be placed at location changes, in the direction of cables and at interval of not more than 50 m.

A minimum clearance of 300 mm shall be maintained between cable trench and parallel runs of underground piping. Cables which enter building below ground level shall pass through the building foundation in G.I. pipes. Space between the cable and pipe shall be sealed so as to be liquid tight. Sealing compound used shall be impervious to liquids that may be in the ground.

Following guide shall be used for sizing the pipe size :

- a. 1 cable in pipe 53% full
- b. 2 cable in pipe 31% full
- c. 3 or more cables 43% full
- d. Multiple cable 40% full

At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends. All cable entry places to the buildings shall be suitably sealed as instructed by the Engineer-in-charge.

Drum number of each cable from which it is taken shall be recorded along with the cable number in the cable schedules. As proper register to indicate the drum No., type of cables,

size of cable, length cut and laid, the points between which the lengths are laid and corresponding dates etc. shall be prepared and maintained in consultation with the Engineer-in -charge.

A similar register for cable termination and jointing work shall also be prepared and maintained.

e. Tray and Supports for Cables :

Armoured cables which run exposed above ground shall generally be run in cable racks or cables trays except individual cables or groups of upto two or three running along structures may be attached directly to the structures. In the cable trenches below the switchgears, cable racks and trays shall be used for supporting cables. Cable trays shall be ladder type of steel construction with ladder runs of 450 mm centres or the trays may be perforated type. Lengths shall preferably be 6 meters [approx. depending on fabrication facilities] in widths of 150, 300 and 450 mm as per design requirements for greater width, trays may be bolted together. Side heights shall be sufficient to provide mechanical protection for the cables.

Cable trays shall be supported at every 300 mm or less longitudinal run [based on maximum uniform loading of 35 kg. per meter length for 3 meter span] shall be so fouted that there is no danger of mechanical damage.

They shall be kept separate as far as possible from major piping and where practicable at elevation above the top level. Routings shall follow the major structure axes.

Where more than one level of cable trays is required, levels shall have a minimum of 450 mm clear space between top of cable layer and bottom of next higher load tray. Top level shall also have 450 mm clearance to any overhead construction running immediately over and parallel to it. This is to allow adequate access to all cables. A 300 mm clearance is satisfactory for short obstruction of 300 mm or less.

Cable trays and inaccessible portion of supporting steel shall be painted if necessary, before laying of cables. The painting shall be done with one coat of red lead paint and two coats of aluminium white paint.

Cable laid in horizontal trays shall be fixed to the tray at intervals not exceeding 1 meter where cables are run individually or structures strapping intervals shall not exceed 600 mm. Vertical runs shall have strapping at intervals.

Outdoor cable trays shall be galvanised and the cable fixing straps, bolts, nuts, washers etc. shall also be galvanised.

f. Cable Termination :

Cable termination shall include the following :

- a. Making necessary holes in the bottom/top plates for fixing cable gland/box.
- b. Fixing double compress cable gland/box, connecting armour clamp to cable armour.
- c. Dressing of cables, pouring compound etc. wherever necessary to make termination complete.

- d. Putting cable lugs, crimping them on to cores of cables, taping bare conductors upto lugs, wherever necessary.
- e. Terminating to equipment terminals.
- f. Supply and fixing of cable and core identification ferrules.

Wherever purchaser has not provided M.S. plates for fixing cable tray supports, contractor shall install approved concrete fasteners for fixing cable tray supports.

g. Conduits & Pipes :

Contractor shall supply and install conduits, pipes as specified and as shown in drawings prepared by him and approved by purchaser. All accessories/fittings required for making installation complete shall be supplied by contractor.

Flexible metallic conduits shall be used for termination to equipment which are likely to be disconnected at periodic intervals.

Conduits or pipes shall run along walls, floors and ceilings on steel supports embedded in soil, floor, wall or foundation, in accordance with relevant layout drawings. Under ground position of conduit installation to be embedded in the foundation or structural concrete shall be installed in close coordination with co-lateral work. Exposed conduit shall be neatly run and evenly spaced.

Exposed conduit shall be adequately supported by racks, clamps, straps or by other approved means. These fittings shall be of same material as conduits.

Each conduit run shall be marked with its designation as indicated on the drawings. Identification shall be made where possible

When one or more cables are drawn through a conduit, cables shall fill not more than 50% of the internal cross sectional area of the conduit.

The entire system of conduit after installation shall be tested for mechanical and electrical continuity throughout and permanently connected to earth by means of earthing clamp efficiently fastened to the conduit.

For jointing purpose, contractor shall have available at site, dies for threading, pipe or conduit. All such threaded ends shall be cleaned after threading and anticorrosive paint applied.

10.2 Specification for Erection, Testing and Commissioning Illumination System :

10.2.1 Scope :

This specification covers complete installation, testing and commissioning of indoor and outdoor illumination system.

10.2.2 Code and Standards :

The wiring, installation and commissioning of complete illumination system shall comply with all currently applicable statutory regulations, fire insurance and safety codes in the locality where the work will be carried out. Nothing in this specification shall be construed to relieve contractor of his responsibility.

10.2.3. Unless otherwise specified, the work, material and accessories shall confirm to the latest applicable Indian, British or IEC standards, some of which are listed below :

IS : 2274 & 732	Electrical Wiring installation
IS : 1653	Specification for conduits
IS : 694	PVC insulated [light duty]electric cables for working upto 1100 V
IS : 3961 Part V	Recommended current ratings for PVC insulated [light duty] cables
IS : 2208	HRC cartridge fuse links
IS : 1293	3 pin plugs and socket outlets
IS : 3854	Switches for domestic and similar purpose
IS : 5133	part I Steel & cast Iron boxes for the enclosure of electrical accessories.
IS : 5216	Guide for safety procedures and practices in electrical work
IS : 6665	Code of practice for industrial lighting
IS : 1913	General safety requirements for electric light fittings.
IS : 3202	Climate proofing of electrical equipments
IS : 3387	Accessories for rigid steel conduits
IS : 3480	Flexible steel conduit for electrical wiring.
IS : 2509	Rigid non-metallic conduits
IS : 3419	Fittings for rigid non-metallic conduits.
IS : 2667-1964	Fittings for rigid steel conduits for electrical wiring.

10.2.4 Good workmanship will be in accordance with best engineering practices to ensure satisfactory performance and service life.

10.2.5 General Requirements :

Except as specifically approved by the site office, installation of conduits and lighting fixtures shall be taken only after all major services such as piping, structural work etc. in that particular area have been completed.

Location of lighting fixtures, switches and receptacles shown on the drawing are indicative and shall be relocated to suit site condition.

Except as noted mounting height of various lighting equipment from finish floor level shall be as follows :

- i] Lighting Panels 1200 mm
- ii] Lighting control switches 1000 mm
- iii] Receptacle with switch
 - a] For indoor 500 mm
 - b] For outdoor 1000 mm

All cables and conduits from lighting panel upto first lighting fixture shall be identified with aluminium tags giving circuit reference number.

Lighting panel number shall be indicated when more than one panel for an area is to be provided.

A number of lighting panels shall be marked separately for supplying power to the space heaters mounted in the various switchgear panels and motors.

Steel surfaces exposed to weather shall be thoroughly cleaned for removal of rust and shall be given a primary coat of zinc chromate and two finishing coats of paint. All metal parts not accessible for painting shall be made of corrosion resistant material.

Cable/Conduit separators shall be provided at an interval of 500 mm for horizontal runs and 750 mm for vertical runs.

Cable/Conduits shall be kept, wherever possible atleast 300 mm away from pipes, heating devices and other equipments.

For the purpose of calculating connected loads of various circuits a multiplying factor of 1.25 will be assured to account the losses in the control gear.

Contractor shall supply junction boxes, pull boxes, terminal blocks, glands, conduits and accessories [elbows, tees, bends etc.] and supporting anchoring, materials to make the installation complete.

Contractor shall work in co-ordination with the civil contractor when opening sleeves are required in walls and floors. Holes made by contractor shall necessarily be patched in a good and approved manner.

All types of wiring concealed or unconcealed shall be capable of easy inspection. In all types of wiring due consideration shall be given for neatness and good appearance.

In hazardous areas, the grounding wire shall run along the conduits throughout the installation and all conduits and fixtures shall be effectively grounded. Conduits shall be grounded at the ends adjacent to switch at which they originate.

Wherever specified, Delighting system shall be installed to provided necessary illumination in case of an emergency. Emergency lighting cables shall run in a separate conduit system.

A street lighting, steel tubular poles conforming to I.S. complete with fixing brackets shall be used. These poles shall be coated with bituminous preservative paint on the inside surface as well as embedded on outside surface.

Exposed outside surface shall be painted as with red lead primer and two coats of Aluminium paint.

Before a complete installation or an extension to an existing installation is put into service, installation tests stipulated in I.S.2274 and other codes of practices shall be carried out by contractor in the presence of Surat Smart City Development Limited's representative.

10.2.6 Working in Conduits :

Individual lighting circuits inside building shall be wired with 250/440 V grade copper/aluminium conductor of approved make PVC insulated flexible wires/cables. The circuit wire shall be colour coded as follows :

White - Phase or DC positive wire

Black - Neutral or DC negative wire.

Full wires in a conduit shall be drawn simultaneously. No subsequent drawings are permissible. Necessary pull wires shall be provided by the Contractor.

Wires shall not be pulled through more than two equivalent 90 deg.bends in a single conduit run.

Wiring shall not be spliced at any place other than junctions boxes with approved type connectors of terminal strips and for lighting fixtures, connections shall be Tee off through suitable roundconduit or junction box.

For vertical run of wires in conduit, wires shall be suitably supported by means of wooden plays at each pull junction boxes.

10.2.7 Outdoor Lighting :

Lighting for all outlying areas shall be carried out using 1.1 KV grade aluminium conductor, PVC insulated steel wire armoured cables between lighting panel and junction box near the lighting fixture.

All lighting poles shall be stopped tubular steel poles type ISTP as per IS;2713 and shall be painted.

Cables for road and out-door lighting shall be directly buried in ground at a depth of 900 mm or routed in available cable trenches.

10.2.8 Earthing :

For outdoor earthing of lighting poles, masts etc. cut G.I. wire shall be used. The wire shall be run buried in ground at a depth of 900 mm.

Lighting fixtures, receptacles, junction boxes, switches, conduits and hand rails shall be earthed using G.I.wire of minimum size 12 SWG.

The earthing wire shall run over the entire length.

10.2.9 Testing and Commissioning :

After completion of the work, complete illumination system shall be thoroughly checked and tested by contractor inpresence of the Surat Smart City Development Limited's representative as per check list.

The contractor shall provide all tools, materials, labour and supervising personnel for carrying out the test.

The contractor shall carry out all rectifications, repairs or adjustment work, found necessary during testing and commissioning.

The contractor shall record the test results on approved peoforms and furnish test reports/results [4 copies] for approval.

On successful commissioning of the system and carrying out necessary rectification work, the purchaser will take over the installation either wholly or in parts as the case any be.

Signature & Seal of Contractor

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

27. SPECIFICATION FOR INTERCONNECTING PIPING

11.1 General :

All pipe work shall be in conformity with the requirements of the applicable drawings and this specification. Velocities shall be adopted as per standard practice and shall be approved by Engineer-in-charge.

All the pipeline shall be of MS SAW or CI or DI pipes as the latest IS, except specified hereunder.

All chemical dosing pipes shall be of HDPE material of class III. All water supply and distribution piping to various utility services shall be GI-Class C. The relevant applicable standards to be adopted for supply, laying, jointing of various type of pipes, notation and description are as under :-

S.No.	Notation	Description	Relevant IS code
	C.I.	Centrifugally cast [spun] iron pipes & fittings for water, gas and sewage	IS-1537 & IS-153
	C.I.	Code of practice for laying Cast Iron Pipes.	IS-3114
	C.I.	Cast Iron Sluice Valves	IS-780
	G.I.	Galvanised iron pipes and fittings	IS-1239
	H.D.P.E	High Density Poly Ethylene Pipes.	IS-4984
	H.D.P.E	HDPE Fittings	IS-8008
	H.D.P.E	Code of Practice for laying HDPE pipes	IS-7634
	H.D.P.E	Testing of HDPE Pipes	IS-7634
	M.S.	Mild Steel hexagonal bolts and nuts.	IS-1367
	M.S.	Steel pipe flanges	IS-6392
	M.S.	M.S. Pipes - Steel for manufacture	IS:2062:1992
	R.C.C.	Supply of Reinforced Cement Concrete NP3 Class pipes.	IS-458
		Code of practice for RCC Pipe	IS-783
		Rubber for flanged joints.	IS-638
	G.R.P.	Glass Reinforced Plastic Pipe	IS 14402: 1996 IS 13916 : 1994

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

Signature & Seal of Contractor

28. SPECIFICATIONS FOR INSTRUMENTATION AND SCADA

This section outlines the particular requirements for the Instrumentation System. The Scope of Instrumentation, Control and Automation works Repairing / Replacement / Modification for Existing STP system and new Plant under this contract shall comprise of design, manufacture, programming, configuration, supply, installation and erection, testing and commissioning of the entire system as per the scope of work. The scope of work also includes the 10 years of O&M of Instrumentation System for Existing as well as New Plant.

The scope of work under column of New Plant in the table below shall include but not limited to the items indicated below.

MINIMUM SCOPE OF STP INSTRUMENTATION AND AUTOMATION WORK

Sr. No.	Description	Existing Plant Qty.	New Plant Qty.
1	Online pH Analyzer (Sensor + Transmitter)	3 Nos.	2 Nos.
2	Ultrasonic open channel Flow Transmitter for Inlet Parshall Flume	2 No.	As per Design Req.
3	Ultrasonic Differential Level Transmitter at Fine Screen	2 Nos.	2 Nos.
4	Insertion Type Ultrasonic Flow Transmitter on treated outlet Pipe	--	1 No.
5	Ultrasonic Level Transmitters	Lot	Lot
6	Magnetic Flow Transmitters	Lot	As per Design Req.
7	Online DO Analyzers (Dual Channel)	3 Nos.	6 Nos.
8	Hydrostatic Type Level Transmitters	--	6 Nos.
9	MLSS Analyzer	--	As per Design Req.
10	TSS Analyzer	--	As per Design Req.
11	Pressure Transmitter	--	Lot
12	Temperature Transmitter	--	As per Design Req.
13	Differential Pressure Transmitter	1 No.	As per Design Req.
14	Inbuilt VFD with Air Blowers	--	9 Nos.
15	Inbuilt VFD with Air Blowers for existing Plant	5 Nos.	--
16	Magnetic Flow Transmitter	4 Nos.	As per Design Req.
17	VFD For Gas Collecting Blower	Lot	---
18	Online Residual Chlorine Analyzer On Treated Outlet	--	1 No.
19	Chlorine leak Detector	3 Nos.	3 Nos.
20	VFD For Gas Feed Blower	3 Nos.	---

21	Auto Sampler	1 No.	1 No.
22	Instrumentation Cables	Lot	Lot
23	PLC Based SCADA System	Set	Set
24	Computer System	---	3 Nos.

MINIMUM SCOPE OF TSTP INSTRUMENTATION AND AUTOMATION WORK

SR. NO.	DESCRIPTION	LOCATION
FILTER BEDS		
1	ULTRASONIC LOH/ROF	FILTER BEDS
2	ULTRASONIC LEVEL TRANSMITTERS	BACKWASH TANK
UF FEED		
3	ULTRASONIC LEVEL TRANSMITTERS	UF FEED TANKS
4	ONLINE TURBIDITY ANALYZER	
5	ONLINE CONDUCTIVITY METER	
6	ONLINE TOTAL CHLORINE ANALYZER	
7	ONLINE ORP ANALYZER	
8	ONLINE pH METER	
9	DIFF. PRESSURE TRANSMITTERS	STRAINERS
10	PT	UF FEED HEADER
UF TRAINS		
11	MAGNETIC FLOW METER	INDIVIDUAL UF TRAIN OUTLET
12	BUTTERFLY TYPE CONTROL VALVE	INDIVIDUAL UF TRAIN OUTLET
13	PT	UF TRAINS
14	ONLINE TURBIDITY ANALYZER	UF TRAIN COMMON HEADER
15	MAGNETIC FLOW METER	UF BACKWASH COMMON HEADER
16	MAGNETIC FLOW METER	UF REJECT LINE

SR. NO.	DESCRIPTION	LOCATION
17	PT	UF BACKWASH COMMON HEADER
18	PRESSURE REGULATING VALVES	UF AIR INLET
19	ROTAMETERS	UF REJECT LINE
20	ROTAMETERS	UF CIP INLET LINE
RO FEED		
21	ONLINE TURBIDITY ANALYZER	RO FEED TANK
22	ONLINE ORP ANALYZER	
23	ONLINE pH ANALYZER	
24	ONLINE CONDUCTIVITY ANALYZER	
25	ULTRASONIC LEVEL TRANSMITTERS	
26	LEVEL SWITCH	
27	ONLINE TOTAL CHLORINE ANALYZER	
RO TRAINS		
28	MAGNETIC FLOW METERS	RO TRAIN PERMEATE
29	MAGNETIC FLOW METERS	RO TRAIN REJECT LINE
30	GLOBE TYPE CONTROL VALVE	RO TRAIN REJECT LINE
31	ONLINE CONDUCTIVITY METER	RO TRAIN PERMEATE
32	PT	RO FEED, REJECT
33	ROTAMETERS	RO FEED, REJECT
34	ROTAMETERS	RO CIP INLET LINE
UTILITY		
35	ONLINE pH METER	UF CIP CIRCULATION LINE

SR. NO.	DESCRIPTION	LOCATION
36	ONLINE pH METER	WASTER WATER TANK
37	ULTRASONIC LEVEL TRANSMITTERS	UF CIP TANK
38	ULTRASONIC LEVEL TRANSMITTERS	WASTE WATER TANK
39	MOV	WASTE WATER TANK
40	LEVEL SWITCH	RO CIP TANK
41	ON/OFF BUTTERFLY VALVE	UF CIP TANK
42	ON/OFF BUTTERFLY VALVE	UF CIP TANK
43	ON/OFF BUTTERFLY VALVE	UF CIP TANK DRAIN LINE
44	LEVEL SWITCH	DEGASSATION TANK
45	MAGNETIC FLOW METER	ACF TANKS
46	BUTTERFLY TYPE CONTROL VALVE	ACF TANKS
47	ULTRASONIC LEVEL TRANSMITTERS	DIRTY WATER SUMP
48	ULTRASONIC LEVEL TRANSMITTERS	DOSING TANKS
49	VORTEX FLOW METER	AIR COMPRESSOR HEADER
50	PRVs	AIR COMPRESSOR HEADER
CHEMICAL HOUSE		
51	ULTRASONIC LEVEL TRANSMITTERS	ALL CHEMICAL TANKS
52	FLOW METER	
53	ROTAMETERS	UF CIP DOSING LINE
TREATED WATER OUTLET		
54	ONLINE pH METER	TREATED WATER OUTLET

SR. NO.	DESCRIPTION	LOCATION
55	ONLINE CONDUCTIVITY METER	TREATED WATER OUTLET
56	ONLINE TURBIDITY METER	TRATED WATER SUPPLY LINE
57	ONLINE CONDUCTIVITY METER	TRATED WATER SUPPLY LINE
58	MAGNETIC FLOW METER	TRATED WATER SUPPLY LINE
59	AIR RELEASE VALVES	AS PER DESIGN REQUIREMENTS
60	VFD SYSTEM	UF FEED PUMPS
		RO FEED PUMPS
		UF BACKWASH PUMPS
		ALL DOSING PUMPS
GENERAL TTP PLANT INSTRUMENTATION		
61	PLC SYSTEM	FULLY AUTO PLANT OPERATION
62	PRESSURE GAUGES	AS PER DESIGN REQUIREMENTS
63	INSTRUMENTATION CABLES	LOT
64	INSTRUMENT HARDWARE	LOT
65	GALVENIZED IRON INSTRUMENTATION CABLE TRAYS	LOT
66	40" LED ANTI GLARE TYPE DISPLAY WITH WIRELESS MOUSE (MAKE :SONY / SAMSUNG / LG)	1 NO.
67	OVERHEAD PROJECTOR (MAKE : SONY, BENQ, TOSHIBA)	1 No.
68	LAPTOP	1 No.

Note:-

The above plant operation is envisaged as a fully auto operated plant through PLC based SCADA system. Tenderer has to consider above details as a minimum instrumentation and automation work requirement for guidance purpose only. However, tenderer has to provide all the required instrumentation and automation items for fully auto plant operation through PLC

based SCADA system. The tenderer must make site visit and obtain details of all units/machineries/plant equipments & accessories before giving his offer. Existing all units/machineries/plant equipments & accessories are covered under the scope of work. No dispute of any kind regarding quantity/capacity of equipment/unit at later date shall be entertained.

SCOPE OF WORK FOR INSTRUMENTATION:

General

A complete instrumentation and control system shall be provided for semi automatic operation of the Sewage treatment plant as specified. The bidder shall take into consideration the following aspects:

- 1) Complete System Integration including Design, Supply and Installation of all field instruments, PLC system for the complete Process control of the Sewage Treatment Plant shall be done by one agency. The Bidders shall identify this agency and provide their credentials in advance.
- 2) Wherever Civil, Electrical or Mechanical inputs are required, the same can be provided by the respective disciplines as per the Automation system integrator's requirement.
- 3) The Equipment Cabinets, system Cabinets, Panels, Power distribution Cabinets, etc. in the complete Project shall be sourced from One Approved Enclosure Supplier and shall be assembled & wired by one Approved Control Panel Vendor thus providing uniform documentation and uniform Look & Feel for Operation and Maintenance.
- 4) The bidder to provide documentary evidence of undertaking given by their identified Automation system integrator for comprehensive support (Warranty) including all services, spares and consumables for a period of 36 months after taking over the system.

Reference Standards:

Unless otherwise approved, instrumentation shall comply with relevant quality standards test procedures and codes of practice collectively referred to as Reference Standards including those listed below in accordance with the requirements detailed elsewhere in this specification.

IEC 60381-1:1982	Analogue signals for process control systems. Specification for direct current signals.
IEC 60947-4-1:2000	Specification for low-voltage switchgear and control gear. Contactors and motor starters. Electromechanical contactors and motor starters.
IEC 60947-4-2:1999	Specification for low-voltage switchgear and control gear. Contactors and motor-starters. AC semiconductor motor controllers and starters.
IEC 60947-4-3:1999	Specification for low-voltage switchgear and control gear. Contactors and motor-starters. AC semiconductor controllers and contactors for non-motor loads.
IEC 60770-1:1999	Transmitters for use in industrial process control system. Methods for performance evaluation.
IEO 6817:1997	Measurement of conductive liquid flow in closed conduits. Method using electromagnetic flow meters.
BS EN 837-1:1998	Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing.
BS EN 60529:1992	Specification for degrees of protection provided by enclosures (IP code).
BS EN 60546-1:1993	Controllers with analogue signals for use in industrial-process control system. Methods for evaluating performance.
BS EN 60584-2:1993	Thermocouples. Tolerances.
BS EN 60654 : 1998	Operating conditions for industrial –process measurement and

	control equipment. All relevant parts.
BS EN 61000-6:2001	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments.
BS 89:1990	Direct acting indicating analogue electrical measuring instruments and their accessories. All parts.
BS 90:1975	Specification for direct-acting electrical recording instruments and their accessories.
BS 1042-1.4:1992	Measurement of fluid flow in closed conduits. Pressure differential devices. Guide to the use of devices specified in sections 1.1 and 1.2.
BS 1041-2.1 :1985	Code for temperature measurement. Expansion thermometers. Guide to selection and use of liquid-in-glass thermometers.
BS 1041-2.2 :1989	Code for temperature measurement. Expansion thermometers. Guide to selection and use of dial-type expansion thermometers.
BS 1041-3 :1989	Temperature measurement. Guide to selection and use of industrial resistance thermometers.
BS 1042-1.4 :1992	Measurement of fluid flow in closed conduits. Pressure differential devices. Guide to the use of devices specified in sections 1.1 and 1.2.
BS 1553-1:1977	Specification for graphical symbols for general engineering. Piping systems and plant.
BS 1646-1 :1979	Symbolic representation for process measurement control function and instrumentation. Basic requirements.
BS 1646-2:1983	Symbolic representation for process measurement control functions and instrumentation. Specification for additional basis requirements.
BS 1646-3 :1984	Symbolic representation for process measurement control functions and instrumentation. Specification for detailed symbols for instrument interconnection diagrams.
BS 1646-4:1984	Symbolic representation for process measurement control functions and instrumentation. Specification for basis symbols for process computer, interface and shared display/control functions.
BS 2765:1969	Specification for dimensions of temperature detecting elements and corresponding pockets.
BS 3680	Measurement of liquid flow in open channels. All relevant parts.
BS 3693:1992	Recommendations for design of scales and indexes on analogue indicating instruments.
BS 4675-2:1978	Mechanical vibration in rotating machinery. Requirements for instruments for measuring vibration severity.
BS 4999-142:1987	General requirements for rotating electrical machines. Specification for mechanical performance vibration.
BS 6739:1986	Code of practice for instrumentation in process control systems installation design and practice.

Instrument Society of American Standards and Recommended Practices:

S 5.1	Instrumentation symbols and identification.
S 5.4	Instrumentation loop diagrams.
S 7.3	Quality standard for instrument air.

RP 16.1	Terminology, dimensions and safety practices for indicating variable 2, 3 area meters.
RP 16.4	Nomenclature and terminology for extension type variable area meters (Rota meters)
RP 16.5	Installation, operation, maintenance instructions for glass tube variable area meters (Rota meters)
RP 16.6	Methods and equipment for calibration of variable area meters (Rota meters)
RP 18.1	Specifications and guides for the use of general purpose annunciators.
S 26	Dynamic response testing of process control instrumentation.
S 37.1	Electrical transducer nomenclature and terminology.
S 37.3	Specifications and test for strain gauge pressure transducers.
S 50.1	Compatibility of analog signals for electronic industrial process instruments.
S 51.1	Process instrumentation terminology.
RP 60.08	Electrical Guide for Control Centers.

DETAILED SPECIFICATION OF INSTRUMENTATION ITEMS:

ULTRASONIC TYPE LEVEL TRANSMITTER

ULTRASONIC OPEN CHANNEL FLOW METER		
A.	GENERAL	
1	FUNCTION	INDICATING & TRANSMIT
2	TYPE	NON-CONTACT TYPE, PROGRAMMABLE
3	ELECTRICAL AREA CLASS.	SAFE
4	SERVICE	FLOW MEASUREMENT OF RAW SEWAGE AT PARSHALL FLUME
5	OPERATING TEMPERATURE	AMBIENT, MAX. 50 °C
B.	TRANSMITTER	
7	ENCLOSURE - MOC	POLYCARBONET/MFR. STD.
	PROTECTION CLASS	IP-65
8	POWER	24 VDC, 4 WIRE
9	MEASUREMENT RANGE, M	0-20000 M ³ /HR
10	BLANKING DISTANCE, M	300 MM
11	NO. OF MEAS. CHANNELS	ONE
12	ACCURACY	± 0.25% OF MAXIMUM RANGE
13	LOCAL DISPLAY	LCD DISPLAY
14	OUTPUT - SIGNAL	4-20 MA DC ISOLATED

	- CONTACT	4 NOS. - CONTROL RELAYS, 2 NOS. - ALARM RELAYS
15	CABLE ENTRY	3/4" ET BOTTOM TO ENCLOSURE
16	MOUNTING	PIPE MOUNTED
17	PROGRAMMER	REQUIRED
C. SENSOR		
18	MEASURING PRINCIPLE	ULTRASONIC TYPE
19	NO. OF SENSORS PER INSTRUMENT	ONE
20	MOC	PVDF COPOLYMER ENCLOSURE AND CSM FACE
21	PROTECTION CLASS	IP-68
22	MEASUREMENT RANGE	0-20000 M ³ /HR
23	PROCESS CONNECTION	1" NPT
24	POWER SUPPLY	FROM TRANSMITTER UNIT
25	CABLE LENGTH	10 M MIN.

Flow (Instantaneous & totalized) readings shall be continuously displayed along with real time and historical trends for last 365 days at PLC HMI in main control room / CSCR, as minimum. Required control actions shall be furnished during detailed engineering.

ULTRASONIC LEVEL TRANSMITTER

ULTRASONIC LEVEL TRANSMITTER		
A.	GENERAL	
1	FUNCTION	INDICATING & TRANSMIT LEVEL
2	TYPE	MICRO PROCESSOR BASED
3	ELECTRICAL AREA CLASS.	SAFE AREA
4	SERVICE	LEVEL MEASUREMENT OF WATER/SLUDGE AT DIFF TANKS/SUMPS
5	OPERATING TEMPERATURE	AMBIENT, MAX, 50 OC
B. TRANSMITTER		
7	ENCLOSURE - MOC	POLYCARBONET MFR. STD.
	- PROTECTION CLASS	IP-65 MIN.
8	POWER	24 VDC, 4 WIRE
9	MEASUREMENT RANGE, M	0.3 TO 5M OR 10 M
10	BLANKING DISTANCE, M	300 MM
11	NO. OF MEAS. CHANNELS	ONE CHANNEL FOR LEVEL
12	ACCURACY	± 0.25% OF MAX RANGE

13	LOCAL DISPLAY	LCD DISPLAY
14	OUTPUT - SIGNAL	4-20 MA DC ISOLATED
	- CONTACT	2 + 1= 3 NOS. RELAYS
15	CABLE ENTRY	1/2" NPT BOTTOM TO ENCLOSURE
16	MOUNTING	PIPE MOUNTED
17	PROGRAMMING	PROVIDED THRU PROGRAMMER
C. SENSOR		
18	MEASURING PRINCIPLE	ULTRASONIC TYPE
19	NO. OF SENSORS PER INSTRUMENT	ONE
20	MOC	PVDF COPOLYMER ENCLOSURE AND CSM FACE
21	PROTECTION CLASS	IP-68
22	MEASUREMENT RANGE	0.3 TO 05M OR 10 M OR AS PER SITE REQUIREMENT
23	PROCESS CONNECTION	1" NPT (M)
24	POWER SUPPLY	FROM TRANSMITTER UNIT
25	CABLE LENGTH	10 M OR AS PER SITE REQUIREMENT
26	CABLE GLANDS & CABLE ENTRY	PROVIDED & 1/2" NPT
27	CONTACTS FOR FAULT / ECHO LOSS	PROVIDED
28	MAKE	AS PER TENDER APPROVED MAKE
29	LOCATION	AS PER PROCESS REQUIREMENT

ON-LINE pH ANALYSER (SENSOR + TRANSMITTER):

ONLINE pH ANALYZER		
A.	GENERAL	
1	FUNCTION	MICRO PROCESSOR BASED, INDICATE & TRANSMITE PH
2	ELECTRICAL AREA CLASS	SAFE
3	SERVICE	TO MONITOR PH
B.	TRANSMITTER	
4	ENCLOSURE-MOC	CAST ALUMINIUM CASE WITH CHEMICALLY RESISTANT COATING. POLY- CARBONATE FLEXIBLE WINDOW.
	PROTECTION CLASS	IP66, NEMA 4X
5	POWER SUPPLY	90 TO 264 VAC
6	OUT PUT-SIGNAL	4-20mA, FOR PH WITH SENSOR FAILURE ALARM
	CONTACT	4-SPDT RELAY WITH DISPLAY INDICATORS. 100VA,250VAC, 5 AMP

7	MOUNTING	PIPE/WALL/PANEL
8	LOCAL DISPLAY	GRAPHIC QUARTER VGA (320 X 240 PIXELS) LCD WITH LED BACKLIGHT AND TOUCHSCREEN.
9	ACCURACY	0.01 PH
10	MEASSURMENT RANGE	0-14 PH
12	LOAD RESISTANCE	600 OHMS.
13	ELECTRICAL CONNECTION	1/2" Poyamide Glands
C.	SENSOR	
14	TYPE	COMBINE ELECTRODE -- DOUBLE JUNCTION REF. TYPE
15	MOUNTING	INSERSION TYPE
16	MOC	RYTON BODY WITH GLASS FILLING.,POROUS PTFE REFERENCE JUNCTION BOX
17	PROTECTION CLASS	IP 68
18	PROCESS CONNECTION	3/4" NPT
19	SENSOR CLEANING	AUTO CLEANING / MANUAL
20	CABLE LENGTH	10 MTR
21	TEMPERATURE COMPENSATION	INBUILT WITH PT100 SENSOR AUTOMATIC
22	MAKE	AS PER TENDER APPROVED MAKE
23	Location	AS PER PROCESS REQUIREMENTS

pH readings shall be continuously displayed along with Low / High pH level alarm and real time and historical trend shall be available for last 365 days at PLC HMI in main control room / CSCR, as a minimum.

FULL BORE ELECTRO MAGNETIC FLOW MEASURING SYSTEM

Generally, the flow meter shall be as follows:

Flow metering System

Each flow metering system shall consist of the primary transducer (Sealed to IP-67/68), earthing rings, the necessary signal converter and power supply unit and all cabling between the primary transducer and signal converter and power supply unit. Shall be suitable for submerged application.

The contractor shall provide sufficient suitable cable to allow for the primary transducers to be situated up to 10 meters from their signal converters, unless a longer length is specified.

The general specifications for electromagnetic flow meter shall be as under:

Type	:	Electromagnetic, Microprocessor based
Type of Excitation	:	Pulsed or Dual Frequency Excitation
End Connection	:	Flanged
Flange Material	:	CS

Process Connection	:	As per ANSI 16.5/DIN standards
Meter	:	Remote (Non-Integral)
Local Display	:	LCD Type, Flow Rate & Tot. Flow in Engg. Units
Material of Construction	:	
Meas. Tube	:	Meter size upto 100mm: SS 304 or as per mfr. Std.
Meter size more than 100mm	:	CS or better as per mfr. Std.
:	:	
Liner	:	Teflon / PFA
Electrodes	:	SS-316L / Ha-C
Housing	:	SS 304 or CS or Die Cast Alu. as Mfr. Std.
Grounding Ring	:	Required, SS316
Meas. Range (Fluid Vel.)	:	0.1 to 10 m/sec
Accuracy	:	+ 0.5% of Flow Rate or better
Supply Voltage	:	230V AC or 24V DC
Load Resistance	:	upto 500 ohms max.
Output	:	4-20 mA DC current output One Pulse Output / Alarm Output
Enclosure	:	IP-67 as a minimum
Classification	:	
Vibration Conditions	:	Conformity with IEC 60068-2-6
Capable of measuring	:	
With Conductivity	:	Greater than 5 μ Siemens/Cm
Signal Cable Length	:	Min. 10m
Conduit Entry	:	1/2" NPTF
Transmitter Mtg.	:	2" Pipe
Pipe not Full Detection	:	Required

Flow (Instantaneous and Totalised) readings shall be continuously displayed at ICP (Control Panel) in main control room on panel mounted indicators/totalizers as well as at HMI.

Flow meter mounting locations shall be such for ease of monitoring and operation of the plant and also ease of maintenance of instrument and shall be as per manufacturer's recommendation and to be finalized during detailed engineering and as directed by engineer-in-charge.

Flow meter shall be mounted above ground level / HFL as far as possible. In case of flow meter mounted below ground level / HFL shall be provided with suitable water proof chamber constructed in RCC elevated sufficiently above GL of sufficient size for ease of operation and maintenance as decided during detailed engineering and provided with brick masonry cabin / covering arrangement to avoid submergence in water.

Flow meter shall be mounted as per manufacturer's recommendation and good engineering practices and each flow meter shall be provided with a bellows at suitable location to enable ease of removal / insertion of flow meter for maintenance. For flow meter mounted below ground level, chamber shall be sized suitably to accommodate flow meter and bellows in the same chamber.

Venturi Tubes and Nozzles.

Venture, nozzles etc. shall be designed in accordance with BS 1042 :part 11

The primary units shall be supplied with flanges in accordance with the relevant General Mechanical Specification Requirements relating to pipes, flanges, fittings, etc.

Each primary unit shall be supplied and installed complete with a Viking Johnson flange coupling or similar approved arrangement to permit removal for repair or inspection.

The sensing lines shall be installed with continuous slope to avoid blocking by condensation or air locks. Stop cocks shall be provided close to each pressure tapping point.

Case material shall be cast iron to BS 1452 of grade suitable for the application and finish painted in accordance with Section 15 of the Specification Liners shall be zinc free bronze to BS 1400.

Orifice Plate Installations

Orifice plates shall be designed in accordance with BS 1042 : part 1 and supplied in carrier rings incorporating the pressure tapping.

The sensing lines shall be installed with a continuous slope such that condensation will not collect in the pipe. Stop cocks shall be provided close to the tapping points.

Smart Type Pressure and Temperature Transmitter (with Duplex type, Platinum element, 3-wire RTD, 100 ohms resistance at 0 deg C, Cast aluminum head, WP to IP-65, SS316 Thermowell - drilled bar stock with 1.5” flanged connection of suitable length) also shall be provided for flow compensation with each air / biogas flowmeter.

Specification for Transmitter (P / DP / T) for / gas flowmeters

Transmitters shall be manufactured from material suitable for use with the process medium and for the site ambient conditions. Only Smart transmitters of approved make shall be used.

The transmitter housing shall be WP to IP-67, yoke mounting, provided with mounting arrangements suitable for 2” pipe mounting. Body material shall be of Cast aluminium. The materials of construction shall be suitable for the climatic conditions described in the specification and where necessary suitable, heavy duty GRP weather proof enclosure with viewing windows shall be provided.

Transmitters shall provide 4mA to 20 m A output signals proportional to the measured conditions. They shall operate on a 2 wire system receiving their power form the residual 4 m A in the transmission signal.

Transmitter power supply will be 24V DC. They shall be fitted with output meters to give an approximate indication of transmitter output scaled 0–100%. Output meter shall be fo Digital LCD type.

Pressure / Differential pressure transmitters, which shall have capacitance or indicative type

sensing element of SS 316L, shall be fitted with direct mounted, stainless steel, 3 valve manifolds. Pressure and transmitters shall be fitted with two valve manifolds. For flow measurements with DP Transmitter, the transmitter shall be provided with in-built square root extraction facility with switch selection.

Pipe work shall be of SS316 steel tube / pipe as appropriate with a minimum gradient of 1 in 12 after an initial rise (gas) or fall (liquid) or 300 mm.

Transmitter equipment should be supplied and installed complete in all details including tube / pipe work, stop cocks, drain clocks and any similar ancillary item of equipment.

Process data, calibrated range, output, protection, accuracy and connecting details shall be as necessary to satisfy the particular specification requirements.

The transmitter shall have non-induction external zero and span adjustment and shall have facility for an optional external damping adjustment.

Each transmitter shall be equipped with a stainless steel nameplate, permanently attached, indicating the transmitter data.

SPECIFICATIONS FOR RECEIVING INDICATORS MOUNTED AT ICP WHERE SPECIFIED IN ABOVE INSTRUMENT REQUIREMENT:

Supply of Panel mounted indicators / totalizers wherever specified above along with any instrument shall be considered forming integral of that instrument and shall be as per below specifications:

All indicators/controllers shall be electronic (microprocessor based) type programmable indicator and shall be mounted on the control panel located in the control room. Multiplying factors, shall be specified on manufacturer's nameplate, if applicable.

Retransmission of process indicator/totalizer shall not be used for feeding the analog input signal to PLC.

Specifications, as applicable are as follows:

Process Indicator:

Type	:	Microprocessor based, programmable
Input	:	4-20 mA
Display	:	4 ½ Digit, 7 Segment LED display
Display Units	:	% or Engg. Units, user programmable at site
Alarm Setpoint	:	Two nos., pot. free relay contact rated at 5A @230V AC resistive load, adj. over entire range
Transmitter Supply	:	Required, 24V DC @30mA
Retransmission	:	Required, 4-20 mA in 600 ohm load
Output		
Accuracy	:	± 0.25% of FSD
Terminals	:	suitable for up to 2.5 sq.mm. wires
Mounting	:	panel flush mounting

Power : 110/230 V AC, 50 Hz

Flow Indicator cum totaliser shall also have following in addition to above:

Totalising : User Programmable at site
 Counts/Hr
 Totaliser Display : 6/8 Digit Digital Display with Battery Backup to retain totalized data in the event of power failure for a minimum period of 24 hours.

CHLORINE RESIDUAL ANALYSER/TRANSMITTER:

1. General:

- Function: Continuously measure, indicate, and transmit free or total chlorine residual concentration of sample process stream.
- Type: Amperometric with pH buffering and reagent supply equipment for sample conditioning.
- Parts: Analyser/transmitter unit, mounting hardware, sample tubing and connectors, reagent bottle(s), and expendables.

2. Service:

- Measurement Type: Total chlorine residual, unless otherwise specified.
- Sample Flow: 8 litres per minute total flow, 50ml per minute to sample sensor.
- Sample Supply: Continuous.
- Sample Temperature Range: 0 to 52 degrees C.
- Ambient Temperature Range: 5 to 52 degrees C.

3. Performance:

- Range:
 - a. Field Selectable: 0-0.1, 0-0.2, 0-0.5, 0-1, 0-2, 0-5, 0-10, 0-20, 0-50mg/l.
- Sensitivity: 0.001mg/l or 1 percent of full scale, whichever is greater.
- Response Time: 90 seconds, maximum.
- Accuracy: Larger of 0.001mg/l or plus or minus 1 percent of range.
- Stability: Under favourable conditions, plus or minus 1 percent of full-scale for 1 month.
- Operating Range: 100:1 for each measurement range.

4. Features:

- Operators Interface:
 - a. Display: 3-1/2 digit LCD, 16-character alphanumeric.
 - b. Touch keypad.
 - Three Electrodes: Two platinum and one silver/silver chlorine reference electrode.
 - Electrode Cleaning System: Agitated.
 - Reagent Storage: 7-day supply bottle(s), minimum.
 - Reagent Deliver: Peristaltic pump or gravity feed.
- 5. Piping Connections, Prepiped: Sample in and overflow drain.
- 6. Signal Interface: One of the following interfaces as required:
 - Profibus PA Digital Communication.
 - 4 to 20mA DC into load resistances in the range of 0 to 600ohms without load adjustments minimum for 24V DC supply.

7. Enclosure:

- Electronics: IP66.
- Mounting: Wall, unless otherwise specified.

8. Power Requirements: 230V AC, 50-Hz

9. Expendables:

- Reagent Chemical(s): 16-week supply of the required reagent chemicals, including pH buffer, for each instrument provided.

CHLORINE LEAK DETECTORS

Leak detection equipment shall comprise detector heads and remote mounted transmitters/monitors.

The detector heads shall be of the bimetallic amperometric or solid state types designed for stability and minimum maintenance. The leak detection system shall operate on a continuous basis with a maximum response time to low level leaks of 5 seconds. They shall be wall mounted and reasonably equidistant from potential sources of chlorine.

Each detector head shall be connected electrically to its associated transmitter/monitor. Multi point “sniffer” type pumped sampling systems will not be acceptable.

The chlorine detector shall not respond to a leakage of any other gases.

The cells shall be suitable for operation in an indoor environment with a temperature maintained above freezing point (0C)

The monitoring units shall have wall mounting enclosures protected to at least IP 54 or shall be panel mounted. The units shall not be mounted in the gas hazardous area. They shall incorporate solid state circuit cards of the plug-in type. The units shall have self-checking circuitry and detector failure alarm indication, the latter with provision for re-transmission.

The detection systems shall not be susceptible to radio frequency interference.

Leakage alarms shall be adjustable from 5% to 100% of the instrument range to facilitate setting of the following trip levels:

Chlorine	-	low level 0.5 mg/l
	-	high level 1.0 mg/l

The monitors shall have indicator lights for both alarm levels and at least two sets of volt-free changeover contacts for re-transmission of the alarms and controls through PLC to:-

- Ventilation system control's, switching of Cl₂ supply, switching on scrubber system and giving external warning
- Remote monitoring system.

Local alarm indication and contact position shall be maintained until an alarm reset button is activated at the monitor.

The monitors shall incorporate a test button to facilitate the checking of satisfactory operation of the electronic circuits and alarms.

This specifications covers the complete materials, equipment and incidentals required to place into operation an integrated low voltage variable frequency drive (VFD) system, electrical machines and covers all components of the engineered system.

Every variable frequency drive system shall consist of all system components required to meet the performance, protection, safety, testing and certification criteria of this specification. These components may include harmonic filter / power factor correction unit, multi-pulse, phase shifting input rectifier-grade isolation transformer, VFD converter / DC-link / inverter, and output filter/

PRESSURE MEASURING SYSTEM:

PRESSURE GAUGES:

- a. Pressure gauges shall comply with IS 3624/BS 1780. The dial shall be 150 mm size.
- b. The internal parts of pressure gauges shall be of stainless steel material. In chlorine applications the diaphragm shall be silver or tantalum. For other fluids an appropriate non-corrosive diaphragm materials shall be used.
- c. The minimum diameter for round pressure gauges shall be 150 mm unless specified otherwise or where the gauge forms part of a standard item of equipment.
- d. The accuracy of pressure gauges shall be of scale over the operation range. The zero and span of pressure gauge shall not change by more than 0.1% of the span per C changes in ambient temperature. The gauges shall be of precision type.
- e. Pressure gauges shall be installed at raw sewage inlet to inlet chamber, all pumps suction and discharge, blower discharge. For pump suction compound gauge or vacuum gauge in MWC shall be provided. All pressure gauges shall be provided with siphon loop as required to dampen flow chatter and isolating valve of suitable size.
- f. Pressure gauges shall be supplied with a dead weight tester with all accessories such as pump, standard weights, and tubes. Hoses, Couplers as required for re-calibration of all pressure gauges.

PRESSURE SWITCH

SPECIFICATIONS FOR PRESSURE SWITCH			
A.	GENERAL		
1	Location of Measurement		Gauge Pressure at discharge of various pumps as per specifications
2	Service		Sewage / Sewage Sludge / Water or other Liquid Application
3	Function		Detect and On/Off Switching (Flow or No Flow detection at set point)
4	Type		Diaphragm
5	Mounting		Bottom

6	Operating Temperature	Ambient	Ambient, 50 °C Max.
7	Operating Pressure		Atm., Max. 5 Bar
8	Installation		Field / Outdoor / Indoor, as applicable
9	Overall Accuracy		<u>± 1%</u> of Span
	B. Measuring Unit / Enclosure		
1	Service		Sewage / Sewage Sludge / Water or other Liquid Application
2	Element Type		Diaphragm Sealed Piston Actuator or suitable better technique
3	Element Material	Seal	SS316
		Socket	SS316
		Wetted Parts	SS316
4	Body Material	MOC	Die Cast Alu. or equi. as per mfr. Std. suitable for withstanding harsh environment
5	Over range Protection		130% of maximum static pressure
6	Process Connection		1/2" NPTF
7	Connection Location		Bottom
8	Calibration Certificate		Required
9	Measurement (Calibration) Range		Shall be from 0 to 5 Kg/Cm2, to be finalised during detailed engg.
10	Accuracy		<u>± 1%</u> of Span
11	Output - Contacts	Nos. & Type	Potential free relay contacts, min. 1NO + 1NC, Rating 5 amps
12	Cable Entry		1/2" NPT F
13	Protection:		
a	Elec. Area Classification		Safe
b	Enclosure	Type & Protection Class	Weatherproof to IP-65 as a minimum
		MOC	Cast Alu. or equi. as per mfr. Std. suitable for withstanding harsh environment
		Paint	Chemical Resistant / Epoxy Coating
	C. Options / Accessories:		
1	Mounting Accessories		Required
2	Tag Plate		Required, SS 304
3	Cable Glands		Required, IP-65/66 as a min., Ni-Plated Brass / Polyamide
4	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, Ni-Plated Brass / Polyamide

D.	Recommended Spares	For 1 Year Normal Operation	Bidder to submit recommended spares list along with part nos., part description and qty. required for 1 year normal operation along with their technical bid for procurement, if required, by client in future. However, O&M spares shall be separately include
E.	Make		As per approved Vendor List
	Model	Pressure Switch	Bidder to Furnish
F.	Quantity of Instruments:		Refer Quantity / Location table below for each Zone (STP/SPS)
G.	Approved Vendors		Dag Process Instrumetns, Danfos, E+H, Indfos, N.K. Instruments, Switzer

TEMPERATURE TRANSMITTER

SPECIFICATIONS FOR TEMPERATURE TRANSMITTER			
A.	GENERAL		
1	Location of Measurement		Temperature measurement at a) Air Line for Temperature Compensation of Air / Gas Flow measurement across Venturi / Orifice b) Each Sludge Digester Unit (On mixing / digester sludge sample pipe) c) Power Transformer
2	Service		Air / Gas / Sewage / Liquid
3	Function		Transmit & Indicate
4	Type		Smart
5	Mounting		Direct or other suitable
6	Operating Temperature	Ambient	Ambient, 50 °C Max.
		Process	150°C Max.
7	Operating Pressure		Atm.
8	Installation		Field / Outdoor
B.	Measuring Unit		
1	Service		Air / Gas / Sewage / Liquid
2	Element Type		3-Wire RTD, See Specifications for RTD provided separately or Thermocouple, as applicable

C.	Transmitter		
1	Type		Microprocessor based, User Programmable, 2-Wire, Smart
2	Input		User Selectable, RTD / Thermocouple
3	Measurement (Calibration) Range		Suitable for Temperature measurement on Air / Gas / Digester Sludge Line, Max. 150°C
4	Accuracy		$\pm 0.2^\circ\text{C}$ (Pt100, 3-wire RTD as per IEC-751, $\alpha=0.00385$) or + 0.25% of Cal. Span, whichever is greater
5	Output		4-20 mA, Two Wire, with protocol
	- Load Resistance		600 Ohms max.
6	Tx. Power Supply		24V DC
7	Cable Entry		1/2" NPT F
8	Local Indicator / Display		LCD Display
9	Scale Graduation / Measuring Units		Engg. Units
10	Protection:		
a	Elec. Area Classification		Hazardous Area for Digester Application / Safe Area for rest application
b	Intrinsically Safe		Required for Hazardous Area with Safety Barrier
c	Enclosure	Type & Protection Class	Weatherproof to IP-65 as a minimum
		MOC	Cast Alu. or equi. as per mfr. Std. suitable for withstanding harsh environment
		Paint	Chemical Resistant / Epoxy Coating
		Requirement for Hazardous Area	Ex-Proof as per hazardous area classification
11	Mounting		Direct on Temp. Sensor or through suitable mounting bracket or other suitable
D.	Options / Accessories:		
1	Mounting Accessories		Required
2	Tag Plate		Required, SS 304
3	Cable Glands		Required, IP-65/66 as a min., Ni-Plated Brass / Polyamide
4	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, Ni-Plated Brass / Polyamide
5	Canopy for Analyzer / Transmitter	To prevent from direct sun and rain	Required. MOC: FRP - min. 4mm thick / G.I. - min. 2mm thick
E.	Consumables		Bidder to Specify if required for proper running of the instrument including

			Calibration
		a)	
		b)	
		c)	
F.	Recommended Spares	For 1 Year Normal Operation	Bidder to submit recommended spares list along with part nos., part description and qty. required for 1 year normal operation along with their technical bid for procurement, if required, by client in future. However, O&M spares shall be separately include
G.	Make		As per approved Vendor List
	Model	Transmitter	Bidder to Furnish
H.	Quantity of Instruments:		Lot
I.	Approved Vendors		ABB, Emerson, Honeywell, Siemens, Yokogawa

ORIFICE PLATES & FLANGES

SPECIFICATIONS FOR ORIFICE PLATES & FLANGES (FOR AIR FLOW MEASUREMENT)			
A.	GENERAL		
1	FUNCTION		MEASURING ELEMENT
2	TYPE		FLANGED, CONC. SQ. EDGE ORIFICE PLATE
3	MOUNTING		FLANGED
4	LINE SIZE		200MM TO 600MM, AS PER SITE CONDITION
5	SERVICE	FLUID	AIR
		FLUID STATE	GAS
5	OPERATING TEMPERATURE	AMBIENT	AMBIENT, 50 °C MAX.
		PROCESS	150°C MAX.
6	OPERATING PRESSURE		ATM., MAX. 1 BAR, AS PER SITE CONDITION (NORMALLY OPERATING PRESSURE OF AIR BLOWERS SHALL BE FROM 5000-7000 MMWC)

7	INSTALLATION		FIELD / OUTDOOR
8	PLATE ONLY OR ASSEMBLY		ASSEMBLY
	B. METER		
1	DIFF. RANGE, IN MM H ₂ O		BIDDER TO FURNISH
2	METER MAXIMUM		BIDDER TO FURNISH
	C. PLATE		
1	TYPE		CONC. SQ. EDGE
2	SIZING AS PER		ISO-5167
3	MATERIAL		SS 316
4	THICKNESS 'W' MM		3MM MIN.
5	BETA = D/D		BIDDER TO FURNISH
6	BORE DIA. 'D' MM		BIDDER TO FURNISH
7	VENT / DRAIN, DIA. IN MM.		BIDDER TO FURNISH
8	CENTRE DIST. 'R' MM.		BIDDER TO FURNISH
	D. FLANGES		
1	TYPE		WNRF
2	TAP TYPE / SIZE		FLANGE / 1/2" NPT (M)
3	NO. OF TAPS PER FLANGE		TWO PER FLANGE
4	MATERIAL		CS FOR AIR SERVICE / SS 304 OR SS 316 FOR BIO-GAS SERVICE
5	SIZE & RATING		BIDDER TO FURNISH / 300#
6	FACING & FINISH		RF / BIDDER TO FURNISH
7	LINE SIZE - I.D./O.D., IN MM.		200MM TO 600MM, AS PER SITE CONDITION
8	LINE - SCHEDULE		SHALL BE AS PER SITE CONDITIONS
9	GASKET THICKNESS, IN MM.		BIDDER TO FURNISH
10	GASKET MATERIAL		CAF / TEFLON / SS304, SUITABLE FOR SERVICE - BIDDER TO FURNISH
11	PLATE HOLDER		BIDDER TO FURNISH
12	PLATE HOLDER MATERIAL		BIDDER TO FURNISH
13	STUD BOLT MATERIAL		A307 GR. B FOR AIR SERVICE / A193GRB7 FOR BIOGAS SERVICE
14	NUT MATERIAL		A307 GR. B FOR AIR SERVICE / A194GR2H FOR BIOGAS SERVICE
	E. OPTIONS / ACCESSORIES:		
1	MOUNTING ACCESSORIES		REQUIRED

2	TAG PLATE		REQUIRED, SS 304
3	VENT / DRAIN ARRANGEMENT		REQUIRED, AS PER APPLICATION
4	MODIFICATION WORK IN PIPING / SUPPLY OF FLANGES ON PIPING SIDE		SHALL BE INCLUDED IN THE SCOPE OF CONTRACTOR, AS REQUIRED, FOR MOUNTING AND PROPER OPERATION OF ORIFICE / FLOW METER (INCLUDES PROVIDING THE NECESSARY STRAIGHT RUN OF UPSTREAM/DOWNSTREAM PIPE, TOTAL 10 MTRS LENGTH MAXIMUM, WITH NECESSARY FLANGES ON ORIFICE / PIPE SIDE). MOC OF STRAIGHT RUN AND FLANGES SHALL BE EITHER C.I. OR MSEP FOR AIR APPLICATION. NECESSARY TUBING / FITTINGS / ISOLATION VALVES IN SS 316 SHALL ALSO BE PROVIDED.
F.	MAKE		AS PER APPROVED VENDOR LIST
	MODEL		BIDDER TO FURNISH
G.	QUANTITY OF INSTRUMENTS:		LOT
H.	APPROVED VENDORS		ADITYA ENGG., BALIGA, DANIEL (USA), FAIRFLOW, GENERAL INSTRUMENTS CONSORTIUM, MICRO-PRECISION PRODUCTS, PLACKA, STAR MECH, THEMISON

ULTRASONIC TYPE DIFF. LEVEL TRANSMITTER

ULTRASONIC DIFF. LEVEL TRANSMITTERS		
A.	GENERAL	
1	FUNCTION	INDICATING & TRANSMIT DIFF. LEVEL
2	TYPE	MICRO PROCESSOR BASED
3	ELECTRICAL AREA CLASS.	SAFE AREA
4	SERVICE	DIFF. LEVEL MEASUREMENT ACROSS SCREENS
5	OPERATING TEMPERATURE	AMBIENT, MAX, 50 OC
B.	TRANSMITTER	
7	ENCLOSURE - MOC	POLYCARBONET MFR. STD.
	- PROTECTION CLASS	IP-65 MIN.
8	POWER	24 VDC, 4 WIRE

9	MEASUREMENT RANGE, M	0.3 TO 5M
10	BLANKING DISTANCE, M	300 MM
11	NO. OF MEAS. CHANNELS	TWO FOR DIFF. LEVEL
12	ACCURACY	$\pm 0.25\%$ OF MAX RANGE
13	LOCAL DISPLAY	LCD DISPLAY
14	OUTPUT - SIGNAL	4-20 MA DC ISOLATED
	- CONTACT	3 NOS. SPDT RELAYS
15	CABLE ENTRY	1/2" NPT BOTTOM TO ENCLOSURE
16	MOUNTING	PIPE MOUNTED
17	PROGRAMMING	THRU PROGRAMMER
C. SENSOR		
18	MEASURING PRINCIPLE	ULTRASONIC TYPE
19	NO. OF SENSORS PER INSTRUMENT	ONE
20	MOC	PVDF COPOLYMER ENCLOSURE AND CSM FACE
21	PROTECTION CLASS	IP-68
22	MEASUREMENT RANGE	0.3 TO 05M
23	PROCESS CONNECTION	1" NPT (M)
24	POWER SUPPLY	FROM TRANSMITTER UNIT
25	CABLE LENGTH	10 M
26	CABLE GLANDS	REQUIRED
27	MAKE	AS PER TENDER APPROVED MAKE

ON-LINE MLSS ANALYZER / MEASUREMENT SYSTEM

SPECIFICATIONS FOR MLSS (SS) ANALYZER			
A.	GENERAL		
1	Location of Measurement		To monitor concentration of mixed liquor suspended solids (MLSS) at Aeration Basin in each Tank / Compartment (through necessary sampling system)
2	Service		Sewage / Sewage Sludge Application
3	Function		To measure & indicate the MLSS / Transmit
4	Operating Temperature	Ambient	Ambient, 50 °C Max.
		Process	40 °C Max.
5	Operating Pressure		Atm., Max. 1 Bar
6	Installation		Outdoor
B.	Electrodes & Electrode Holder		

1	Type of Sensor		Optical type, transmitted / scattered light measurement, colour independent measurement
2	Measurement (Calibration) Range		0 -6000 mg/l or suitable higher
3	Sensor Design Philosophy		Shall offer colour independent measurement i.e. eliminate effect of coloring components
4	Sensor Cable		Integral Cable or with water tight (IP-68) connector assembly with necessary cable
5	Measuring Elements:		
a	Measuring Electrode	Probe / Shaft MOC	SS 304 / PVC equiv. suitable as per mfr. Std.
		Optical Window	Scratch proof / resistant Glass or Sapphire or equiv. as per mfr. Std.
6	Protection Class		IP-68
7	Cable Length	Integral or for Variopin/ equiv. water tight connector	Min. 10 Mtrs. (without junction box or after junction box)
8	Process Connection (Mounting)	Type	Suitable for immersion (open tank / sump) type mounting with Ball Float Assembly or In-line pipe mounting type with retractable sensor assembly.
		For measurement on Open Tank / Sump	Measurement of MLSS at Open Tank / Sump shall be through suitable immersion mounting assembly along with Ball Float Assembly or with Jet Cleaning or Wiper Cleaning assembly as per mfr. std. or in-line type with jet cleaning or wiper cleaning as per mfr. Std. All associated civil, mechanical and other modification work shall be included in the scope of bidder.
		Size	1" NPT or equiv. thread as per mfr. Std. for immersion mounting.
		Flow Velocity	Required arrangement shall be provided by bidder to limit the maximum flow velocity of measurement sample as permitted by sensor specifications for proper measurement / operation, if required.
9	Mounting Accessories (Complete with adaptor, O rings, etc. of suitable MOC as required) :		

a	Immersion Fitting	MOC –Pipe / Fittings	PP / CPVC / SS304 or suitable equi. MOC Pipe mount immersion assembly, with pipe of required length. Swivel / Pivot / Pipe Clamp Assembly suitable for hand rail mounting in SS/equi. non-corrosive material. Shall be with Ball Float Assembly.
b	Ball Float Assembly (along with Immersion Mount Assembly)	MOC	PP / CPVC / SS or equiv. material
c	Sampling system	MOC / Size -Sampling Pipe Fittings	SS304, GI, PP or CPVC / Min. 1" size with necessary adaptor for flow assembly.
		Isolation / Flow Regulation Valves	Required no. of SOVs for sample flow switching between various tanks and collecting sample from atleast 3 locations in each tank. Also Min. 2 nos. manually operated valves, at inlet and outlet of sensor assembly, SS 304 shall be provided on common header.
		Sampling Pump	Shall be provided of required capacity, as required as per process / site condition for collecting flow sample from each tank as well as from 3 locations in each tank.
			The withdrawn sample shall be suitably transferred back to same unit or immediate down stream -shall not be drained / discharged in open. Pipe / Fitting associated or grouted with civil unit / structure shall be in GI / SS only.
10	Cleaning System		Bidder may offer Jet cleaning system or wiper cleaning system in lieu of ball float assembly
a	Jet cleaning System	Type	Required for electrode cleaning through PLC, Water or Air/Water Jet combined type, with necessary solenoid valve and all other required fittings and accessories. Periodic (Time Based) cleaning to be carried out with programmable wash time and washing interval or based on diagnosis of Sensor Scaling input to PLC
		Nozzle / mounting / mounting hardware MOC	SS 304 or better

		Tubing	Nylon / equiv. flexible, non-corrosive and long lasting tubing of min. 10 mtrs. Length for connection with service water header/branch line, with quick release type fittings.
b	Wiper Cleaning System		Shall be self-cleaning wiper device of silicon / other suitable MOC and coupling as per mfr. Std. for long / reliable life, with programmable cleaning time intervals
11	Operating Temperature		40 °C Max.
12	Calibration Certificate		Required
13	Sensor Calibration Kit		Required for on-site during O&M period for periodic calibration of Sensor as per manufacturer's recommendation. Shall be included as part of O&M cost.
	C. TRANSMITTER		
1	Function		Transmit and Indicate
2	No. of Inputs		Single / Dual
3	Transmitter Type		Microprocessor based, User Programmable, 2-Wire or 4-Wire type as per mfr. Std.
4	Location		Field Mounting
5	MLSS Measurement:		
a	MLSS Measurement Range		0 -6000 mg/l or higher as per sensor meas. range, programmable (Normal measurement range shall be 0 -5000 mg/l)
b	Accuracy		± 5% of F.S. or better
c	Resolution		0.1 mg/l
d	Repeatability		± 3% of F.S. or better
6	MLSS Calibration		Semi Automatic, 1 or 2 point calibration or as per mfr. Std. using reference / Manual adjustment to grab sample
7	Output Signal	For MLSS, One per Channel	4 -20 mA analog
8	Instrument Power Supply		100 to 240 VAC + 10%, 50 Hz + 5% or 24V DC as per mfr. Std.
9	Cable / Conduit Entry		1/2" NPT or M20 or equiv. as per mfr. Std.
10	Local Indicator / Display	MLSS	Backlit LCD Display
11	Scale Graduation / Measuring Units		Engg. Units

12	Security Access Code		Required, password protected
13	Protection:		
a	Elec. Area Classification		Safe
b	Intrinsically Safe		N.A.
c	Enclosure	Type & Protection Class	Weather Proof to IP-65 as a minimum
		MOC	Cast Alu. / Polycarbonate or equiv. as per mfr. Std. suitable for withstanding harsh environment
		Paint	Chemical Resistant / Epoxy Coating
		Requirement for Hazardous Area	N.A.
14	Mounting		Wall mounting / Pipe mounting
15	Operating Temperature		0 to 55 °C
16	Humidity		10 to 90% RH @40 °C
D.	Options / Accessories:		
1	Mounting Accessories		Required, Universal 2" Pipe and /or Wall Mounting Kit
2	Tag Plate		Required, SS 304
3	Cable Glands		Required, IP-65/66 as a min., Ni-Plated Brass / Polyamide
4	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, Ni-Plated Brass / Polyamide
5	Canopy for Analyzer / Transmitter	To prevent from direct sun and rain	Required. MOC: FRP -min. 4mm thick min. / G.I. - 2mm thick
E.	UTILITIES:		
1	For Cleaning Mechanism of Sensor		Water or Air/Water Jet
a	Water	Quality / Flow / Pressure	Bidder to Specify
b	Air	Quality / Flow / Pressure	Bidder to Specify
2	Any Other (Bidder to Specify)		Bidder to Specify
H.	Recommended Spares	For 1 Year Normal	Bidder to submit recommended spares list along with part nos., part

		Operation	description and qty. required for 1 year normal operation along with their technical bid for procurement, if required, by client in future. However, O&M spares shall be separately included by the bidder as part of O&M cost as per tender.
I.	Make		As per approved Vendor List
	Model	Transmitter	Bidder to Furnish
		Sensor	Bidder to Furnish
K.	Approved Vendors		E+H, Emerson, Hach, Polymetron (Forbes Marshall), Yokogawa

AUTO SAMPLER

SPECIFICATIONS FOR PORTABLE AUTO SAMPLER			
A.	GENERAL		
1	Type		Portable, Waster Water / Battery / Mains operated Liquid Sampler,
2	Location of Measurement		To collect composite sample or at time intervals (say, hourly, etc.) of Raw Sewage (at Inlet Unit of STP), Treated Sewage (at Treated Outlet Chamber / Channel)
3	Service		Sewage / Sewage Sludge Application
4	Function		To collect composite sample or at regular time intervals
5	Operating Temperature		Ambient, 50°C Max.
6	Operating Pressure		Atm.
7	Installation		Outdoor
B.	Sampling System		
1	Sample Drawal Pump	Type	Positive Displacement peristaltic type pump
		MOC	Corrosion Resistant, Delrin or other suitable MOC as per mfr. Std.
2	Suction Height / Lift		Min. 7-8m
3	Sampling Tube	Size	3/8" ID or other suitable as per mfr. Std.
		MOC	Silicon / Equi. Suitable
		Suction hose length	7-8m
4	Sample Volume Repeatability		± 5% (Typ.)

5	Intake Strainer		Required, suitable for Sewage Application, SS equi. / Construction
6	Intake Line Purging Facility		Required
7	Intake Line Rinsing Facility		Required, For future use by client
8	Manual Sample Facility		Required, shall initiate sample collection independent of program in progress
9	Automatic Shutdown		Required, after complete revolution of distributor arm for multiple bottle mode and after preset number of samples has been delivered for composite sample mode
10	Interval between Samples		Programmable
C.	CONTROLLER / SAMPLER ENCLOSURE		
1	Type		Portable, Battery Programmable / Mains operated,
2	Sampling Modes		Multiple / Composite Bottle based on time / quantity proportion / flow
3	Sampling Program Storage		Required, Through battery backup internal lithium / suitable
4	Sample Container	With each sampler	1 x 20 Ltrs. PE Bottle / Jar for Composite Sample with necessary Distributor Arm / Accessories, and
		With each sampler	24 x 1 Ltrs. PE Bottles for sample at Programmed Time Intervals with necessary Distributor Arm / Accessories
5	Power Supply:		
a	Power Requirement		12V DC (supplied by 12V DC and / or 12V AC Adaptor), with necessary overload protection
b	Battery		Required, Rechargeable, Lead Acid type or other suitable
c	Battery Charger		Required, Integral Trickle charge type of suitable, to maintain battery at full charge, suitable for 230V AC Mains
d	AC Adaptor		Suitable for 230V AC Mains
e	AC Power Backup	Battery/Mains Powered	Required, auto changeover to battery on AC power failure
		Only Battery Powered	Min. 1 no. of spare battery set shall along with each sampler be provided
6	Sampler Enclosure	MOC	High Impact ABS or other suitable for Harsh Environment

7	Cable / Conduit Entry		1/2" NPT or M20 or equi. As per mfr. Std.
8	Local Indicator / Display		24 character or suitable equi. alphanumeric LCD Display. Backlit Type.
9	Security Access Code		Required, password protected
10	Protection:		
a	Elec. Area Classification		Safe
b	Intrinsically Safe		N.A.
c	Enclosure	Type & Protection Class	Weather Proof to IP-65 as a minimum
		MOC	High Impact Resistant ABS or other material as per Mfr. Std. suitable to withstand harsh environment
		Paint	Chemical Resistant / Epoxy Coating
		Requirement for Hazardous Area	N.A.
11	SDI interface		Required to connect sonde for programming the sampler to collect sample on process (pH, DO, etc.) basis
12	Communication Interface		Preferred, RS 232 / equi. suitable for configuring and / or data transmission
13	Operating Temperature		0 to 45°C (Sampler with 40 °C max. ambient withstanding temperature may be accepted subject to provision of suitable weather shed by contractor to prevent sampler from exposure to direct sunlight & high fluctuation in temp.)
	D. Options / Accessories:		
1	Tag Plate		Required, SS 304
2	Cable Glands		Required, IP-65/66 as a min., Ni-Plated / Brass Polyamide
3	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, Ni-Plated Brass / Polyamide
4	Weather Shed / Canopy for Auto Sampler	To prevent from direct sun and rain	Required. MOC: FRP -min. 4mm thick / G.I. - min. 2mm thick
	E. UTILITIES:		
1	For Purging / Rinsing Requirement of Sampling System		Water or Air

a	Water	Quality / Flow /Pressure	Bidder to Specify
b	Air	Quality / Flow /Pressure	Bidder to Specify
2	Any Other (Bidder to Specify)		Bidder to Specify
H.	Make		As per approved Vendor List
	Model		Bidder to Furnish

Auto samplers shall be utilized to collect necessary samples, composite or time interval based samples as directed by engineer-in-charge, for necessary laboratory analysis.

ON-LINE TSS ANALYZER / MEASUREMENT SYSTEM

SPECIFICATIONS FOR TSS ANALYZER			
A.	GENERAL		
1	Location of Measurement		To monitor concentration of total suspended solids (TSS) at following locations / applications:
			a) Inlet Chamber of STP for Raw Sewage
			b) Treated Sewage Discharge
2	Service		Sewage / Sewage Sludge Application
3	Function		To measure & indicate the TSS / Transmit
4	Operating Temperature	Ambient	Ambient, 50 °C Max.
		Process	40 °C Max.
5	Operating Pressure		Max. 2-3 Bar for Pump Discharge Headers / Max. 1 Bar for Process Units, Gravity Flow, other applications
6	Installation		Outdoor
B.	Electrodes & Electrode Holder		
1	Type of Sensor		Optical type, transmitted / scattered light measurement, colour independent measurement
2	Measurement (Calibration) Range	Application 1: Low Sludge Conc. Meas.	0 -10 g/l i.e. 0 -1%
		Application 2: Med. Sludge Conc. Meas.	0 -50 g/l i.e. 0 -5%
		Application 3: High Sludge Conc. Meas.	0 -150 g/l i.e. 0 -15%

3	Sensor Design Philosophy		Shall offer colour independent measurement i.e. eliminate effect of coloring components, without requiring separate calibration for colour change
4	Sensor Cable		Integral Cable or with water tight (IP-68) connector assembly with necessary cable
5	Measuring Elements:		
a	Measuring Electrode	Probe / shaft MOC	SS 304 / PVC equi. suitable as per mfr. Std.
		Optical Window	Scratch proof / resistant Glass or Sapphire or equiv. as per mfr. Std.
6	Protection Class		IP-68
7	Cable Length	Integral or for Variopin/ equi. water tight connector	Min. 10 Mtrs. (without junction box or after junction box)
8	Process Connection (Mounting)	Type	Suitable for in-line (pipe) or immersion (open tank / sump) type mounting along with wiper or jet cleaning system with mounting as under for both this applications:
		-For measurement on Pipe	Measurement of TSS on pipe line shall be through In-line mounting with retractable sensor assembly. All associated civil, mechanical and other modification work shall be included in the scope of bidder.
			Application / Location: TSS measurements at all locations for Application 2 (Med. Sludge Conc) & 3 (High Sludge Conc.)
		-For measurement on Open Tank / Sump	Measurement of TSS at Open Tank / Sump shall be through suitable immersion mounting assembly. All associated civil, mechanical and other modification work shall be included in the scope of bidder.
			Application / Location: TSS measurements at all locations for Application 1 (Low Sludge conc.)
9	Flow Velocity (In-line or immersion type)		Required arrangement shall be provided by bidder to limit the maximum flow velocity of measurement sample as permitted by sensor specifications for proper measurement / operation, if required.
10	Mounting Accessories (Complete with adaptor, O rings, etc. of suitable MOC as required) :		
a	Immersion Fitting	MOC -Pipe /	PP / CPVC / SS304 or suitable equi. MOC

		Fittings	Pipe mount immersion assembly, with pipe of required length. Swivel / Pivot / Pipe Clamp Assembly suitable for hand rail mounting in SS/equi. non-corrosive material.
b	Retractable Assembly for In-line mounting on pipe	MOC	Shall have ball valve and extraction system as per mfr. Std. Wetted parts MOC shall be in SS 304 or better.
11	Cleaning System		Bidder shall offer either Jet cleaning system or wiper cleaning system
a	Jet cleaning System	Type	Required for in-line electrode cleaning through PLC, Water or Air/Water Jet combined type, with necessary solenoid valve and all other required fittings and accessories. Periodic (Time Based) cleaning to be carried out with programmable wash time and washing interval or based on diagnosis of Sensor Scaling input to PLC
		Nozzle / mounting / mounting hardware MOC	SS 304 or better
		Tubing	Nylon / equi. Flexible, non-corrosive and long lasting tubing of min. 10 mtrs. Length for connection with service water header /branch line, with quick release type fittings.
b	Wiper Cleaning System		Shall be self-cleaning wiper device of silicon / other suitable MOC and coupling as per mfr. Std. for long / reliable life, with programmable cleaning time intervals
12	Operating Temperature		40 °C Max.
13	Calibration Certificate		Required
14	Sensor Calibration Kit		Required for on-site during O&M period for periodic calibration of Sensor as per manufacturer's recommendation. Shall be included as part of O&M cost.
C.	TRANSMITTER		
1	Function		Transmit and Indicate
2	No. of Inputs		Single / Dual
3	Transmitter Type		Microprocessor based, User Programmable, 2-Wire or 4-Wire type as per mfr. Std.
4	Location		Field Mounting
5	TSS Measurement:		
a	TSS Measurement Range	Application 1: Low Sludge conc. Meas.	0 -10 g/l i.e. 0 -1%, programmable

			Bidder shall note that the normal meas. Range for treated sewage shall be 0-50 mg/l and instrument span shall be programmable for the same
		Application 1: Medium Sludge conc. Meas.	0 -50 g/l i.e. 0 -5%, programmable
		Application 1: High Sludge conc. Meas.	0 -150 g/l i.e. 0 -15%, programmable
b	Accuracy		+ 5% of F.S. or better
c	Resolution		0.1 mg/l
d	Repeatability		+ 3% of F.S. or better
6	TSS Calibration		Semi Automatic, 1 or 2 point calibration or as per mfr. Std. using reference / Manual adjustment to grab sample
7	Output Signal	For TSS, One per Channel	4 -20 mA analog
8	Instrument Power Supply		100 to 240 VAC + 10%, 50 Hz + 5% or 24V DC as per mfr. Std.
9	Cable / Conduit Entry		1/2" NPT or M20 or equi. As per mfr. Std.
10	Local Indicator / Display	TSS	Backlit LCD Display
11	Scale Graduation / Measuring Units		Engg. Units
12	Security Access Code		Required, password protected
13	Protection:		
a	Elec. Area Classification		Safe / In case of hazardous area for Digester Sludge, the sample shall be drawn through suitable piping and instrument shall be located in safe area.
b	Intrinsically Safe		N.A.
c	Enclosure	Type & Protection Class	Weather Proof to IP-65 as a minimum
		MOC	Cast Alu. / Polycarbonate or equi. as per mfr. Std. suitable for withstanding harsh environment
		Paint	Chemical Resistant / Epoxy Coating
		Requirement for Hazardous Area	N.A.
14	Mounting		Wall mounting / Pipe mounting
15	Operating Temperature		0 to 55 °C
16	Humidity		10 to 90% RH @40 °C

D.	Options / Accessories:		
1	Mounting Accessories		Required, Universal 2" Pipe and / or Wall Mounting Kit
2	Tag Plate		Required, SS 304
3	Cable Glands		Required, IP-65/66 as a min., Ni-Plated Brass / Polyamide
4	Plugs for addl. cable entries		Close up Plugs shall be provided for all unused cable entries, Ni-Plated Brass / Polyamide
5	Canopy for Analyzer / Transmitter	To prevent from direct sun and rain	Required. MOC: FRP -min. 4mm thick / GI - min. 2mm thick
E.	UTILITIES:		
1	For Cleaning Mechanism of Sensor		Water or Air/Water Jet
a	Water	Quality / Flow / Pressure	Bidder to Specify
b	Air	Quality / Flow / Pressure	Bidder to Specify
2	Any Other (Bidder to Specify)		Bidder to Specify
I.	Make		As per approved Vendor List
	Model	Transmitter	Bidder to Furnish
		Sensor	Bidder to Furnish
K.	Approved Vendors		E+H, Emerson, Hach, Polymetron (Forbes Marshall), Yokogawa

ON-LINE DO ANALYSER ON-LINE DISSOLVED OXYGEN (DO) ANALYSER (WITH TWO SENSORS PER TANK)

ONLINE DO ANALYZER		
A.	GENERAL	
1	FUNCTION	INDICATE & TRANSMITE DO
2	ELECTRICAL AREA CLASS	SAFE
3	SERVICE	TO MONITOR DO
B.	TRANSMITTER	
4	ENCLOSURE-MOC	CASE-PLASTIC POLYCARBONATE FLEXIBLE POLYCARBONATE WINDOW.
	PROTECTION CLASS	IP65, NEMA 4
5	POWER SUPPLY	230 V AC
6	OUT PUT-SIGNAL	4-20mA, WITH HART PROTOCOL

7	MOUNTING	PIPE/WALL/PANEL
8	LOCAL DISPLAY	ANTI-GLARE LCD WITH A TOUCH SCREEN:BLACK/WHITE(213 X 160) PIXELS CONTRAST ADJUSTMENT AVAILABLE ON THE SCREEN
9	ACCURACY	± 0.05 mG/L
10	RANGE	0-20 mG/L
12	LOAD RESISTANCE	600 OHMS.
13	ELECTRICAL CONNECTION	1/2" Poyamide Glands
C. SENSOR		
14	TYPE	LUMINISCECE TYPE METHOD
15	NO. OF SENSORS	TWO SENSORS PER INSTRUMENT
16	MOUNTING	INSERTION TYPE
17	CLEANING	JET CLEANING / OTHER SUITABLE
18	MOC	HARD PVC,STAINLESS STEEL JIS(SUS304),FLIURINATED ETHYLENEPRO- PYLENE,NITRILE RUBBER,HEAT RESISTANT SOFT PVC
19	PROTECTION CLASS	N.A
20	PROCESS CONNECTION	DIRECT INSERTION IN TANK
21	CABLE LENGTH	10 MTR
22	TEMPERATURE COMPENSATION	INBUILT WITH PT1000 SENSOR

PRESSURE TRANSMITTER

PRESSURE TRANSMITTER		
A.	GENERAL	
1	FUNCTION	MEASURE & INDICATE GUAGE PRESSURE
2	TYPE	SMART TYPE PRESSURE TRANSMITTER
3	CASE	HOUSING : ALUMINUM ALLOY
4	MOUNTING	2" PIPE MOUNTING
5	ENCLOSURE	IP67
6	ELECTRICAL AREA CLASS.	SAFE
7	CABLE ENTRY	1/2" NPT (F)
8	ACCURACY	BASE ACCURACY 0.075%
9	ZERO ELEVATION & SUPPRESSION	INBUILT
B. TRANSMITTER		

10	OUTPUT	2 -WIRE, 4-20MA WITH HART PROTOCOL
11	TX. POWER SUPPLY	24 VDC
C.	MEASURING UNIT	
12	SERVICE	GAUGE PRESSURE
13	ELEMENT TYPE	DIAPHRAGM
14	BODY MATERIAL	DIAPHRAGM : SS316, HOUSING : ALUMINUM ALLOY
15	ELEMENT MATERIAL	HAST-C
16	OVERRANGE PROTECTION	OVER PRESSURE LIMIT OF 210 BAR
17	PROCESS CONNECTION	1/2" NPT (F)
18	CONNECTION LOCATION	BOTTOM
D.	OPTIONS	
19	OUTPUT METER	LCD DIGITAL DISPLAY
20	MOUNTING ACCESSORIES	2" PIPE MOUNTING BRACKET
21	CABLE ENTRY	1/2" NPTF
22	MAKE	AS PER TENDER APPROVED MAKE

CONDUCTIVITY ELEMENT AND TRANSMITTER

1. General:

- Functional: Measure, indicate, and transmit the conductivity of the required process liquid.
- Type: Probe with electrode or electrodeless sensor.
- Parts: Element, transmitter, interconnecting cable, junction box, and expendables.

2. Performance:

- Range: as required.
- Accuracy: Plus or minus 0.5 percent of measured range. Features:
- Temperature Compensation: Automatic thermocompensator of process liquid temperatures 0 to 200 degrees C.
- Temperature Slope: Adjustable from 0 to 5 percent per degree C.

3. Element:

- Type: With electrode, unless otherwise specified.
- Electrode Material: 316 stainless steel, unless otherwise specified.
- Other wetted Parts: Nonmetallic synthetic materials; manufacturer to confirm compatibility with process liquid.
- Probe Constant: As required.

- Mounting/Process Connection: As shown on the Drawings.
 - Mounting Hardware: As recommended by the manufacturer for the specific application and/or shown on the Drawings.
4. Transmitter:
- Features:
 - a. Indicator: LCD or LED digital display.
 - b. Scale Range: As required.
 - c. Contact Set Point: Set point adjustable from 0 to 100 percent of full range, initial setting as required.
 - Signal Interface:
 - a. Output: one of the following interfaces as required:
 - i. Profibus PA Digital Communication.
 - ii. 4 to 20mA DC into load resistances in the range of 0 to 600ohms without load adjustments minimum for 24V DC supply.
 - b. Contacts: when required, SPST rated 3A continuous at 24V AC, minimum.
 - Enclosure:
 - a. Type: IP 66.
 - b. Mounting: Wall, unless otherwise specified.
 - Power:
 - a. Four-Wire Unit: Unless otherwise specified ; 230V AC, 50-Hz.
 - b. Two-Wire Unit: When required; powered from a remote 24V DC power supply.
5. Cable: Length as required to accommodate the device locations.
6. Expendables (for Each Unit Provided): One 500 ml bottle of 2,000 microS/cm conductivity standardizing solution if appropriate for required range.

ORP ELEMENT AND TRANSMITTER:

1. General:
- Function: Measure, indicate, and transmit the oxidation-reduction potential (ORP) of a process fluid.
 - Type: Potentiometrically measure ORP without requiring electrolyte flow.
 - Parts: Element, transmitter, interconnecting cable, junction box, and expendables.
2. Performance:
- Range: Minus 1,500mV to plus 1,500mV.
 - Accuracy: Plus or minus 1.0mV.
3. Element:
- Type: With measuring and reference electrodes.
 - Measuring Electrode: Platinum, field replaceable.
 - Reference Electrode: Double junction type, field replaceable.
 - Liquid Junction: Porous Teflon or ceramic material.
 - Features: Integral preamplifier/signal conditioner.

- Zero Stability: Plus or minus 1.0mV per month.
- Operating Conditions: Capable of withstanding up to 275kPa at 60 degrees C minimum.
- Mounting/Process Connection: As shown on the Drawings.
- Mounting Hardware: As recommended by the manufacturer for the specific application and/or as shown on the Drawings.
- Wetted Parts: Non-metallic synthetic materials; manufacturer to confirm compatibility with process fluid.
- Connection Between Sensor and Cable: Protection Class IP 68.

4. Transmitter:

- Features:
 - a. Indicator: LCD or LED digital display.
 - b. Scale Range: As required.
 - c. Contact Set Point: When required, set point adjustable from 0 to 100 percent of full range, initial setting as required.
 - d. Microprocessor based.
- Signal Interface:
 - a. Output: One of the following interfaces as required:
 - i. Profibus PA Digital Communication.
 - ii. 4 to 20mA DC into load resistances in the range of 0 to 600ohms without load adjustments minimum for 24V DC supply.
 - b. Contacts: When required, SPDT rated 2.5A continuous at 230V AC, minimum.
 - c. Upgradeable plug-in option for additional outputs for controlling automatic cleaning system.
- Enclosure:
 - a. Type: IP 65.
 - b. Mounting: Wall unless otherwise specified.
- Power:
 - a. Four-Wire Unit: Unless otherwise specified; 230V AC, 50-Hz.
 - b. Two-Wire Unit: When required; powered from a remote 24V DC power supply.

5. Cable: Length as required to accommodate the device locations.

6. Junction Box:

- Quantity: For each element when required.
- Type: IP 65 with terminal block, receptacle, cable clamp adapter, and watertight plug.

7. Expendables (for Each Unit Provided):

- Liquid Junction: One of the type required.
- Electrodes: One double junction reference electrode and one platinum measuring electrode.
- O-Rings: One complete set of O-rings and one tube of O-ring lubricant.
- Electrolyte Solution: Quantity as required to make one complete changeout of gel-filled solution contained in sensor body.

TURBIDITY ELEMENT AND TRANSMITTER (LOW RANGE):

1. General:

- Function: Continuously measure, indicate and transmit a signal proportional to turbidity of a sample stream of process fluid.
- Type: Light scatter detection measurement using a 90-degree scatter photocell detector.
- Parts: Element, transmitter, interconnecting cable, mounting hardware and expendables.

2. Performance:

- Range: 0-100NTU.
- Resolution: 0.001NTU
- Repeatability: Plus or minus 1.0 percent or plus or minus 0.002NTU, whichever is greater.
- Response Time: For a full scale step change, 90 percent response in 5 minutes at 500ml/min flow.
- Required Flow: 250-750ml/min.
- Sample Fluid Temperature: 0-50 degrees C.
- Operating Temperature: 0-40 degrees C.

3. Element:

- General: Flow-through body using focused light and a photodetector cell to measure 90-degree scattered light within the fluid.
- Internal bubble trap and vent.

4. Transmitter:

- Features:
 - a. Indicator Range: 0-100NTU.
 - b. Four-digit display.
- Signal Interface: One of the following interfaces as required:
 - a. Profibus PA Digital Communication.
 - b. 4 to 20mA DC into load resistances in the range of 0 to 600ohms without load adjustments minimum for 24V DC supply.
- Enclosure:
 - a. Type: IP 66
 - b. Mounting: Wall-mounted.
- Power: 230V AC, 50-Hz.

5. Cable: 6 metre.

6. Expendables:

- Lamp Units: One for each unit provided.
- Formazin Calibration Kit: One for each unit provided.

AMMONIA ANALYSER/TRANSMITTER

1. General

- Function: Continuously measure, indicate and transmit ammonia level of the required process liquid.
- Type: Photometric or colorimetric measuring principle.
- Parts: Analyser/transmitter unit, mounting hardware, sample tubing and connections, reagent bottle(s) if required and expendables.

2. Performance:
 - Range: 0.2 to 30 mg/l NH₄-N.
 - Accuracy: plus/minus 3% of full scale.
 - Repeatability: Equal or better than plus/minus 2% of measured value.
 - Calibration Interval: less than or equal to 72 hours programmable.
 - Cleaning Interval: less than or equal to 72 hours programmable
 - Maintenance Requirement: less than 30 mins per week.
 - Operating temperature: 5 to 40 deg C.
3. Transmitter:
 - Display: 4 digit LED display for measured value alphanumeric LCD display for configuration.
 - Output: 4-20mA galvanic isolation for ammonium measurement for each channel.
 - Enclosure:
 - a. Type: IP43 stainless steel cabinet in 3 separate compartments for electronics, measurement and reagents (if any).
 - b. Mounting: Wall or panel mounted.
 - Power: 230V AC, 50 Hz

SPECIFICATONS FOR VARIABLE FREQUENCY DRIVE (VFD) SYSTEM:

1.0 SCOPE

- 1.1 This specifications covers the complete materials, equipment and incidentals required to place into operation an integrated low voltage variable frequency drive (VFD) system, electrical machines and covers all components of the engineered system.
- 1.2 Every variable frequency drive system shall consist of all system components required to meet the performance, protection, safety, testing and certification criteria of this specification. These components may include harmonic filter / power factor correction unit, multi-pulse, phase shifting input rectifier-grade isolation transformer, VFD converter / DC-link / inverter, and output filter/
- 1.3 The VFD system must
 - Represent a fully integrated package
 - Include all labour and material necessary to interconnect any VFD system elements like input choke, harmonic filter, output choke, etc., even if shipped separately.
- 1.4 The VFD system shall have the following protection features:
 - IP-54 enclosures shall be formed for a group of motors with incoming MCCB (without protection elements) to work as isolator and requisite number of outgoing feeders, each having individual shunt operated MPCB with S/C and O/L protection, E/F (if motor is rated above 5.5 KW), indications on each compartment for ON/OFF/TRIP/Thermistor Trip/EF Trip (as applicable).
 - Group fault signals and status of each motor shall be annunciated in the automation system at main control room.
 - Any modifications to a standard product required to meet this specification shall be performed by VFD manufacturer only.

- VFD system as defined in 1.2 above shall be completely factory pre-wired, assembled and then tested as a complete package by the VFD manufacturer, to assure a properly coordinated, fully integrated drive system.

CODES AND STANDARDS

The AC Drive shall comply with latest National and International standards and the recommendations for electrical industrial control devices (IEC, EN, UL, NFC, VDE) of:

- National Electrical Code (NEC)
- Underwriters Laboratory (UL)
- American National Standards Institute (ANSI)
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Canadian Standards Association (CSA)
- International Electrotechnical Commission (IEC)
- Federal Communications Commission (FCC)
- CENELEC

The AC Drive shall be of the most modern design, yet user friendly and be simple to install, commission and maintain. The AC Drive shall be able to start and control the speed of a standard squirrel cage induction AC motor. The AC Drives shall be :

CE marked, conforming to European Low Voltage (73/23/CEE and 93/68/CEE) and EMC (89/336/CEE) Directives,

UL/CSA marked according to UL 508C.

The AC Drives have to be built to comply with the IEC standards.

The materials used in the AC Drive shall be recyclable, non-toxic and flame retardant. The AC Drive shall comply with the European directive RoHS (Restriction Of Hazardous Substances) that prohibits the use of materials such as lead, chromium 6...

PERFORMANCE

Operating Envelope

VFD shall meet the following speed and torque requirements:

The VFD shall be capable of producing a variable AC voltage / frequency output to provide continuous operation over the normal 30-100% speed range. The VFD must be capable of sustained operation at 1/10th speed to facilitate checkout and maintenance of the driven equipment. As a commissioning and trouble shooting feature, the VFD power circuit shall be capable of operating without a motor connected to the VFD output.

VFD shall be capable of operating any standard AC motor of equivalent rating (HP and speed) over the specified speed range.

The VFD shall be capable of momentary overload of 150% for one minute.

The VFD shall be able to produce full rated torque at any speed in the operating range (constant torque capability).

The AC Drive in general shall be a digitally controlled drive, using, at least, the Pulse Width Modulation (PWM) with flux/sensorless vector control open loop and closed loop, with both speed and torque control modes, an algorithm to control unbalanced loads (ENA system), and a safety function (see chapter safety). It shall have IGBT's in the inverter section of the throughout the power range.

AVAILABILITY

Firing Signals All internal firing signals and other communications which link operational controls with power components (such as status or diagnostic signals) must utilize fiber optic cables.

Power interrupt Ride-Through The VFD system shall be capable of producing full rated torque in the event of a power loss of 5 cycles or less.

The VFD must be capable of automatically restarting in the event of a momentary loss of power, or a clearing of a drive trip. The VFD system shall provide the user with the choice of automatically restarting or not.

Power Sag Ride-Through The VFD system shall be capable of continuous operation with a 30% voltage sag on the input power line.

“Catch-a-Spinning Load” Capability The VFD system must be able to catch and take control of a spinning load if started while rotating equipment is already spinning. Appropriate safeguards must be included in this operation to prevent damaging torques, voltages or currents from impacting any of the equipment. The user shall have the option of employing this feature or disabling it.

Ground Fault Withstand In the event of a ground fault, the VFD shall be capable of annunciating the ground fault condition, safely operating and by user selection, either trip or continue operation. As a result of a ground trip, the VFD shall be capable of being reset and operating normally. There shall be no risk of fire or electric shock as a result of ground fault.

SERVICEABILITY / MAINTAINABILITY

Front Access

VFD system should be designed for front access only.

Remote Diagnostics

The VFD system shall be provided with the capability for remote diagnostics via modem communication. The required hardware shall be included in the supply and shall be

interconnected with PLC system at main control room.

PHYSICAL REQUIREMENTS

Environmental Requirements VFD system shall be capable of continuous operation in an average ambient temperature between -10 deg C and 60 deg C at an elevation upto 1000m above MSL, with necessary derating, as applicable for the design of the VFD. The VFD system shall also be simultaneously suitable for continuous operation in a maximum humidity between 0 and 95% non-condensing.

Heat Dissipation / Cooling System Preferably
VFD system shall be air cooled.

Air-Cooling Requirements Air cooled VFDs shall be provided with 100% redundant fans and automatic switchover in the event of a fan failure for enhanced reliability. If a blower fails, the system must automatically switch to the alternate blower and generate necessary alarm at main control room. Necessary air flow detection switches shall be provided for this purpose.

VFD system manufacturer shall provide heat dissipation data necessary to design all auxiliary HVAC systems.

Enclosure All VFD system components including transformer shall be mounted and wired by the VFD system manufacturer in a grounded enclosure meeting the following requirements without exception:

Input filters, transformer, power conversion, output filters and auxiliary equipment enclosure shall be NEMA-12 design. Air cooled units shall be NEMA-12 ventilated, IP-32 or better degree of protection, with gasketed doors. Air cooled units shall have cleanable filter media covering all air inlets. Inlet air filters shall be 100% washable, front replaceable with VFD in operation. The Medium Voltage VFD cabinet shall be 631 shade of IS:5.

STANDARD EQUIPMENT OF THE ENCLOSURE

Protection by Switch and Super Fast Fuses The Programming terminal of the AC Drive shall be accessible for programming and controls with the main door closed. The whole assembly shall be implemented with a strict consideration of the EMC Compatibility and Regulations as described further in this specification. Total harmonics distortion shall comply with IEC 61800-3-12. Harmonic reduction shall be carried out with a 3% inductance or equivalent. Cables shall be handled by mechanical fixation. Air output shall not be located in on the front of the enclosure.

Main power bus shall be tin plated, high conductivity copper, appropriately sized.

Refer specifications of LT Panels elsewhere in conjunction with this for further applicable detailed specifications including those for fabrication.

VFD will be preferably kept in electrical control room with necessary provisions as per manufacturer's recommendations.

PROTECTIVE DEVICES / DIAGNOSTICS

Power Component Protection

VFD system shall include distribution class surge arrestors to protect input transformer and VFD against voltage surges. These shall be integral with the drive panel cabinet.

Protective Features and Circuits

Main Protections : Over current, short circuit between phase, short circuit between phase and ground, independent short circuit, input phase loss, output phase loss, motor overload, over voltage, under voltage, over speed, IGBT over temperature, heat sink over temperature, other internal faults.

The VFD shall include a customer selectable automatic restart feature. When enabled, the VFD shall automatically attempt to re-start after a trip condition resulting from over current, over voltage, under voltage, or over temperature. For safety, the drive shall shut down and require a manual reset and restart if the automatic reset/restart function is not successful within a maximum of three attempts within a customer programmable time period. Auto-restart shall be programmable to allow for individual fault selection. If required to provide this function, the VFD system manufacturer must supply and mount within the VFD a separate programmable logic controller of approved make to provide this feature.

DATA DISPLAYS / PROGRAMMING TERMINAL

A door mounted LCD display shall be furnished, capable of displaying the VFD operational status and drive parameters. The digital display must present all diagnostic message and parameter values in English engineering units when accessed, without the use of codes.

As a minimum the following door mounted digital indications shall be supplied: Speed demand in % Output current in Amps. Output frequency in Hz Input Voltage Output Voltage Total 3-phase KW output Kilowatt hour meter (Digital Energy meter) Elapsed time running meter Using a shuttle button shall carry out the navigation in the menu and the parameter setting.

Parameter setting shall be easily accessible and user friendly with actual text messages and actual setting range.

Visibility and protection shall be selected for each parameter. Password protection shall be provided to avoid unauthorized tampering with the set parameters.

The programming terminal shall offer the possibility of memorizing and downloading 2-4 configurations of the AC drives to save time during the commissioning and to avoid mistakes. Preferably 4 programmable function keys shall be available for short cuts, application functions

The AC Drive shall have self-diagnostic properties to display faults and warnings as they occur. The fault memory shall be accessible by the programming terminal.

A FAULT LOG and HISTORY LOG for each VFD system shall be logged in HMI at main control room. To provide necessary communication/interconnection between VFD system and PLC system.

Further it shall be suitable to following / have the following minimum specifications:

Operating conditions:

Rated Input Voltage	:	380V -15% 480V +10%, three-phase
Rated Input Frequency	:	50Hz –5% to 60Hz +5%
Fundamental Power Factor	:	0.97 or better at nominal load
Efficiency	:	≥ 98 % at nominal load
Output Voltage	:	0 - UN, three-phase
Output Frequency Range	:	0 to 1000 Hz up to 37kW (50HP), adjustable
	:	0 to 500 Hz above 37kW (50HP), adjustable
Accel/Decel Time	:	0.01 – 6000 s, adjustable, linear, with S, with U or customised shapes
Operating ambient Temperature : below	:	See elsewhere of this specifications and also Note-1
Maximum operating altitude	:	1000 m without derating
Max. Relative Humidity	:	95 %, without condensation and dripping water. (IEC 60068-2-3)
Max. Corrosion Level of the Cooling Air:		IEC 721-3-3, class 3C1.
Chemical Gases	:	Coating shall be requested to comply with IEC 721-3-3 Class 3C2.
Solid Particles	:	IEC 721-3-3, class 3S2
Max. Vibration Level (IEC 60068-2-6)		
2 to 13 Hz	:	1.5 mm, peak to peak
13 to 200 Hz	:	1 m/s ²
Shock Level	:	according to IEC/EN 60068-2-27
Max. Ambient Pollution degree according to EN 50178	:	Degree 2, up to 15 kW (20 HP)
according to UL 508C	:	Degree 3, above 15 kW (20HP)
Control supply	:	could be internal so provided by the AC Drive itself, or provided by an external 24V DC supply

Note-1: The AC Drive shall be able to give a 100 % output current continuously in the above specified conditions. In order to ensure that the drive can provide the required output current in the specified ambient conditions, the Manufacturer shall inform the required derating, if the ambient temperature given in the project-specific specification is higher than 50 °C or if the installation altitude is more than 1000 m above the sea level. The derating factor shall be specified so that neither the lifetime of the AC Drive nor the unit's performance, overload capability included, nor the reliability of the AC Drive shall suffer.

Quality assurance

Every AC Drive has to be tested functionally. The inverter part of the AC Drive or each inverter module at least has to be tested by running it with a motor at full nominal load. A test report of the tests made shall be delivered by the Frequency Converter Manufacturer on engineer's request.

Application programming

The AC Drive shall be designed for both simple and the most complicated applications, yet it shall be user friendly. The AC Drive shall have built-in application macros available in the Simply Start menu, to allow selection of the range of pre-programmed control configurations and further, the AC Drive shall be able to store at least two customer modified macro-configuration, to suit the specific application. It shall be possible to reset the parameter settings back to the original macro settings through the keypad. The parameter readouts shall be in text format and not coded.

Digital Flow indicator & Flow integrator:

Digital flow indicator and flow integrator shall be modular in design. It shall consist of two separate dedicated backlit LCD/LED displays for flow rate indication and total flow indication. It shall accept 4-20 mA DC input from flow transmitters. It shall have a battery back up for flow totalizer. The flow indicator and flow totalizer shall have a facility on PCB for changing the multiplying factor.

Digital Panel Meters:

Digital panel meters (DPM) shall be microprocessor based and modular in design. They shall accept 4-20 mA DC signals from transmitters. The DPM's shall provide an output of 4-20 mA DC proportional to input signal for re-transmitting. The DPMs shall have back – lit LCD/LED display. Digital panel meters shall provide excitation voltage to the respective transmitters.

Cabinets for Field Instruments:

A cabinet shall be provided for enclosing instrument and associated accessories which are mounted outside the control panel such as transmitter, SPDs, Terminal blocks etc. at all measurement locations. The cabinets for electronic indication instruments like transmitters, flow computing units etc. mounted outdoors shall be provided with proper sunshades. It shall be fabricated from cold rolled steel with powder sheet of standard gauge and shall be suitable for wall mounting or pedestal mounting as required. The cabinet shall be properly painted from inside by white paint and from outside by paint shade RAL 7032.

The cabinet shall conform to IP-65 protection and shall have built in locking facility. The cabinet shall be earthed properly. A steel plate/pipe, as per the requirement, shall be provided in the cabinet for mounting the instrument and accessories.

Instrument Power Supply Cables and Instrumentation Signal Cables: Cables for Digital Signals (D.C.) and D.C. power supply to instruments:

660/1100 V grade multicore cables, multistranded high conductivity annealed 1.0 sq.mm stranded tinned copper conductor, extruded PVC insulated, overall shielded with aluminium mylar tape, ATC drain wire run continuously in contact with aluminium tape, inner sheathed with extruded PVC, Armoured with galvanized steel wire overall sheathed with extruded PVC conforming to IS: 1554 & IEC: 189 Part II.

Cables for analog signals:

660/1100 V grade annealed, tinned, high conductivity 1.0 sq.mm stranded copper conductor, extruded PVC insulated two/three core twisted into pair/triad, laid up collectively, individual pair shielded and overall shielded with aluminium mylar tape, ATC drain wire run continuously in contact with aluminium side of the tape, inner sheathed with extruded PVC, Armoured with galvanized steel wire overall sheathed with extruded PVC conforming to IS: 1554 & IEC: 189 Part II.

Laying of Cables:

- I. A distance of minimum 300 mm shall be maintained between the cables carrying low voltage AC and DC signals and a distance of minimum 600 mm shall be maintained between cables carrying HT and LT signals. Each instrumentation and power supply cable shall be terminated to individual panel/Terminal box. Identification of each cable shall be by proper ferrules at each junction as per cable schedule to be prepared by Contractor.
- II. Cables shall be laid in accordance with layout drawings and cable schedule which shall be prepared by Contractor and submitted for Project Manager's approval.
- III. All cable routes shall be carefully measured and cable cut to the required lengths, leaving sufficient amount for the final connection of the cable to the terminals on either end. A loop of 1 metre shall be left near each field instrument before terminating the cable.
- IV. Cables shall be complete uncut lengths from one termination to the other.
- V. All cables shall be identified close to their termination point by cable numbers as per cable inter-connection schedules. Identification tags shall be securely fastened to the cable at both the ends.
- VI. Cable shall be rigidly supported on structural steel and masonry, using individually cast or malleable iron galvanized clips, multiple cable supports or cable trays.
- VII. The Contractor shall take the actual measurement of the cables and the measurement of the cables and the associated accessories.

PLC - SCADA SYSTEM

Bidder to design PLC system with SCADA

PROGRAMMABLE LOGIC CONTROLLERS:

CODES AND STANDARDS:

The design material, construction features, manufacture, inspection and testing of Programmable Logic Controllers (PLC) shall comply with all currently applicable statutes, regulations and safety codes. The PLC shall comply with the latest applicable standards and codes. If any such standards are not applicable then the same shall comply with the available recommendations of professional institutes like NEMA, IEC, ANSI, ISA, IEEE, DIN and VDE

DESIGN AND CONSTRUCTION REQUIREMENTS

a) This shall comprise of programmable systems based on operational logic for safe and semi automatic operation of the treatment plant to produce required quality of Effluent as per the specified parameters. PLC shall be provided as a Redundant controller with Remote io connectivity should be a ring network to perform combinational and sequential logic functions, status monitoring and reporting functions with counter and timer facilities, for each station.

- b) PLC shall comprise of necessary processors, Input /Output (I/O) modules, communication interface modules and man-machine interface required to perform the desired functions.
- c) PLC shall have the following attributes as a Redundant controller:
- It shall carry out sequential start/stop logic implementation for operation of the filters.
 - It shall carry out computation and interfacing for data acquisition, data storage and retrieval.
 - It shall accept downloaded program from a programmer.
 - It shall have different functional modules to perform the desired functions.
 - It shall scan the inputs in time cycles and update the status of inputs/outputs.
 - To avoid spurious output because of output module failure, all commands shall be associated with release signals. Release signals shall include information on healthiness of the hardware, software and power supply modules.
 - It shall have relays, counter/timer functions, internal registers/ flags, watch dog timer, set/reset facilities, up-down counter etc.
 - It shall have provision for spare input and output modules.
- d) The PLC system shall be expandable and shall be modular in construction so as to carry out the future expansion without any hardware modifications.
- e) The PLCs shall have analog and digital signal monitoring capability for checking the healthiness of the signals. In case of detection of any unhealthy signal "PLC trouble" alarm shall be generated. In case of failure of a PLC, the status of all the outputs of the PLC shall be stay put.
- f) PLC shall be 32 bit microprocessor based with state of the art technology. System components shall be carefully chosen so that the reliability of the PLC shall be high. PLC shall use open standard bus protocols and structures for all communication within and outside the system.
- g) The PLC used shall have a proven record in the type of application concerned and in the prevailing environmental conditions.
- h) It shall be possible to perform the simulation functions and testing the program by changing the status of contacts and monitoring the output.
- i) The PLC system shall support 'hot swapping' of I/O modules i.e., removal and insertion of I/O modules under power on condition.
- j) The design of system configuration and development of PLC software shall be undertaken by the PLC manufacturer or System Integrator authorized by the PLC manufacturer.
- k) The PLC system shall support rack mounted I/O modules i.e., removal and insertion of I/O modules under power on condition.

CENTRAL PROCESSING UNITS:

- a) The Central Processing Unit (CPU) shall be high performance processor with modular configuration suitable for real time process. High inherent reliability, self checking, error-recovery and trouble-shooting features shall be source of the features of CPU.
- b) Communication between CPU and peripherals shall be by an I/O bus. The individual device, interfaces shall be capable of being plugged into the I/O bus.
- c) CPU shall have a real time clock capability to accept a time synchronization pulse from external communication system and adjust its internal clock with the pulse.

- d) CPU shall have extensive self diagnostic facilities and watch dog timers to identify faults at card levels. Web server for CPU Protocols setup, diagnostic and monitoring
- e) Automatic restart of the system on resumption of power shall be provided.

- CPU and IO scanner module shall support Extended Temperature or higher (-25°C - +68°C) & Conformal coating for Harsh environment.
- CPU shall support Advanced TCP/IP networking functions: NTP client, FTP client or server, HTTP server, SOAP/XML, communication server, SNMP agent, SMTP client.
- CPU shall support multiple client connections up to 4 client connections simultaneously with dedicated event buffer for each client.
- CPU shall have Events queue stored in RAM memory up to 100,000 events for all clients
- CPU Shall support various modem connections
 - Serial and radio modems
 - GSM and PSTN modems
 - IP modems (GPRS, ADSL)
- **CPU shall support following Protocol Features**
 - Time synchronization through protocol facility or NTP
 - Data synchronization on demand of the SCADA
 - Balanced and unbalanced transmission mode
 - Events management with time stamping - Sequence of Events (SOE)
 - Events data backfill to SCADA application via protocol facility
 - Report by exception data exchanges
 - Unsolicited messaging data exchanges
 - Protocol setup via Web page
- **The controller shall support all five IEC 61131-3 programming languages:**
 - Sequential Function Chart (SFC)
 - Functional Block Diagram (FBD)
 - Ladder Diagram (LD)
 - Structured Text (ST)
 - Instruction List (IL)
- CPU Shall support DNP3 over UDP & TCP protocols
- CPU shall support local or remote downloading of operating system firmware
- CPU Shall support upstream communications with SCADA master stations for polling interrogation of data,
 - backfilling of time stamped event data, receiving master commands
- CPU Shall support remote diagnostic and monitoring with a built-in Web server
- CPU shall support remote programming and downloading of control program with software through Ethernet or modem connections

MEMORY UNIT:

- a) Memory unit shall comprise of highly reliable memory chips which are industry standard, proven design with fast random access and suitable for operation in process environments. Main memory shall be modular and facility shall be provided for up gradation and expansion of memory to meet future demands.
- b) Sufficient program memory and data memory space shall be provided. At least 50% extra memory space shall be provided over the actual requirements. System initialization and application software shall be stored in EEPROM or EPROM with necessary hardware. Running data shall be stored in a RAM with internal battery back-up. The battery back-up provided shall last for at least one month with life of battery a minimum of 3 years. Appropriate programs for application software modification shall be provided.

INPUT/OUTPUT MODULES:

- a) Standard rack mounted I/O modules with plug-in cards shall be provided. Field wiring shall be terminated in screwed terminal blocks and interconnected to the processor I/O system with pre-fabricated cables and plug in card type connectors.
- b) 20% extra I/Os of installed capacity for each type shall be provided as spares and shall be wired to the terminal block of the control panel. Provision shall be made for future expansion of extra I/O modules of the installed capacity.
- c) Some of the common features of the I/O modules shall be as follows:
 - i. All inputs shall be terminated with input protective network and necessary isolating barriers.
 - ii. Filters for noise rejection.
 - iii. Provision for isolation of faulty channels.
 - iv. Input /output status shall be indicated by LEDs.
 - v. Test points and fault indication LEDs shall be provided to carry out
 - vi. All the modules shall be of addressable type.
 - vii. Protection for continuous overload upto 20% of all input ranges.
 - viii. All outputs shall be provided with fuse protection and fuse failure detection. The fuses may be mounted externally from the output module.
 - ix. All the modules shall be of addressable type.
 - x. The I/O modules shall have diagnostic features i.e., in case of failure of any I/O channel an alarm "PLC trouble" shall be generated automatically.
 - xi. Internal battery back up.
- d) Analog input modules
They shall consist of an input isolation unit, signal conditioning unit and an analog to digital converter (ADC). In addition, the following features shall be provided:
 - i. Cross talk attenuation.
 - ii. Provision for monitoring of the ADC for overflow detection.
 - iii. Gain amplifier with high common mode rejection ratio.
 - iv. Accuracy for analog signals shall be minimum + 0.5%.
 - v. Screwed terminals with fuse and LED for indication of 'fuse blown' shall be provided for each analog input.
- e) Digital input modules
The following design features shall be provided.
 - i. Contact bounce protection.
 - ii. Choice of type of contacts.
 - iii. Screwed terminals with fuse and LED for indication of 'fuse blown' shall be provided for each digital input.
 - I/O Modules shall be hot swappable

- LED indication to indicate status of field signals, card healthiness and communication healthiness shall be provided.
- Isolation of DI with internal circuit shall be preferably 1.5KV A.C / 500V DC
- Insulation resistance should be > 10Mohms

f) Digital output modules

The digital output module shall provide contact closure output by driving relays. The features to be provided are as follows:

- i. Contact bounce protection.
- ii. Relay output to operate pump motors and motorized valve actuators.
- iii. Fail safe position in case of output module failure and fault indication.
 - The modules shall be individually protected against continuous over-current and short circuit
 - The module shall be capable of verifying the state of each output
 - Fall back state of the channel shall be configurable.

G) Analog Inputs:

- Shall be rack based and hot swappable
- Isolation of +/-300 VDC channel to channel, 1400 VDC channel to Bus and 1400 VDC Channel to ground shall be provided.
- Suitable for 4-20mA/ 0-10V DC software configurable.
- Shall have 16 bit resolution and Measurement error shall be within 0.15% of full scale
- LED indication to indicate status of field signals, card healthiness and communication healthiness shall be provided.
- Broken wire diagnostics shall be provided
- Software filtering shall be supported

DEFAULT VALUES:

Every operator selectable parameter shall be provided with a default value held in EPROM or EEPROM in the relevant PLC.

The default value shall be used if no other value has been entered through the local PLC or if the value entered through the local PLC has been lost. The default values shall be made available for interrogation by the local PLC at all times. Sensible and logical default values shall be inserted prior to the start of system tests. The default values at the time of handing over the plant shall be those found operationally suitable during commissioning. The PLCs shall make available for interrogation by the local PLC for bits corresponding to the following PLC faults:

- (a) Failure of PLC as indicated by the PLC watchdog relay;
- (b) Failure of each I/O card;
- (c) Failure of communication link
- (d) Status of 24 V DC power supply for I&C system.

SCADA System requirement for plant :

Sr	Description	Unit	Particulars	To be filled by Bidder

A	GENERAL		
1	Description	Supervisory control and Data Acquisition System (SCADA)	
2	Make	As per Approved	
3	Quantity	1 Set	
4	Model/Version	PI. Furnish	
5	Type	Run time , Control & Development	
6.	Computer	Latest Version processor available in the not less than 3 months older at the time of approval, RAM Min.4 GB and Hard disk 500 GB, 17 ENCH LCD SCREEN WITH Keyboard, Mouse, 4 Hour capacity of UPS, Industrial Class Housing of reputed make only like IBM, LG, SAMSUNG, SIMENS, ZENITH, WIPRO, DELL,HP	
7.	Platform	Microsoft Windows, latest version Windows NT or better.	
B	SOFTWARE FEATURES		
1	Tags	Suitable for running system successfully with necessary reports	
2	Graphics	Easy to configure with support of library, Suitable to any resolution.	
3	Animation links	Animation link facility for analog, discrete, string value, etc. with editing facility.	
4	Library	Frequently used wizards/icons with facility for conversion AUTOCAD drawings.	
5	Drivers	Connectivity for network protocols, and third party developer (commonly used).	
6	Trends	Built module for Real time & historical trend with stamping of Tag name, min, max, avg. value, zooming/scrolling of scale & time, Export data facility to excel, text. Multiple trend pages facility, comparison facility between actual & predicated/Ideal values.	

7	Alarm and Events		Analog/discrete type alarms, Alarm & Event display, logging & printing. Alarm stamping Time, Value, status of alarm, ack.	
			Time, security level, interlinks, etc. Group facility	
8	Messaging		Pop up messages, Flash messages with conditions & action to be taken details	
9	Password		Password protection for all facilities. Separate levels for Engg, Operators, Incharge	
10	Reports		Built in report formats for daily, shift, weekly, efficiency, etc. format in sheet format.	
11	Condition Editor		Support of Condition script editor for operator use	
12	Control Strategy		Facility to Control strategy as per attachment.	
13	Storage Capacity of Date		Minimum of 60 days for any kind of form such as trending, reports, etc.	
C	SUPPORTS			
1	Hardware		Pl. Furnish	
2	Platform Software		Pl. Furnish	
3	Laser Printer		Pl. Furnish (HP/SAMSUNG/CANON ONLY)	
4	Communication		TCP/IP	

*Note : Data Given for Guideline Purpose & Design Purpose only

Human Machine Interface (HMI) Software

HMI SCADA Software shall be of Server-Client architecture and One full development Runtime License is required.

The operator interface software, herein described as the HMI (Human Machine Interface) shall be common for engineering and as operator works station. - an integrated package for developing and running automation applications and also to be just running the automation application.

The HMI shall be designed for use in Microsoft Windows NT /WINDOWS 2000/WINDOW XP and shall use OLE, ODBC, DDE, OPC and ActiveX technologies for optimal performance and integration with other software systems.

The HMI shall have several Methods for collecting data from programmable controllers. One method shall rely on DDE servers. Another method shall rely on OPC servers. And still another shall use a C-API interface through direct device tags.

The tag database shall be organized in a hierarchy, each level represented by a folder that can be expanded or collapsed.

The HMI shall have the ability for the current value of a tag to be updated from the device it is connect to and stored in RAM so it is immediately accessible to all parts of the HMI.

The tag database shall provide the ability to generate tag names of up to 40 characters long. The tag names shall be able to contain the following characteristics: A through Z, 0 through 9 underscore (_) and dash (-).

The HMI shall have the ability to create a tag whose value is the result of an expression. The expression can be made up of mathematical operations, tag values, if-then-else logic and other special functions. The current value of the derived tag shall be stored in an analog, digital or string tag in a value table.

The HMI shall provide a Macro capability that will execute system commands, user defined commands and other macros.

The alarm system shall have the ability to monitor any analog or digital tag for alarms, up to a maximum of 10,000 tags.

The alarm system shall have the ability to define up to eight different severity classes to visually and audibly distinguish alarms.

The alarm system shall have the ability to use system default messages or create unique messages to describe an alarm log messages to a file, to a printer or to both suppress alarms for maintenance and tuning purposes and set up global alarm monitoring.

The alarm system shall provide a means of displaying up to 1000 tags that are in alarm. This alarm summary display shall be fully configurable.

The alarm system shall have the ability to create alarm log files periodically, at specified times and on event. This alarm log system shall have the ability to automatically purge old files after a specified time.

The HMI shall have the ability to trigger actions based on an event that has an expression applied to it. An expression is an equation containing tag values, mathematical operations, if-then-else logic, or other functions. An action shall have the ability to produce a variety of functions including, but not limited to, initiating a snapshot of tag values, displaying an error screen and changing a tag value.

The HMI shall have the ability to allow certain users or groups of users to access only certain parts of the system. The security shall be based on a series of codes. Each code shall allow the users, or groups of users, with security privileges for that code to access the HMI commands allowed by that code. Users shall be allowed to be assigned combinations of security codes, allowing for each user to access a different set of features.

The security system shall assign each person a user account with a login name, password, and any desired macros. The HMI shall have a minimum of 17 different security codes.

The HMI shall provide a graphics display editor for creating displays using graphic objects.

The graphics display editor shall have the ability to drag and drop objects from a pre-configured graphics library, paste objects that are copied to the clipboard from another Windows application, and insert objects created by another Windows application using OLE. The graphic display editor shall allow the user to create libraries of graphic objects.

The graphic display editor shall have the ability to attach, as a minimum, the following control to objects: blinking colors, visibility, rotation, horizontal and vertical movement, resizing (width and height), fill and touch.

Additional requirements

The HMI package shall be able to specifically provide the following features:

- Display status of Plant in a graphical and tabular format (i.e. running, stopped, fault etc.)
- Display Analog values on the appropriate graphic screen.
- Display status and values at other down stream pumping station as required.
- Annunciator alarms associated with the area of the plant concerned including details of the time the alarm occurred

The HMI package shall provide following facilities for the operator Station

- Adjust process set points
- Select process modes
- Acknowledge alarms
- View a journal of unacknowledged alarms
- View a journal of the last 200 alarms acknowledged and unacknowledged.
- Display process set points
- Provide real time and historic trending of local analogue values
- Provide data archiving of all local analogue values
- Prepare daily and weekly reports (providing details of daily and weekly throughputs against numbers of pump running hours and power usage)
- Display a total running hour's log of local transmission pump drives.
- Any additional features required to assist in the effective and efficient operation of the STP.
- Power monitoring/management using various analogue / digital inputs provided from the HT switchgear breakers, PMCC / MCC breakers & feeders, VFDs, etc for STP.

Graphic screens shall be provided as follows but not limited to this:

- Main and subsystem menus
- Plant / Process overview (i.e. providing details of Nos. of pumps / blowers / equipment running, Flow, totalized flow, levels, process parameters / power supply status, etc.)
- Overview of power monitoring system
- Overview of control system
- Screens to permit viewing of process set points

- Tabular screen of Pumping Plant status and values
- Running hours log for Pumping Station and process pumps.

The screens shall display data commensurate with their size and the area of and number of Plant items covered. In addition to the specific screen requirements stated above, any additional screens to ensure comprehensive coverage of the Works needs to be provided.

A comprehensive screen navigation system shall be provided giving access to all screens via a system of menus and short cuts (i.e. it shall be possible to follow the process from one screen to another by clicking the mouse cursor on screen 'hotspots' to effect the move from one screen to another).

The sample rates required for the displaying of trends shall typically be one sample every 15 seconds for flow values and one sample every 30 seconds for levels. The system shall be capable of storing real time data for one day and historic data for 60 days.

The sample rates for archiving shall be the same as for trending. The archives shall be stored in daily files. The system shall provide capacity to store archives for 60 days. A warning alarm shall be provided to the operator to advise that archiving to disk should take place or archived data will be overwritten.

The data derived from archiving to the MMI and the archived data viewed using the trend facility. The HMI shall have the ability to record specific tag values under certain conditions .Several models shall define these conditions. This data that is collected shall be stored in .dbf (dBase IV) format for displaying in trends, archiving for future processing or analysis, and/or using with third-party software, such as FoxPro, Crystal Reports, and Microsoft Excel, for display or analysis .It shall be possible to log historical data directly to an ODBC compliant database

The Contractor shall provide a disc drive with the MMI in order to download archive data or to upload previously stored archive data onto electronic storage media.

Contractor shall provide minimum of 3 sets of as-built control panel wiring drawings, PLC logic write-up, I/O Schedule/assignment, ladder diagram and other relevant documents in hard copy format and 3 sets in soft copy form on CDs. Soft copy format shall be in editable form to enable incorporating any changes in future. 3 sets of application program as back-up shall also be provided in soft form on CDs

LAPTOP CONFIGURATION :

Latest Version processor available in the not less than 3 months older at the time of approval, RAM Min.6 GB and Hard disk 1 TB, 17 INCH LCD SCREEN WITH Keyboard, Mouse, 4 Hour Battery Backup, Industrial Class Housing of reputed make only like IBM, SUMSUNG, DELL,HP

LT / INSTRUMENT POWER CABLES

All power & control cables for use on medium / low voltage shall be heavy duty type,

aluminum / copper conductor. PVC (XLPE may also be accepted) insulated, inner sheathed, armored and overall PVC sheathed as described below.

The Power and Control cables shall have the following minimum overall cross sectional areas:

- .a. Medium Voltage Power 6 sqmm (Aluminium) / 1.5 sqmm (Copper)
- .b. Control Cables 1.5 / 2.5 sqmm (Copper)

Cables shall be sized based on the maximum continuous load current and the voltage drop. The derating due to ambient air temperature, ground temperature, grouping and proximity of cables with each other etc. shall be taken into account.

Below grade cables in paved areas shall be in concrete lined trenches with concrete covers having proper slope and suitable drainage arrangement to avoid water collection. In unpaved areas cables shall be in lined trenches or directly buries in ground. In hazardous areas and transformer bays, trenches shall be completely filled up with sand. Concrete lined cable trenches shall be sealed against ingress of liquids or gases wherever the trenches leave a hazardous area or enter control room or substation. The cable trenches shall be sized depending upon the number and voltage grade of cables. Where underground cables cross roadways, pipe sleepers at grade, etc., they shall be protected by being drawn through PVC sleeves/ducts or suitable RCC Pipes to provide a permanent crossing. Pipes laid for mechanical protection shall be sealed at both ends.

High voltage, medium/low voltage, control and signal cables shall be separated from each other by adequate spacing or running through independent pipes, trenches or cable trays as applicable. Cable trays, racks and trenches shall be sized to allow for 20% future cables. Cable installation shall provide minimum cable bending radii as recommended by cable manufacturer.

Cable route markers shall be installed at every 30m interval all along the routes of directly buried cable trench and also at locations where the direction of cable trench changes.

All power and control cables shall be of continuous lengths without intermediate joints. Where joints are unavoidable, these shall be provided with the permission of Engineer-in-charge. All cables shall carry tag numbers for easy identification. In case of control cables all cores shall be identified at both sides by their terminal numbers using PVC ferrules as per interconnection diagrams.

Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing/engraving shall be legible and indelible.

Control cables having 6 cores and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers shall contrast with the colour of insulation with a spacing of maximum 50mm between two consecutive numbers. Colour coding for cables up to 5 cores shall be as per IS.

A. Specifications for PVC Insulated Power Cables (LT / Instrument Supply)

Cables of 660V/1100V grade, multi-core cables, multi-stranded high conductivity

annealed 1.5 / 2.5 sq.mm or higher size as specified, stranded, tinned copper conductor, PVC insulated, PVC inner sheath, armoured with galvanised steel wire overall sheathed with PVC, conforming to IS:1554 & IEC:189 Part I & II shall be used for instrument power supply. (Higher diameter aluminium conductor where specified shall be of solid conductor)

The conductors of nominal area less than 25 sq.mm shall be circular and above that it may be circular or sector shaped.

The inner sheath shall be of vulcanized rubber proofed or plastic tap shall not be harder than PVC used for insulation. This shall conform to requirements of type ST-1 of IS:5831.

Armouring shall be applied over inner sheath, where specified and shall be of galvanized steel strip as per IS 3975. The armour shall be applied as closely as possible with left hand direction of lay. For cables having diameter over the inner sheath less than 13 mm, the armour shall be of galvanized round steel wires or galvanised steel strips. The dimension and resistance of armour shall be as per IS 1554 Part 1.

The outer sheath of the cable shall be applied by extrusion and shall be of black colour PVC compound conforming to requirements of type ST-1 compound of IS. 5831. The thickness of outer PVC sheath and its tolerance shall be as per IS 1554 (Part – I). To protect the cable against rodent and termite attack, suitable chemicals may be added into the PVC Compound of the outer sheath.

B Cable Accessories

All accessories like cable glands, lugs and terminal markings etc. shall be used conforming to relevant standards / as specified. For 650/1100 V grade cables, Ni-Plated Brass Double Compression type glands WP to IP-65 as a minimum and tinned copper crimping type lugs shall be used.

Cable Laying

HV, MV / LV, control and signal/communication cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cable trays.

Cable Laying and termination shall be such that chances of cable getting damaged are remote.

LT cable shall be laid in cable tunnel or tray racks or buried underground with appropriate protection. Black shall indicate the neutral, while red, yellow and blue for three different phases. All LT cables when laid on the cable racks shall be properly dressed and clamped as required without crisscrossing and unnecessary overlapping. Cables shall be properly dressed and clamped.

Laying of HT and LT under ground cables.

Minimum depth of cable trench shall be 750mm for LT cables and 900mm for HT

cables. The cables shall be protected by filling trench bottom with a layer of sand after clearing the bottom from all rocks, stones and sharp objects, before the cables are placed. This sand shall be leveled and cables laid over it. These cables shall be covered with 150mm of sand on top of the largest diameter cable and sand shall be lightly compacted. A flat protective cover of 75mm thick second class red bricks shall then be laid and compacted and then remainder of the trench shall then be backfilled with soil, rammed and leveled.

In routing, necessary barriers and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angles and these two shall not run in close proximity.

LT cables shall be bent in radius not less than 12 times their individual overall diameters, while HT cable shall have bends not less than 15 times their individual overall diameter.

Cable routing between cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45 Deg to the trench wall. Bending radii of pipes shall not be less than 8D. It is ensured that both ends of the GI pipe sleeves shall be sealed with approved WP sealing plastic compound after cabling. In places where it is not possible, cables shall be laid on smaller branch trays.

All cable shall be identified close to their termination point by cable tag numbers as per cable schedule. Cable tags shall be punched on aluminium straps (2mm thick, 20mm wide of enough length) securely fastened to the cable and wrapped around it.

Routes of these cables shall be arrived at on the basis of the relevant drawings and after consulting the Engineer in charge.

A distance of minimum 300 mm shall be maintained between the cables carrying low voltage AC & DC signals and a distance of minimum 600 mm shall be maintained between cables carrying HT & LT cables.

Identification of each cable shall be by proper ferrules at each junction as per cable schedule to be prepared by contractor. All cables shall be identified close to their termination point by cable numbers as per cable interconnection schedule. Identification tags shall be securely fastened to the cables at both ends.

E Drawings and Schedules

Size of cables shall be given in single line power diagrams. A cable schedule shall be prepared on the basis of relevant drawings. All cables and wires shall be adequately sized to carry continuously the normal currents expected on the relative circuits. All trenches for electrical cables shall be separate from water or sewage pipe line trenches.

F Splicing and Termination

Straight through joints shall be avoided. In case, these are absolutely necessary they shall be made at convenient locations suitably protected as approved and sanctioned by the Engineer in charge but in no case within the conduit pipes or ducts. Branch circuit wiring shall be spliced only in switch boxes, panel switch socket outlet boxes light fixtures outlets and circular junction boxes. They shall be made only with approved porcelain connectors.

Cables shall be tested in accordance with IS : 1554 / 7098

Note: The cables shall be supplied, laid (below ground or above ground in trays) and provided

with necessary accessories like cable glands, lugs, etc. and terminated (at instrument, junction box, panel, etc. as applicable) in accordance with above specifications and price quoted by bidder shall be inclusive of all complete in all respects.

APPROVED VENDORS: CCI, Finolex, Fort Gloster, Havells, Torrent, Universal, Associated Cables, Associated Flexibles & Wires, Brooks Cables

Unit of Measurement: Length in Meteres (RM)

LT / Instrument Power cable including Supply, laying (buried in Ground / Over head cable in Cable tray), termination, etc. complete in all respects as per above specification for the specified size of Cable.

LT / INSTRUMENT CONTROL (DIGITAL SIGNALS) CABLES

Specific requirement / specifications for control cables shall be as under:

A Specifications for Cables for digital signals:

Cables of 660V/1100V grade, multi-core cables, multi-stranded, high conductivity, annealed, 1.5 sq.mm stranded, tinned copper conductor, PVC insulated, overall shielded with aluminium mylar tape, PVC inner sheath, armoured with galvanised steel wire overall sheathed with PVC, conforming to IS:1554 & IEC:189 Part II shall be used for digital signals.

Rest all specifications (except for Specifications for PVC Insulated Power Cables for LT / Instrument Supply) including for supply, laying, accessories and termination shall be as mentioned above for “LT / INSTRUMENT POWER CABLES”.

APPROVED VENDORS: CCI, Finolex, Fort Gloster, Havells, Torrent, Universal, Associated Cables, Associated Flexibles & Wires, Brooks Cables

Unit of Measurement: Length in Meteres (RM)

Control (Digital Signal) cable including Supply, laying (buried in Ground / Over head cable in Cable tray), termination, etc. complete in all respects as per above specification for the specified size of Cable.

CABLES FOR ANALOG SIGNALS

Specific requirement / specifications for analog (signal) cables shall be as under:

A Cables for analog signals:

Cables shall be of 660V/1100V grade, single or multi-pair cables, annealed, tinned, high conductivity 1.5 sq.mm stranded copper conductor, PVC insulated two cores twisted into pair, laid up collectively, individual pair shielded and overall shielded with aluminium mylar tape, ATC drain wire running continuously in contact with aluminium side of the tape, PVC inner sheath, armoured with galvanised steel wire overall sheathed with PVC, conforming to IS:1554 & IEC:189 Part II shall be used for analog signals. Multi pair cables shall be of 6 pair or 12 pair.

Rest all specifications (except for Specifications for PVC Insulated Power Cables for LT / Instrument Supply) including for supply, laying, accessories and termination shall be as mentioned above for “LT / INSTRUMENT POWER CABLES”.

APPROVED VENDORS: Associated Cables, Associated Flexibles & Wires, Brooks Cables, Delton, Havells, Uday Pyro

Unit of Measurement: Length in Meteres (RM)

Analog Signal cable including Supply, laying (buried in Ground / Over head cable in Cable tray), termination, etc. complete in all respects as per above specification for the specified size of Cable.

COMMUNICATION CABLES

Communication cables suitable for supporting communication over Profibus, Serial (Modbus Protocol), Ethernet, etc. as per the communication option selected by bidder for various proposed analysers, instruments, VFDs, power analysers, relays and instrument, as applicable (existing instrument / equipment where applicable shall normally be without communication port or if available shall be with Modbus, Profibus or Ethernet communication). Communication cables shall be shielded and shall be laid in PVC ducts of minimum 1” size (for buried cables) / on ducts / trays (for in air / overhead cables). Bidder shall offer the price for various communication cable options as specified in the price bid and in case bidder is opting for any other communication option not mentioned there in, he shall quote the price in “Other Communication” option providing all necessary details in the technical bid. However, bidder shall note that selection of communication option other than those specified in the price bid are subject to review of client / consultant and client reserves to reject the proposal without

assigning any reason there of in which case bidder shall offer instrument / equipment with communication options mentioned in the bid (Profibus, Modbus, Ethernet,). Necessary repeaters, couplers, termination kits, converters, connectors / plugs, etc. as applicable for connecting with necessary instrument / equipment shall be included appropriately by bidder based on the quantity (BOM) furnished for all instrument / equipment for proposed as well as existing instrument / equipment for necessary connection to communication network and communicate with PLC/SCADA system

In general, cables for Ethernet shall be twisted pair with RJ45 connector, for Modbus it shall be twisted pair, shielded cable with terminators, for Profibus-DP it shall be shielded twisted-pair line or a fiber optic cable (with transmission standard EIA RS485).

Rest all requirements (except for Specifications for PVC Insulated Power Cables for LT / Instrument Supply) including for supply, laying, accessories and termination shall be as mentioned above for “LT / INSTRUMENT POWER CABLES” as applicable.

APPROVED VENDORS: D-Link, Delton, Finolex, Lapp Cable, Molex

Unit of Measurement: Length in Meteres (RM)

Communication Cable including Supply, laying (buried in Ground / Over head cable in Cable tray), termination, etc. complete in all respects as per above specification for the specified type of communication.

CAST ALUMINIUM JUNCTION BOXES

Junction Box material shall be Cast Aluminium (LM-6) only and shall be weather proof to IP-65. Flame proof junction boxes shall be supplied with Ex(d) certification in addition.

The boxes shall have terminals suitable for a minimum of 4 mm² cable termination mounted on rails. 20% spare terminals shall be supplied in junction boxes.

Each junction box shall have 10% or minimum 2nos., whichever is higher, spare entries of each size. Spare entries shall be provided with plugs. Junction box shall have necessary provision / lugs for earthing and shall have suitable tag plate.

APPROVED VENDORS: Ex-protecta, CEAG, Sudhir, Baliga

Cast Aluminium Junction Boxes along with structural support, etc. complete in all respects as per above specification, having 20 Terminals.

Cast Aluminium Junction Boxes along with structural support, etc. complete in all respects as per above specification, having 30 Terminals.

EARTHING PIT / STATION

Supply, Erection, Testing and commissioning of earthing station having ‘ Pipe in Pipe ’ technology using Safe Earthing Electrode. The special type back filling compound having inherent moisture absorption characteristics must be used to make the earthing station

maintenance free and no periodic water pouring should be required. The work shall include excavation refilling providing manhole cover, chamber etc. the earthing station shall as per IS 3043:1987 requirements.

Earthing station shall be provided for Instrumentation / PLC / SCADA system as per above technology. Earthing station shall be provided having G.I. electrode 3000 mm long, outer diameter of minimum 50 mm and inner diameter of minimum 25 mm with GI earthing strip.

Multiple earth connection shall be taken from suitably located earth plates connected to earth loop. All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections of equipment. Unless otherwise specified, earthing connections to individual equipment shall be done in accordance with standard equipment earthing schedule.

Plant instrument system clean earthing, UPS system clean/safety earth shall be separate from the electrical earthing system.

Earth connections shall be made through compression type cable lugs / by welded lugs.

All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections and all connections adequately locked against loosening.

METHOD OF MEASUREMENT :

Provision of earthing station complete with excavation, electrode, watering pipe, soil treatment. Masonry chamber with cast iron cover etc. shall be treated as one unit of measurement.

TEST :

The entire earthing installation shall be tested as per requirements of Indian standard Specification IS : 3043.

The following earth resistance values shall be measured with an approve earth megger and recorded.

4. 1. Each earthing station.
5. 2. Earthing system as a whole.
6. 3. Earth continuity conductors

Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 ohm in each case.

Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

All tests shall be carried out in presence of the Surat Smart City Development Limited's representative.

Recommended Size of Earthing Conductors

Below are the recommended minimum sizes of earth conductors. However, Earthing Strips/conductors, if required of higher size as per Ground Fault Calculations, should be laid.

Type of Equipment Earth conductor size (See Note-1)

Small equipment and instrument 8 SWG GI solid wire Or through min. 1.5 sqmm earth conductor of power cable Lighting, Power and Instrument Panels 10mm dia GI wire rope Or 25 x 3 mm GI Strip Push Button Stations (LCS) 8 SWG GI solid wire

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

Signature & Seal of Contractor

29. OPERATION & MAINTANANCE (O&M)

DETAIL SPECIFICATION:

The scope of work of Operation and Maintenance work for a period of 10 years broadly covers for the following major items of works.

- [A] O & M of augmented 39 MLD SPS with PLC/SCADA.
- [B] O & M of augmented 167 MLD STP with PLC/SCADA & existing Bio-Gas based Power Generation Plant.
- [C] O & M of new 40 MLD net output capacity TSTP with PLC/SCADA.

The contractor shall be responsible for smooth and satisfactory operation and maintenance of the augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant and 40 MLD net output capacity TSTP at Dindoli on round the clock basis for a period of 10 (Ten) years from the date of completion of trial run and commissioning of augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant and 40 MLD net output capacity TSTP. The contractor will also operate and maintain existing 2 nos. 400 KWe capacity Bio Gas Power Generation Plant as per scope of present contract & PLC-SCADA System of the existing plant and the proposed plant.

More specifically, the contractor shall be responsible for the following:-

1. To operate and maintain the augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant and 40 MLD net output capacity TSTP and 2 nos. 400 KWe biogas based Power Generation Plant in accordance with the aim and purpose of treatment. The plant & equipments covered under the above contract will be totally attended to, by the contractor including any "Trouble shooting" to ensure smooth and trouble free operation. The scope also includes all minor and major spares, chemical and consumables.
2. The contractor shall monitor the performance of the SPS, STP, TSTP and biogas based power plant, conduct the analysis of the influent as well as effluent quality after treatment and bio gas. Contractor shall initiate and take adequate actions to ensure smooth and satisfactory performance/ running of the plants on a 24 hours/round the clock basis.
3. The contractor shall prepare and implement an effective plant maintenance programme in consultation with Surat Smart City Development Limited. Surat Smart City Development Limited will not provide any skilled or unskilled work force. It is an absolutely contractor's responsibility to look after all sorts of maintenance whether preventive or break-down.
4. The contractor shall determine operating parameters for all chemical dosing as well as chlorine dosing and generally optimize the process, and working of the sewage treatment plant and power generation plant.
5. For the smooth running of the plant all the required equipment, machineries, units, accessories, major and minor spares consumables for augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant and 40 MLD net output capacity TSTP and 2 nos. 400 KWe Biogas based power plant with PLC-SCADA system including chemicals,

consumables, all minor, major gas engine spares and engine lube oil, grease, lubricating oils, cleaning agents, packing, rubber sheet, all hardware (S.S. stud, hot deep galvanised nut bolt, fuel for D.G. set, rewinding works, required quantity of white wash, oil paint colour, all types of epoxy paint, material required for housekeeping and cleaning etc. are to be brought by the contractor. The quality of all consumable and spare (i.e. technical requirement as per manufacture recommendation) shall remain unchanged.

6. During Operation & Maintenance tenure, all the repair and replacement related to civil components and Roads as well as interconnecting piping shall be carried out by the contractor without any financial implication to SMC
7. The contractor shall have to frequently / regularly clean the existing pumping and treatment unit by manual cleaning as well as desilting of wet wells / sumps / tanks as a part of preventive maintenance.
8. If the interconnecting under ground piping required to be replace as a whole (for existing pipeline only), SMC will supply pipes only. All remaining accessories / materials and erection / laying shall be done by the tenderer without any extra cost. However any repairing of break down and part replacement of pipeline will be contractor's responsibility.
9. The O & M scope of work also includes supply of all spares, consumables, chemicals & standards for calibration etc. and routine as well as periodic maintenance. The successful bidder has to maintain all the existing instruments in good working condition and also ensure the periodic replacement of sensors / spares / consumables of all the analyzers, as applicable.
10. **The bidder shall visit the site prior to participation in the tender for proper understanding of existing units and equipments alongwith instrumentation to quote the tender. The SMC shall not be responsible for non-working of any equipment at later stage and in such cases, the contractor has to bear all the necessary modification / repairing charges for 100% smooth running of augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant and 40 MLD net output capacity TSTP and 2 nos. 400 KWe biogas based power plant on automated system.**

The details provided in this tender for existing STP facility is indicative only. The tenderer shall have to verify the same at site and may carry out necessary modification / repairing / alteration / upgradation for 100% smooth running of complete augmented STP and new TSTP and biogas based power plant. The tenderer shall have to quote their bid accordingly.

Further, the details provided in this tender is for guidance purpose only, not exhaustive and tenderer must make site visit and obtain details of all units/machineries/plant equipments & accessories before submitting his offer. Existing all units/machineries/plant equipments & accessories are covered under the scope of work. No dispute of any kind regarding quantity/capacity of equipment/unit at later date shall be entertained. Further, wherever replacement / modification / alteration / upgradation / repairing suggested in Scope of work, the same shall have to be replaced / repaired / altered / modified and maintained.

11. The contractor shall be responsible for keeping up-to-date record of documents including History Card for equipments and maintaining every day log book relating to various analysis performed. The contractor shall maintain and update logbook, in which details of operational parameters are recorded in every shift and at regular interval say hourly or as decided mutually. The Contractor shall maintain separate check list register for daily, weekly, fortnightly, monthly, quarter yearly, half yearly and a yearly. Also during checking if any abnormalities found it must be rectified by the contractor.
12. The contractor shall prepare and submit a daily report for the performance of plant and shall assist the Surat Smart City Development Limited in preparing the necessary documents for their purpose and records.
13. The contractor shall be responsible to carry out day to day as well as periodic maintenance, repairs and replacements, necessary to ensure smooth and efficient performance/running of all equipments/instruments comprising the sewage treatment plant and biogas power plant including providing required consumables and chemicals and maintaining the record of the same.
14. The contractor shall have to provide identity card with photograph and uniform to all staff at STP during operation and maintenance as per factory act.
15. The contractor shall employ minimum following staff for operation and maintenance for these plants which also include relievers as required.

Designation	Nos. during augment	Nos. After augment	Qualification	Experience
Plant Incharge	1	1	B.E.(Electrical)	Min.-2 year experience in this field
Instrumentation Engineer	0	3	B.E. (Instrumentation /Electronics)	Min.-2 year experience in this field
Supervisor	1	2	DME / DEE	Min.-2 year experience in this field
Chemist	1	3	B.Sc./ PGD in Chemistry / Environment / B.E. Chemical	Min.-2 year experience in this field
Fitter-cum-plant operator	3	6	ITI fitter	Min.-2 year experience in this field
Electrical Technician	3	9	ITI Electrician	Min.-2 year experience in this field
Operators	6	15	SSC pass	Min.-2 year experience in this field
Beldar	6	15	STD VII	Health, Knowledge of swimming
Safety cum Security Supervisor	1	1	Diploma in Safety Engineer or Equivalent	Min.-2 year experience in this field
Security Guard /	9	9	STD VII and	Min.-2 year experience in

Watch man			Physically Scout	this field.
Garden Mali / Gardener	1	1	STD V	Min.-2 year experience in this field.

The security of the entire plant is rest with the contractor. Any unauthorized entry of person or animal is prohibited and if found so all the liabilities of the same shall rest with contractor.

16. Relaxation in qualification and number of staff shall not be allowed. The above staff shall be distributed in three shifts as per mutual agreement between contractor and SMC. As per agreement the No. of staff in each shift should always remain present otherwise penalty towards absence of any staff shall be levied and recovered from the contractor. The relives are included in above staff members. The arrangement of reliever for weekly off/holiday etc. shall be made by the contractor. Absence on any ground like weekly off or holiday shall not be considered except plant in charge and supervisor. The presence of staff in each shift should be marked in muster to be maintained at office of shift in charge at Dindoli Sewage Treatment Plant which shall be considered as final. The contractor's staff must mark their presence in this muster. The contractor may maintain a separate register for his own purpose.
17. The staff of contractor shall always remain in contact with the Assistance Engineer/Supervisor In charge of the Surat Smart City Development Limited and follow their instructions.
18. All the existing as well as new plantation in the campus of STP, including lawn, trees, shrubs, plants etc. shall have to be maintained by the contractor during the Operation and Maintenance period of ten years.
19. Unsatisfactory and inefficient running of the plant supported by the reasons which are under control of contractor will be highly objected. In such cases SSCDL decision will be final and binding to the contractor.
20. A technical expert of the contractor shall visit the plant on every fortnight and will suggest if required, to improve the efficiency and working of the plant. The visit must be recorded at SMC's document and out come of the visit/minutes of meeting should be got signed by SMC's authorized representative without which the visit shall not be considered.
21. Contractor shall comply with all safety rules and regulations and all inter disciplinary measures as followed by the SMC. All the necessary safety equipments, materials shall be brought by the contractor.
22. The SMC shall not be responsible for any accident/injury to the staff of the contractor. It is contractor's responsibility to take insurance of his employee, medical facility, work compensation etc. as per workman compensation act and all other relevant laws. Further the SMC will not provide any insurance, medical facility, workman compensation, etc. to the staff of contractor.
23. All the consumables including the fuel for DG sets shall be in the scope of contractor.

24. The contractor shall have to follow all the safety norms and procedure as per relevant prevailing rules, code, acts etc. All the necessary safety equipments and materials shall have to be provided to all the workers. Moreover, contractor has to follow all safety norms and procedures as per factory acts and shall provide all the safety equipments likes Safety Shoes, Hand Gloves, Helmets, Safety belts, SCABA (minimum 3 nos. – 30 mins. Capacity) / SBA sets etc. to all his staffs. Also regular safety training will be given by contractor to all his staff through government authorized safety auditor/agency and report of same shall be submitted to SMC. The safety audit from Authosrised Safety Auditor shall be carried out at least once in a year and shall be subitted to SMC. On site and Off site emergency plan as per factory act shall be prepared by contractor and shall be got approved from competent authority during and after augmentation and shall be implemented accordingly.
25. Safety auditing shall be carried out as per prevailing government norms, by the contractor through government certified safety auditors during construction as well as operation – maintenance period.
26. The contractor shall have to carry out the energy audit at every three years post commissioning of all the equipment compulsorily and whatever remedial measures suggested by auditors shall have to carried out at free of cost.
27. Power consumption mentioned in tender data sheet shall be verified annually and if power consumption observed more than the specified in the technical bid by contractor, SMC shall deduct the additional power consumed at the rate and condition specified in the tender from the RA bills of contractor.
28. Electrical and Factory license shall be obtained and renewed time to time as per the prevailing norms, rules, code and act and all the formalities required to be completed to obtain / to renew such license shall be carried out by contractor. The legal fees shall be paid by SMC.
29. Once the possession of the premises is handed over to the contractor, all the responsibility for the supervision is rest with the contractor till the plant is handed over to SMC after expiry of period of O&M. SMC staff shall not be expected to visit the plant on day to day basis and may monitor all the activity from Central SCADA Control Room (CSCR), Drainage Office, Tadwadi, Rander Road, Suart and SMC Shall not be responsible for any mishap / accident. However, SMC reserves the right to visit any time and contractor is obliged to facilitate the same. Any suggestions / comments made during the visit shall be dealt diligently by the Contractor.
30. Due to strike by the contractor's employees, the operation and maintenance of plant must not be affected and the property of SMC should not be damaged. In such case any dispute/discrepancy occur the decision of SSCDL will be final and will be binding to the contractor. Also if any expense will be made by SMC, it will be deducted from Contractor's bill/SD.
31. All Central/State Government/Semi-Government/Local Body's Rules and Regulations pertaining to this contract shall be strictly followed and observed by the contractor without any extra cost to the Surat Smart City Development Limited.

32. Accommodation/guest house/transportation facility shall not be provided by the Surat Smart City Development Limited to the contractor.
33. The duration of the contract shall be for 10 years after completion of the trial run and commissioning of treatment plant. However Surat Smart City Development Limited reserves the right to terminate the contract at any time by giving 3 months notice to the contractor.
- 34. The contractor shall employ all the staff and start operation and maintenance of existing STP till commissioning of augmented STP and new TSTP, within 3 months of award of contract otherwise payment shall not be made. In such case period for payment shall be reckoned from the date of employment of full nos. of staff. Further, the penalty shall be also levied for non-starting the operation and maintenance and non-deployment of necessary staff for operation-maintenance of existing STP till commissioning of augmented STP and new TSTP. On successful trial run and commissioning of augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant and 40 MLD net output capacity TSTP, the 10 years O&M contract will be in force.**
35. The contractor shall provide the necessary all type of tools and tackles for plant operation and maintenance etc.
36. The plant shall be handed over to contractor in working and good condition. The contractor shall have to handed over the same in working and good condition to SMC. If any dispute arise the decision of Additional City Engineer will be final and bind to contractor.
37. The scope of work also includes cleaning of complete plant complex including floor, roads, railing, door, windows, light fixtures and ceiling etc.
38. This work is inclusive of but not limited to operation, maintenance, house keeping, cleaning, removal of screen and grit along with dewatered sludge cake at Khajod disposal site, preparing data, recording, correspondence work with SMC and the Government Departments, etc. All these works shall be done as per standard practices and by following labour, factory, electrical, GPCB, and all other old and new law and order, Indian standards etc. as applied by Local, State and Central Govt. of India.
39. To operate and maintain the instrumentation / automation and PLC / SCADA facilities at STP in accordance with the aim and purpose of treatment / intended process logic. The plant & equipments covered under the above contract will be totally attended to, by the contractor including any "Trouble shooting" to ensure smooth and trouble free operation.
40. The contractor shall monitor the operation / performance of the sewage treatment plant and biogas based power plant at STP SCADA terminal / control room at STP campus including, keep a vigil on alarms and attend the instrument / equipment if the alarm is pertaining to the same (like instrument fault, need for calibration, warning on sensor life, etc.) and in case of process related alarms shall intimate the engineer-in-charge as well as the engineer of the contractor looking at O&M of that particular site to enable them take necessary corrective actions. Maintenance Contractor shall initiate and take adequate actions to ensure smooth and satisfactory performance/ running of the plants on a 24 hours/round the clock basis.

41. The following process for collection and analysis of samples shall be followed.
The guaranteed effluent quality (For STP) shall be measured on
(i) Complete analysis of composite samples collected on 24 hour basis.
(ii) Analysis of grab samples collected at every 4 hours (except BOD5 test).
(iii) IS:2488 (methods of sampling and test for individual effluent).
The contractor shall do analysis of samples at his own cost
42. The contractor shall prepare and implement an effective plant maintenance program in consultation with Surat Smart City Development Limited. Surat Smart City Development Limited will not provide any skilled or unskilled work force. It is absolutely contractor's responsibility to look after all sorts of maintenance whether preventive or break-down or for instrument calibration.
- Further, contractor shall also determine operating parameters for various process equipment like air blower and re-circulation pumps for aeration process, sludge feed control to mechanical dewatering device, etc. where VFDs are deployed in order to achieve the purpose of power saving through process optimization or to ensure the smooth operation of the process.
43. For the smooth running of the plant, all the required instruments / items, accessories, major and minor spares, calibration kits, consumables including chemicals, grease, lubricating oils, cleaning agents, packing, rubber sheet, all hardware (S.S. stud, hot deep galvanised nut bolt, etc.), required quantity of oil / epoxy paint if required, material required for house keeping and cleaning etc. are to be brought by the contractor. The quality of all consumable and spare (i.e. technical requirement as per manufacture recommendation) shall remain unchanged.

The fuel for DG set is included in the scope of supply of contractor.

In order to attend instrument break down, contractor shall supply / stock the spares as mentioned in below in this section which shall be included in the cost of O&M and shall be the property of SMC and handed over to SMC on completion of O&M period. These spares shall be maintained in their possession and contractor shall be responsible for the replacement of any spare used from the same within a reasonable time frame and in no case exceeding 3 months from the date of consumption. Contractor shall procure genuine spares only from the authorized supplier / manufacturer.

In case of any break down in instrument / equipment requiring spare which is not available in stock, contractor shall be responsible to procure the required spare within a maximum of 7 days from the date of intimation of break down.

It shall be the duty of contractor to inform engineer-in-charge about any break down occurring at site within 24 hours from the time of occurring of break down. The same shall be mentioned in the site log book as well.

44. Routine / preventive / break-down maintenance of plants which includes the attending of routine calibration checks, pump/sampling/utility line leakages, sensor life assessment / checks, minor and major spare replacement or repairs, sensor / instrument replacement, utility / sampling equipment maintenance, and other process of the works under present

contract or jobs of similar nature are included in the scope of Contract. Maintenance of instruments / automation / equipment / PLC & SCADA etc. covered under this contract, and replacement of damaged parts or repairs of damaged parts are also included in the scope of work. The required material for Maintenance work of will be provided by Contractor at his own cost.

45. PAINTING:

This work is also inclusive of painting of plants as per following schedule and paint shall be of the same specification as described in respective unit/mechanism specification.

Sr. No.	Item	Duration
1	Civil Work	Every 4 year
2	Doors & Windows	Every 4 year
3	Shutters, grills, Collapsible gate	Every 1 year
4	All Process Equipment with its accessories, and G.I. railings etc. except pump sets.	Every 1 1/2 year
5	Street/Flood light pole	Every 1 year
6	All H.T./L.T. Panels	Every 2 1/2 year
7	Pump sets, valves, C.I. fittings, Sluice gate, etc.	Every 2 1/2 year

NOTE :-

However, if any unit/mechanism will found to have some defect in paint work at any time, the Contractor has to repaint the same under the instruction of Dy. General Manager.

46. Guilty person or indiscipline person shall not be employed by the contractor.

47. The contractor shall have to take prior permission, from S.M.C. to employ or to terminate his personals. However, right is reserved by the SMC to instruct the contractor regarding suspension, dismissing, termination of any person employed by him.

48. Watch & ward, safety, insurance, security, storage, housing accommodation etc. shall not be provided by SMC. These will be responsibility of contractor.

49. Nothing is to be provided by SMC excluding sewage and electricity. All the necessary correspondence with all the government authorities, i.e. factory inspector, electrical inspector, GPCB, etc. for having NOC, consent, Hazard waste concern, getting certificate/license, approval etc. shall be done by the contractor. However, necessary legal fees (excluding penalty) to all government authorities will be borne by SMC.

50. Contractor shall have to make all the facilities for carrying out all the test of influent / effluent at his own cost. The same shall be randomly verified and checked by SMC whenever required.

51. The successful bidder shall have to enter into a contract agreement for O&M along with the contract execution agreement and shall have to deposit an amount equal to 2% of total order value for O&M contract in form of D.D/FDR in name of Surat Smart City Development Limited, on completion of 1 months satisfactory trial run and commissioning.
52. The quoted rate shall remain firm and valid for 10 years. However, the price escalation shall be paid as per the formula given elsewhere in this tender.
53. The payment of O&M charges will be made every month.
54. The final bill of Capital Works shall be prepared on successful commissioning of the Treatment Plant and its ancillary works. For the Operation and Maintenance works, the final bill shall be prepared at the end of 3rd, 6th and 10th year of O&M. However, the Security Deposits retained for Operation Maintenance Contract shall be released only after the complete contract period, i.e. after 10 years.
55. The defect liability period in the tender is 12 months from the date of commissioning. However, if SMC fails to provide sewage or electricity for 24 months after the date of issue of partial completion certificate (for completing the whole work in the plant in all respects except trial run/performance and commissioning), the SMC shall release the security deposit towards the capital work. In such cases, the contractor shall have to provide safety and security of the plant as well as the contractor shall have to deploy necessary staff for routine maintenance, cleaning etc. The contractor shall be paid at the rate of 50% of the cost quoted under head of the fixed cost of STP & TSTP O&M, for the first year, till the sewage is supplied. Escalation shall be applicable, if SMC is unable to supply sewage beyond 1st year and 1st year of Operation and maintenance shall be reckoned from supply of sewage. However, the base year shall remain 2016-17 (financial year) for calculation of price escalation. This charges shall be payable for general and routine maintenance, housekeeping, safety and security of STP & TSTP.
56. The Contractor shall produce valid labour license & any other relevant license from statutory bodies as required for this type of contract within a period of 10 days from the date of award of the contract.
57. Successful bidder will have to follow all the provisions of P.F. Act, E.S.I. Act, etc. & have to incorporate changes made if any during contract period also.
58. Contractor will have to strictly follow the provisions of Factory Act 1947, wages Payment Act 1936, Bonus Act 1965, Employees Provident Fund & Miscellaneous Provisions Act 1952 & other Industrial & Labour Laws with latest amendments related to this Operation & Maintenance Work & will have to inform accordingly to the Dy. General Manager and Ex. Engr. (Drainage). Contractor will not be given any relaxation regarding these provisions.
59. Routine / preventive / break-down maintenance of plants which includes the attending of pump gland leakages, valve gland leakages and other process of the plant or jobs of similar nature are included in the scope of Contract. Maintenance of pumps, motors, gearbox, electrical control gears etc, and replacement of damaged parts or repairs of damaged parts are also included in the scope of work. The required material for Maintenance work of will be provided by Contractor at his own cost.

60. All types of transportation inside and outside of plants shall be carried out by contractor without any extra cost. Dewatered sludge, Grit, Screening material shall be disposed at Khajod land fill site by the contractor.
61. Dose of chlorination must be maintained continuously as per site requirement and suggested by Dy. General Manager and Ex. Engr. (Drainage). The chlorination tonner (with chlorine) shall be provided by Contractor & all other formality required to be complete in this connection should be completed by the contractor.
62. In the event of major breakdown maintenance required, the fault /failure analysis report (FAR) shall be submitted to Dy. General Manager and Ex. Engr. (Drainage), SMC within five days by the Contractor.
63. The service provider bills towards communication for SCADA operation shall be borne by the SMC.
64. Unsatisfactory and inefficient running of the plant supported by the reasons, which are under control of the contractor, will be highly objected. In such case Municipal Chairman, SSCDL or his authorized officer's decision will be final and binding to bidder
65. There must be one shut-down without affecting the operation of plant (i.e. using minimum stand by capacity) of the entire plant per year which shall not be more than 2 weeks. The Contractor has to do overhauling, cleaning, repairing etc. of all units /machineries /equipments during shutdown. The contractor shall submit the list of activities to be done during shutdown writing to Dy. General Manager and Ex. Engr. (Drainage) before one month of proposed shutdown. The contractor shall have to submit the detailed shutdown report in writing to Dy. General Manager and Ex. Engr. (Drainage) within a week after the completion of shutdown procedure. In case if any dispute arises during shutdown, the decision of Dy. General Manager and Ex. Engr. (Drainage) will be final.
66. The contractor in co-ordination with SMC lab staff shall monitor the performance of the STP / STP conduct the analysis of the influent as well as effluent quality after treatment. Contractor shall initiate and take adequate actions to ensure smooth and satisfactory performance/ running of the plants on a 24 hours/round the clock basis.
67. The Surat Smart City Development Limited shall not be responsible for any death/accident/injury to the staff of the contractor; it is contractor's responsibility to take insurance of his employees, medical facility work compensation etc. as per workman compensation act and all other relevant laws. Further the Surat Smart City Development Limited will not provide any insurance/medical facility, workman compensation etc. to the staff of contractor.
68. Due to strike by the contractor's employees, the operation and maintenance of plant must not be affected and the property of SMC should not be damaged. In such case any dispute/discrepancies occur the decision of head of Dy. General Manager will be final and will be binding to the contractor. Also if any expense will be made by SMC, It will be deducted from contractor's bill/SD

69. All central/state government/semi government /local body's rules and regulations pertaining to this contract shall be strictly followed and observed by the contractor without any extra cost to the Surat Smart City Development Limited.
70. This work is inclusive of but not limited to operation, maintenance, housekeeping, cleaning, preparing data, recording, correspondence work with SMC and the government departments etc. All these work shall be done as per standard practices and by following labour, factory, electrical, GPCB and all other old and new law and order, Indian standards etc. as applied by local, state and central government of India.
71. Bidders will have to submit Electrical license in the tender, then after only Surat Smart City Development Limited will issue work order to the successful bidder as he will have to maintain all the electrical equipments of the plant also. For that he may have his own firm's electrical contractor's license or he may have tie up with other licensed electrical contractor. But in that case he will have to submit the valid registered agreement of tie up along with tender.
72. All the required electrical/mechanical major & minor spares will be provided by contractor at his own cost.
73. Person below the age of 18 years shall not be employed for the work. Proof of age must be submitted to this office before engaging any personnel for the work. The workers engaged for these works must possess physical fitness.
74. The Contractor shall be responsible for and shall pay any compensation to his workmen payable under the Workmen's Compensation Act 1923 (VIII of 1923) or any statutory modification thereof for injuries caused to their workmen during working hour.
75. All the personals employed by the contractor for the execution of the work should be covered under full insurance against any accident/injury. Contractor shall have to produce all such documents before starting the work.
76. Under this contract, the contractor shall have to employ the minimum staff for daily supervision and maintenance. Various register and records required under the law shall be properly maintained. Contractor shall have to keep all the readings/results, records and registers ready at the checking of SMC officials.
77. Contractor will have to employ persons having age above 18 years only. Contractor will have to appoint another persons with same qualification in case of any employee resigns. Contractor will have to issue identity cards to all his employees without it the concerned person will be treated absent on duty.
78. Successful bidders will have to contribute/deduct applicable E.S.I., P.F. etc. contribution of all the employee engaged & deposits it with his own contribution if any to the competent authority as per law. He has to invariably follow the laws of E.S.I., P.F., & other govt. provisions implemented/updated time.

79. All stationary items like logbook/sheet, Check list register, Visit book register, History card transparent /brown tap, paper weight, etc are provided by the contractor at his own cost as directed by plant in charge.
80. The contractor shall have to submit the Initial S.D. at the rate of 2% of total contract value for O&M work to SMC, on completion of one month trial run of the plant.
- The retention money shall be deducted as per capital works clause under memorandum for O&M work also.
- All security Deposits of O & M shall be released on successful completion of O&M period of 10 years.
81. The other terms and condition described in this complete tender documents, wherever applicable shall remain unchanged.
82. The contractor shall have to take care of civil structures while replacing or repairing the membranes or any other electro-mechanical items. No damage shall be done to the civil structures. If any damage is occurred, the same shall have to be repaired by the contractor at his own cost and SMC shall not pay any extra cost for the same.

83. PENALTY:

- ii. If at any time except weekly off, plant in charge/supervisor is found absent, penalty will be charged at following rate.
- For the first 5 days - Rs.300.00 per day per person.
 - For the next 5 days - Rs.600.00 per day per person.
 - For the next 5 days - Rs.1000.00 per day per person.
- If Plant in-charge/supervisor will remain absent for more than 15 days and if contractor fails to make an alternate arrangement for Plant In charge/Supervisor then necessary action shall be taken by S.M.C. and it shall be binding to the Contractor.
- iii. If, at any time present staff excluding plant in charge/supervisor is less than minimum required staff mentioned in this tender, contractor shall be panelized at the rate of Rs.200/- per person per day upto no limit.
- iv. No equipment, shall remain ideal/un repaired or damaged for the period of 7 days. If any equipment is not repaired, rectified and or replaced within 7 days, the contractor shall be panelized with no limit at the rate of minimum Rs.1000/- per day (excluding equipment of Bio-gas plant) for delay per each individual equipment of the plant. However for long delivery spares it can be relaxed .The contractor shall have to get sanction for such delivery period of spares in advance from engineer in charge.
- v. It is considered that the biogas based power plant should be operated for minimum of 5400 Hrs. per year, which includes all types of major – minor shutdown / maintenance schedules / repairs / replacements etc. If biogas power plant run /

operated for less than 5400 hrs. and 1750000 KWH per year, than the contractor shall be penalized at the rate of Rs. 500/- Per hr. or /and Rupees 4.00 per KWH of non-operation of biogas power plant, respectively. Penalty will be levied for failure of gauranted utilization either for hours or in terms of KWH, which ever is higher. Penalty related to electricity generation / minimum working hours for bio gas based power plant shall not be applicable on O&M, till commissioning of complete 167 MLD capacity augmented sewage treatment plant.

During 10 years of O&M period, there may be major scheduled maintenance/ repairs / replacement after specific duration / operating hours of biogas power plant, as per manufacturers recommendation. The waiver in the expected power generation shall be allowed up to 90% - i.e. minimum operation of 4860 hours per year and minimum electricity generation of 1575000 KWH per year, for that particular year, once in the O&M period of 10 year.

- vi. Contractor shall always maintain electric power factor between 0.95 PF to 1.0 PF otherwise penalty will be deducted in contractor bills as charged by electric power supplier company for that necessary capacitor bank shall be provided by the contractor.
- vii. Monitoring shall be done as per guideline given by Engineer-in- charge. Contractor has to run the plant so as to maintain all the parameter of effluent within stipulated limit, otherwise he shall be panelized for not maintaining the parameters given by GPCB or any such government agencies and SMC. All expenditure incurred for the same like, court fee, case fee, or the penalty as decided by Dy. General Manager, SMC and penalty charged by GPCB will be charged to contractor and deducted from his pending bills or S.D.
- viii. Monitoring shall be done as per guideline given by Engineer-in- charge. Contractor has to run the plant so as to maintain all the parameter of effluent within stipulated limit and as per the operation logic / guide lines furnished by client during detailed engineering. Predictive maintenance shall be carried out by contractor as per the predictive maintenance program fed in the SCADA system which shall automatically highlight / display the need of such maintenance at programmed periodicity. Non conformance of any treatment parameter as per Technical Specifications shall be Rs. 5 per MLD per parameter non-compliance as per tender technical specification requirements.
- ix. Contractor shall have to produce the industrial grade water – tertiary treated water as defined in the chapter 17 on process description. If he fails to supply the industrial grade water of desired quality or quantity, due to his own reasons, he shall be penalized at the rate of water production cost of SMC for the non supply of desired grade quality and quantity of water.

The contractor at his own cost shall have to install, maintain and calibrate a water meter on the transmission line in the premises of Bamroli TTP. Total output of the TTP on yearly basis, for minimum of 330 days of operation, shall be 40 MLD average, failing which, a penalty for the deficit quantity for that month shall be levied

at the rate of cost of production and transmission of potable quality of SMC for that specified month.

So far as quality is concerned, the required quantity of balance SMC water, to achieve desired TDS for the quality and quantity of tertiary treated water – industrial grade water, shall be calculated theoretically, on the monthly basis, on the basis of water mass balance for the penalty purpose and the rate of required SMC potable water, as specified in the above para shall be applicable for recovery.

The rate of water production and transmission for first year of O & M shall be considered as Rs.6/- per kL. The same shall be escalated on basis of Wholesale price index as of 31st March of year revision is being made, compared to the Wholesale price index as on 31st March of the year of commissioning.

Based on the past experience, it is observed that industrial effluent gets mixed with the raw sewage and hence there may be presence of toxic material apart from the higher organic matters. In this case, bidder shall have to consider spare UF and RO membranes accordingly. SMC shall not pay any extra amount towards replacement of UF and RO membranes and also for use of additional chemicals due to ingress of industrial effluent.

- x. Regarding the energy consumption, the excess consumption over and above as specified by the contractor in this tender shall be deducted from his payment towards O&M at actual.
- 84. Replacement of spares for gas engine shall be done as per the recommendation schedule of the engine manufacturer on time to time basis.
- 85. Schedule of operation of the gas engine shall be decided in consultation with the engineer in charge of SMC.
- 86. The SMC will only pay electricity charges and all rest of items like chemicals, spares, consumable, manpower etc. will be born by contractor. The all taxes, duties and service tax will be included by contractor in his quoted price.
- 87. The present Operation and Maintenance work is included for a period of 10 years in the scope of work. However, SMC, may insist Bidder to carry out the O&M for a further period after expiry of contract on mutually agreed rates and terms and conditions. For this purpose, the Bidder may consider the cost of total / partial replacement of any of the item looking to the prevailing conditions.

The Bidder will visit the site and check the conditions of all civil, electro-mechanical items of the plant and consider in his O&M cost the items which needs the partial/full replacement. On award of work, the claim by the contractor regarding non-operational of any of the items/units will not be entertained.



Signature of Contractor



Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

30. VENDOR LIST

Vendor's List- Electrical Items

Vendor's List- Electrical Items

SR. NO.	PRODUCT	VENDOR
(1)	H.T VCB PANEL	CGL, ABB, JYOTI, SIEMENS, AREVA, SCHEINDER, BICCO LAWRIE, L & T
(2)	AIR BREAK SWITCH	ATLAS, PACTIL, NATIONAL, POWER SYSTEM GUJARAT, DANKE
(3)	LIGHTING ARRESTOR	CGL, LAMCO, OBLUM, NATIONAL, POWER SYSTEM GUJARAT, ATLAS
(4)	D.O.FUSE ASSEMBLY WITH FUSE	ATLAS, PACTIL, NATIONAL, POWER SYSTEM GUJARAT, DANKE
(5)	PIN, POST INSULATOR	ATLAS, PACTIL, NATIONAL, POWER SYSTEM GUJARAT DANKE, JAYSHREE
(6)	TRANSFORMER	AREVA, CROMPTON GREAVES, SIEMENS, VOLTAMP, ABB
(7)	HT PROTECTIVE RELAYS	L & T, SIEMENS, AREVA, ABB, ESSUN RAY RULL, SCHNEIDER
(8)	L.T POWER CABLE	CCI, UNIVERSAL, FINOLEX, INCAB, TORRENT, HAVELLS, BHARATCAB, GLOSTER, KEI
(9)	H.T POWER CABLE	CCI, UNIVERSAL, FINOLEX, INCAB, TORRENT, HAVELLS, GLOSTER, KEI
(10)	H.T, LT JOINTING KITS	RAYCHEM, XICON, M-SEAL
(11)	AIR CIRCUIT BREAKER	L&T, SIEMENS, SCHNIDER, ABB, CONTROL & SWITCH GEAR
(12)	MCCB	L&T, SIEMENS, SCHNIDER, ABB, CONTROL & SWITCH GEAR
(13)	MCB, ELCB	SIEMENS, MDS, L& T, MG, INDOKOPP, SCHNEIDER, HAGER, HAVELLS, ABB, C & S, LAGRAND
(14)	LT SWITCHGEARS	L&T, SIEMENS, SCHNEIDER, TELEMECHANIQUE, ABB, CONTROL & SWITCH GEAR
(15)	SOFT STARTERS	EMOTRON, SIEMENS, AB, ABB, SCHNEIDER, L & T
(16)	A.C. DRIVES	SIEMENS, AB, ABB, SCHNEIDER, YASKAWA, YOKOGAVA, DENFOSS, HITACHI
(17)	ELECTRONIC TIMERS, TIME SWITCH	GEC, HAGER, SIEMENS, SCHNEIDER, ABB, LEGRAND
(18)	MANUAL CHANGE OVER SWITCH	L & T, SIEMENS, SCHNEIDER, ABB, HPL

SR. NO.	PRODUCT	VENDOR
(19)	FUSES	L&T, SIEMENS, SCHNEIDER, ABB, BUSSMAN
(20)	LED INDICTORS	ESBEE (L & T), SIEMENS, SCHNEDIER, ABB, RAAS CONTROL, TEKNIK, VAISHNO, BINAY
(21)	PUSH BUTTON	L & T, SIEMENS, SCHNEIDER, ABB, RAAS CONTROL, BINAY
(22)	SELECTOR SWITCH	KEYCEE, SALZER, SIEMENS
(23)	EPOXY CAST RESIN C.T	L & T, PACTIL, ASHMOR, KAPPA, C & S, SILKANA, GILBERT, PRECISE
(24)	ELECTRONIC MOTOR PROTECTION DEVICE	SCHNEDIER, L & T, SIEMENS, C & S, ABB, SOFTHARD
(25)	CABLE TERMINATION KIT (LUGS & GLANDS)	DOVELLS, JENSON, HEX, 3D, HMI
(26)	DIGITAL METERS	SECURE, L & T, ABB, CONSERV, SOCOMEC, SIEMENS, TRINITY
(27)	ANALOG METERS	MECO, RISHLINE, IMP, AE, RISHABH (L & T)
(28)	APFC RELAYS	EPCOS, KBR, L & T, DUCATII, BELLUK, TRINITY, SCHNEIDER, ABB
(29)	CAPACITOR	EPCOS, SCHNEIDER, DUCATII, CROMPTON, L & T, YESHA, KHATAU, SUBODHAN, ASIAN, ABB.
(30)	TERMINAL CONNECTOR	CONNECTWELL, WAGO, PHOENIX, ELEMEX
(31)	ON LINE UPS	TATA LIBERT, MERLIN GERIN, SOCOMAC, APC
(32)	SMF BATTERY	PANASONIC, EXIDE, BASE, PRESTOLITE, ROCKET, AMRON, TATA-GREEN
(33)	ENGINE OF D.G. SET	GREAVES, CUMMINS, LEYLAND, KIRLOKAR, CATERPILLAR
(34)	ALTERNATOR OF D.G.SET	CROMPTON, KEC, STAMFORD
(35)	TOOLS & TACKELS	TAPARIA
(36)	TEST EQUIPMENT	KUSUM, RISHABH, WACO, FLUKE, MOTWANE
(37)	PANEL BOARD MANUFACTURER	CPRI &FIA APPROVED (to be got approved prior to supply)
(38)	CRIMPING TOOLS	JAISON, ISMAL
(39)	H.T CONNECTORS	NUTAN, POWER SYSTEM GUJARAT
(40)	CABLE TRAYS	INDIANA, SHARDA, B.M.ENGINEERING, TUSHARTECH, SUPERFAB, BVK ENTERPRISE
(41)	COPPER / ALUMINUM LUGS	DOWELS / JENSON / HEX
(42)	STREET LIGHT POLE	AS PER IS

SR. NO.	PRODUCT	VENDOR
(43)	LUMINARIES	PHILIPS / BAJAJ / CROMPTON / GE/SURYA
(44)	SONT LAMP	PHILIPS / BAJAJ / CROMPTON / GE/SURYA
(45)	FLUORESCENT LIGHT FIXTURE ETC	PHILIPS / BAJAJ / CROMPTON / GE/SURYA
(46)	ELECTRONICS BALLAST	PHILIPS / BAJAJ / CROMPTON / GE/OPAL/INNOVA
(47)	TIME SWITCH	HAGER / SIEMENS / LEGRAND / GE / ABB / SCHNEIDER
(48)	ACCESSORIES OF WIRING	GEWISS / LEGRAND / MG / LK / PRECISION / ABB / ANCHOR / JAINEX / CLIPSEL / OR EQUIVALENT
(49)	EXHAUST FAN	GEC / CROMPTON / BAJAJ / ORIENT/ KHETAN /ORTEM
(50)	CEILING FAN	GEC / CROMPTON / BAJAJ / ORIENT/ KHETAN / ORTEM
**	INSTRUMENTATION	
(51)	PROGRAMMABLE LOGIC CONTROLLERS (PLC)	ABB, HONEYWELL, ROCKWELL (ALLEN BRADELY), SCHNEIDER, SIEMENS
(52)	AUXILIARY CONTROL RELAYS	OEN, PLA, OMRON, PHOENIX, ABB
(53)	SIGNAL (ANALOG) CABLES	ASSOCIATED CABLES, ASSOCITED FLEXIBLES & WIRES, BROOKS CABLES, DELTON, LAPP, FINOLEX, MOLEX, LEGRAND, HAVELLS, UDAY PYRO, RR KABEL
(54)	COMMUNICATION CABLES	LAPP, D-LINK, DELTON, FINOLEX, MOLEX, UDAY PYRO
(55)	DC POWER SOURCE	PHONIX, INTEX, MICROTUX, SCHNEIDER, SIEMENS, ALLEN BRADELY, OMRON, APLAB, IFM
(56)	ULTRASONIC TYPE LEVEL / DIFF. LEVEL / LOH & ROF / OPEN CHANNEL FLOW TRANSMITTER	ABB, E + H, KROHNE, SIEMENS, VEGA, EMERSON (ROSEMOUNT), HONEYWELL, YOKOGAWA, WIKA
(57)	RESISTANCE TEMPERATURE DETECTOR	ABB, ALTOP, DETRIV, GENERAL INSTRUMENTS CONSORTIUM (GIC), WIKA
(58)	PRESSURE SWITCH	INDFOSS /TELEMECHANIC/WAREE/SWITZER/ABB/SIEMENS/DENFOSS
(59)	FLOAT LEVEL SWITCH	ATMI, E+H, NIVELCO, P+F
(60)	SMOKE DETECTOR	GE, HONEYWELL, INVENSYS

SR. NO.	PRODUCT	VENDOR
(61)	CCTV STSTEM & DVR	BOSCH, PELCO, SENSORMATIC, ZICOM, SONY
(62)	DIFFERENTIAL PRESSURE / PRESSURE /TEMPERATURE TRANSMITTER	ABB / SIEMENS / YOKOGAVA / EMERSON / FUJI / DENFOSS
(63)	TEMPERATURE SCANNER	MASIBUS, LECTROTEK, INTAKE, ABB, FUJI
(64)	DIFFRENTIAL ULTRASONIC LEVEL TRANSMITTER	ABB, E+H, KROHNE, SIEMENS, VEGA
(65)	ELECTROMAGNETIC FLOWMETER (FULL BORE)	SIEMENS, ABB, KROHNE MARSHALL, E+H
(66)	WATER METER	ELSTER, ITRON(ACTRIS), ZENER, SAPPLE
(67)	ULTRARSONIC FLOWMETER	SIEMENS, ABB, KROHNE MARSHALL, E+H, ULTRAFLUX
(68)	ULTRASONIC PORTABLE FLOW METERS (FOR PIPE LINE)	DYNASONICS, GE PANAMETRIC (GE SENSING), KROHNE (FORBES MARSHALL), POLYSONICS (THERMO ELECTRON), SIEMENS, YOKOGAWA
(69)	SCADA SOFTWARE	WIN CC / WONDER WARE / RS VIEW / MONITOR PRO / INTTELUTION / VIJEO CITECT
(70)	OPERATOR SCREEN	ABB / SIEMENS / SCHNEIDER MODICON / ALLEN – BRADLEY / PRO-FACE
(71)	PROCESS INSTRUMENTS	SIEMENS / ABB / SCHNEIDER
(72)	ORIFICE PLATE	BALIGA / MICRO-PRECISION / PLACKA / STAR MECH / DANIEL
(73)	FLOAT / BUOYANCY SWITCH	P+F / WAAREE (IMPORTED)
(74)	ULTRASONIC LEVEL TRANSMITTER / OPEN CHANNEL FLOW METER	MILITRONICS / ENDRESS HAUSER/ VEGA/KAB INST/BELLS CONTROLS LTD./ELECTRONET/ISHCO
(75)	PRESSURE GAUGE	BELLS / H.GURU / WAREE
**	LABORATORY INSTRUMENTS	
(76)	PH / D.O. / RESIDUAL CHLORINE ANALYSERS	ABB, YOKOGAVA, FORBES MARSHALL, EMERSON, E + H, HACH

SR. NO.	PRODUCT	VENDOR
(77)	POCKET COLORIMETER, PORTABLE OR DESKTOP PH / TURBIDITY / DO / TDS / CONDUCTIVITY METERS, DATA LOGGING PRE-PROGRAMMED SPECTROPHOTOMETER, ANALYTICAL BALANCE	HACH, ORION, YSI, RADIOMETER, DENVER, THERMO SCIENTIFIC, WTW
(78)	WATER QUALITY ANALYSERS (TURBIDITY, FREE RESIDUAL CHLORINE, ETC.)	HACH, DKK-TOA, WTW, GLI, RADIOMETER
(79)	TOC ANALYSER	HACH, DKK-TOA, SHIDMATZU, TRL, CHEMITEC, WTW
(80)	RECORDER	ABB, HONEYWELL, YOKOGAWA
(81)	JAR TEST, AUTOCLAVE, LABORATORY OVEN, BACTERIOLOGICAL INCUBATOR, WATER STILL	HACH, ORBIT, LAB HOSP
(82)	AUTO SAMPLER	HACH / E + H
(83)	COMPUTER SYSTEM	WIPRO / DELL / ACER / LENOVO / HP-COMPAQ / IBM

Vendor's List- Mechanical Items

SR NO.	Product	Vendor
**	PUMPS	
(1)	NON CLOG SUBMERSIBLE PUMPS WITH GUIDE RAIL, AUTO COUPLING ETC.	GRUNDFOSS, AQUA, KIRLOSKAR, KISHOR, WORTHINGTON (WPIL), KSB, PULLEN, ABS
(2)	HORIZONTAL NON CLOG PUMPS	KSB, M&P, BEACON WEIR, KIRLOSKAR, WPIL, GRUNDFOSS
(3)	VERTICAL NON CLOG PUMPS	KSB, M&P, BEACON WEIR, KIRLOSKAR, WPIL, GRUNDFOSS

SR NO.	Product	Vendor
(4)	VERTICAL TURBINE PUMPS	JYOTI, KIRLOSKAR, WORTHINGTON (WPIL), MATHER & PLATT, FLOW MORE.
(5)	HORIZONTAL SPLITCASE PUMPS	JYOTI, KIRLOSKAR, WORTHINGTON (WPIL), MATHER & PLATT, FLOW MORE, BEACON.
(6)	SUBMERSIBLE PUMP	KSB, KISHORE, AQUA, GRUNDFOSS, KIRLOSKAR, ABS, XYLEM
(7)	SCREW/POSITIVE DISPLACEMENT TYPE PUMP	ROTO, NETZEH, TUSHACO, SEEPEX
(8)	SAMPLING PUMPS	MAIMOON MACHINE TOOLS, TULLU, KIRLOSKAR, CROMPTON
(9)	DOSING PUMPS	SWALLORE, V.K.PUMPS, SHAPOTOOLS, SEEPEX
(10)	TUBE INSTALLED SUBMERSIBLE PUMP	XYLEM, ABS SULZER, KSB
**	MOTORS	
(11)	TEFC MOTOR FOR MECHANICAL SCREEN	ALSTOM, SIEMENS, ABB, NGEF, KIRLOSKAR, BHARAT BIJLEE, WEG, AEG, LOREYSOMER, BONFIGLOLI
(12)	MOTOR	KEC, JYOTI, CROMPTON, ABB, MARATHON, BB, SIEMENS, NGEF, BHEL, HAVELLS
**	VALVES, GATES ETC	
(13)	KNIFE EDGE GATE VALVE	JASH, DEZURIK, KSB, IVC, FOURESS, ORBINOX, BRAY
(14)	NON RETURN VALVE	KIRLOSKAR, IVC, IVI, SR, FOURESS, CALSENS, AVISHKAR, UPADHYA, M & P, BRAY
(15)	NON RETURN VALVE (BALL TYPE)	KIRLOSKAR, IVC, FOURESS, IVI, NORMAX, KISHOR, BRAY
(16)	SLUICE VALVE & AIR VALVES	KIRLOSKAR, IVC, IVI, SR, FOURESS, CALSENS, AVISHKAR, UPADHYA, BRAY
(17)	BUTTERFLY VALVE	KIRLOSKAR, IVC, IVI, FOURESS, INTERVALVE, AUDCO, BRAY
(18)	DUAL PLATE CHECK VALVE	ADVANCE, FLOVEL, KIRLOSKAR, IVC
(19)	METALLIC EXPANSION BELLOWS	D. WREN, PRECISE ENGR. (VEDANTA), PROCO, BELOFLEX
(20)	SLUICE GATE	JASH, I.V.C., YASHWANT, IVI, BRAY
(21)	ELECTRICAL ACTUATOR	BEACON ROTORK, AUMA, LIMITORK, MARSH, BRAY
(22)	S.S. ELBOW	PROCO, DHURUV, BELOFLEX, DWREN
(23)	C.I. FITTINGS	KESORAM, ELECTROSTEEL, KEJRIWAL, TISCO, UPADHYA NEW JANTA.
**	LIFTING EQUIPMENTS	

SR NO.	Product	Vendor
(24)	ELECTRIC HOIST & CHAIN PULLEY BLOCK	INDEF, MORRIS
(25)	E.O.T. CRANE	ACME MFG, MUKAND, EDDY CRANES, MORRIS, INDEF, SAYAJI, W.H.BRADY, BATLIBOI, MEEKA MACHINARY
**	PNEUMATIC SYSTEM	
(26)	AIR COMPRESSOR	INGERSOL RAND, KIRLOSKAR / ATLAS COPCO
(27)	AIR FILTER	GEM, NORGEN, ULTRA / ATLAS COPCO
(28)	AIR FILTER REGULATOR	ABB, DIVYA, JANATICS, PLACKA, SHAVO NORGREN / ATLAS COPCO
(29)	PPRC TUBES	VECTUS, FUSION, LEGRIS
(30)	PNEMATIC CYLINDERS	SCHRADDER, FESTO, SMC, NUCON
(31)	SOLENOID VALVE	JANATICS, SCHRADER ROTEX, ASCO
(32)	LIMIT SWITCHES	TATA HONEYWELL, SIEMENS, BCH
**	CHLORINATORS	
(33)	CHLORINATOR	PENNWALT, ADVANCE, CHLOROTECH, JASCO, METITO, F & P
(34)	CHLORINE PRESSURE GUAGE	WIKA, H. GURU, WAREE, GLUCK
(35)	VACUUM GUAGE	WIKA, H. GURU, WAREE, GLUCK
(36)	CHLORINE BOOSTER PUMP	GRUNDFOSS, ABS, EBARA, FLYGT, KSB, KIRLOSKAR, WILO
(37)	NRV/DIAPHRAM VALVE	DPP, PARCH
(38)	INTERCONNECTING PIPES	ASTRAL, SUPREME, PRINCE
**	PIPES	
(39)	PPRC PIPES	VECTUS OR EQUIVALENT
(40)	SS PIPES	REMI / RATNAMANI
(41)	MS / G.I.PIPES	GST, AMBICA, TATA OR ANY MAKE BEARING ISI MARK / JINDAL / ASIAN
(42)	HDPE PIPES	PIL, MANEKYA, DURALINE, JAIN IRRIGATION, RIL, SANGHIR
(43)	GRP PIPES	GRAPHITE / EPP / CPP

SR NO.	Product	Vendor
(44)	AIR DIFFUSER	OTT / EDI / OVIVO
(45)	FRP PIPES & ACCESSORIES	SINTEX / SUMIP / DAKLE / RANI & CO. / GANDHI & ASSOCIATES / CPE / CHLOROTECH
(46)	PVC SHEETS	FINOLEX, TAINWALA / RANI & CO.
(47)	PAINT	ASIAN PAINTS / BERGER / SHALIMAR / DULUX
**	OTHER PRODUCTS	
(48)	CPVC / UPVC PIPES	ASTRAL / SUPREME / PRINCE
(49)	AUTOMATIC MECHANICAL COURSE BAR SCREEN	JASH, HUBER-CLIMBMAX, DEGREMONT-CLIMBER, JOHNSON, VOLTAS, HYDRODYNE, BRACKETTI-GREEN, SERECO SRL
(50)	GEAR BOX FOR MECHANICAL SCREEN & FOR ACTUATOR	MASTERGEAR, EMTROK, TRANSPOWER, MARSH, PERFECT, SUPRIYA, ELECON, GREAVES, CPEC, NUTEK, ESSENPRO, SANTHI, BONFIGLOLI
(51)	PROCESS EQUIPMENTS	EMCO KCP, HINDUSTAN DORR-OLIVER, VOLTAS, HYDRAULIC & GENERAL ENGINEERS, DEGREMOUNT, OVIVO, SHIVPAD ENGINEERS PVT. LTD., HUBER, TEKNOFANGHI / EKOTON
(52)	FINE SCREEN / MULTI RAKE BAR SCREEN	JASH ENGINEERING, EGNER UMWELTECH NOLOGIE GMBH, SPAANS BAB COCK BV., VOLTAS, HUBER, JHONSON
(53)	CENTRIFUGE / BELT FILTER PRESS	ALFA LAVAL, HUMBOLDT WEDAG, FLOTTWEG / GEA WESTFALIA SEPARATORS / TEKNOFANGHI / EKOTON
(54)	ASPRIRATOR AERATORS	WATER MATRIX, AIRE-O2, CIRCUIT SA, HITACHI
(55)	ARCHIMEDIAN SCREW THICKENER	TEKNOFANGHI, ANDRITZ, SERNAGIOTTO, HUBER
(56)	SURFACE AERATORS	VOLTAS, TRIVENI, BATLIBOI
(57)	BEARINGS	SKF, FAG, RHP, ABC.
(58)	AIR BLOWERS – SCREW TYPE	GARDNER DENVER – ROBUSCHI, INGERSOLL RAND, KAESER
(59)	CENTRIFUGAL / TURBO TYPE AIR BLOWER	SIEMENS / TURBO MAX / DAEHA ENGG. / KOREA FLUID MACHINERY / ATLAS COPCO
(60)	AGITATORS / STIRRER / MIXER	REMI, SCHURTEK GANSONS LTD., STD. ENGG., MIXRITE FIBRE & FIBRE.
(61)	SUBMERSIBLE MIXERS FOR	XYLEM, ABS, KBS, AIR O2-USA

SR NO.	Product	Vendor
	ANAEROBIC / ANOXIC REACTORS	
(62)	GEAR BOX	RADICON, ELECON, NUTEK, SAFEX, GREAVES, SHANTHI
(63)	PRESSURE GAUGE	H. GURU, BELLS, AIR MASTER, PRECISION.
(64)	FRP CHEQUERED PLATE / GRATINGS	SINTEX / TRANS POWER / TRIVANI FIBER
(65)	FABRICATION STEEL PLATES	TATA, SAIL, ESSAR, JINDAL, RASHTRIYA ISPAT
(66)	FIXED FILM BIO MEDIA	BRENTWOOD-USA / OVIVO / NORDDEUTSCHE-GMBH
(67)	RO MEMBRANE	TORAY / HYDRANUATICS / OVIVO
(68)	UF MEMBRANE	INGE / OVIVO / KOCH / HYFLUX / TORAY / HYDRANUATICS
(69)	DISK / CLOTH MEDIA FILTER	SIEMENS / AQUA AEROBIC / NORDIC / SFC / ENVICO
(70)	FILTER NOZZELS	OVIVO / DEGREMONT / ECAIPL
(71)	TUBE SETTLER	BRENTWOOD-USA / SIEMENS / MM AQUA
(72)	MANUAL STRAINER	AMIAD / GOPANI / ECAIPL / ANSYS
(73)	CARTRIDGE FILTER	GOPANI / ANSYS / HY PRICESION OR EQUIVALENT
(74)	ACTIVATED CARBON FILTER	SPINE CODE / SUNSHIL / ECAIPL
(75)	DEGASSER UNIT	SPINE CODE / ECAIPL
(76)	DEGASSER BLOWER	LAXMI PROJECT OR EQUIVALENT
**	MISCELLANEOUS ITEMS	
(77)	FASTENERS	PRECISION TAPS, FIT TIGHT, F.E.DARUKHANAWALA, GKW, ECHJAY, SUNDARAM FASTENERS, AEP& CO., TATA, V.CHUNILAL & CO., STEEL & ALLIED, PRECISION ENGG., .
(78)	FLOAT TYPE FLOW INDICATOR	S.B.ELECTRONICS, NIVO CONTROL (P) LTD., DG CONTROLS, IMPERIAL FLOATS
(79)	REFRIGERATOR	VOLTAS, GODREJ, WHIRLPOOL, VIDEOCON.
(80)	AIR-CONDITIONERS	VOLTAS, BLUESTAR, SAMSUNG, LG, HITACHI, LLOYDS, CARRIER
(81)	HOTAIR BLOWER	WOLF, ARVY
(82)	MEMBRANE GAS DOME / HOLDER	MEMBRANE SYSTEM EUROPE, THE NETHERLANDS / ECO MEMBRANE, ITALY

Note: 1. The contractor shall distinctly understand that efficiency of equipment and energy saving is one of the important aspect of consideration of tender. Hence, SMC hereby reserves its right to decide final selection of make of each equipment/machineries upon the energy saving aspect. Final options to select any particular make shall rest with S.M.C. In this regard the decision of Divisional head of the Department will be final and no dispute of the contractors will be entertained at a later date for the same.

Signature of Contractor

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

31. PREVENTIVE MAINTENANCE GUIDELINES

Centralized Preventive Maintenance Guidelines

Mechanical Item

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency		
1	Compressor	1. Crankcase Oil Level	Weekly		
		2. Drain air receiver			
		3. Check Noise (Normal/Abnormal)			
		1	Compressor	1. Operate safety Valve	Monthly
				2. Check Belt wear and tension	
				3. Blow off cylinder fins	
				4. Blow off intercooler fins	
				5. Clean or replace air filter elements	
				6. Clean and lubricate electric motor	
				7. Pressure Switch Operation	
				8. Pressure Gauge Operation	
		1	Compressor	1. Check and clean compressor valve	Quarterly
2. Change crankcase oil (If required)					
3. Check and tighten bolts					
2	Blower	1. Oil Level and Grease. If required replaced	weekly		
		2. Check Vibration & Noise			
		3. Condition & Tightness of V-belts			
		4. Oil leakage			
		5. Discharge Pressure			
		6. Cleaning of Air Filter and Air silencer			
		7. Current drawn by Motor			
		8. In case the environment is dusty check the filter element			
		2	Blower	1. Functioning of Safety Valve	Quarterly
				2. Check the filter element	
				3. Check tightening of fasteners.	
				4. Change of Oil	
3	Flash Mixer	1. Lubrication in bearing / gear reducer etc.	Monthly		
		2. Check Oil Level and Oil leakages through gear box oil seals.			
		3. Stuffing Box.			
		4. Coupling bushes / v-belts			
		5. Check Vibrations			
		6. Check Shaft alignment			
		1. Change the Oil	Six Monthly		
		3	Flash Mixer	1. Check bearing noise and replace if necessary.	Yearly
				2. Replace stuffing box packing / any mechanical seal worn out component if necessary.	

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency
		3. Replace V-belts / coupling bushes, if necessary.	
4	Agitator	1. Lubrication in bearing / gear reducer etc.	Monthly
		2. Check Oil Level and Oil leakages through gear box oil seals.	
		3. Stuffing Box.	
		4. Coupling bushes / v-belts	
		5. Check Vibrations	
		6. Check Shaft alignment	
		1. Change the Oil	Six Monthly
		1. Check bearing noise and replace if necessary.	Yearly
		2. Replace stuffing box packing / any mechanical seal worn out component if necessary.	
		3. Replace V-belts / coupling bushes, if necessary.	
5	Clarifloculator/Thickner / Clarifier	1. Check Oil level & all vent holes.	Weekly
		1. Replace Oil	Six Monthly
		1. Check condition of gears, oil seals & bearings for any damage and replaced, if required.	Yearly
		2. Check underwater parts for adjustment and deterioration.	
		3. Protective painting/coating apply to all steel surfaces.	
4. Check tightening of all fasteners.			
6	Sluice Valve	1. Leakage through Stuffing Box/Gland.	Weekly
		2. Noise/Vibrations while Opening or Closing the valve.	
		1. Lubricatin of Exposed Moving Parts	Six Monthly
		1. Condition of Body Seat Ring/Wedge Seat Ring faces-scratches, dent marks, intactness	Every Three Years During O/H
		2. Condition of Spindle & Spindle nut/Yoke sleeve threads	
7	Butterfly Valve	1. Leakage through DE/NDE ends	Weekly
		2. Noise/Vibrations while Opening or Closing the valve.	
		1. Lubricatin of Exposed Moving Parts	Six Monthly
		1. Condition of resilient Disc Seal-for cuts, deformation & resilience	Every Three Years During O/H
		2. Condition of Shaft Seals-for cuts, deformation & resilience	
8	NRV	1. Leakage through Valve Seat.	Weekly
		2. Noise/Vibrations while Opening or Closing	
		1. Condition of Door Face/Body Ring faces-scratches, dent marks, intactness.	Every Three Years During O/H
		2. Condition of Hinge Pin	

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency
9	Air Valve	1. Leakage through gasket for small orifice nipple	Weekly
		2. Leakage through Rubber Seal in Low Pressure Chamber	
		3. Continuous leakage through the Low Pressure (Large) Orifice/High Pressure (Small) Orifice	
		4. Eventual passage of air through vent in small orifice plug (for High Pressure Chamber)	
		1. Condition of Float Balls,Rubber Seal in Low pressure chamber.	Yearly
10	Open Channel Gate	1. Operate the gate at least once in a	Quarterly
		1. Cleaning & greasing of stem & nuts	Six Monthly
		1. Lubricate thurst bearing & head stock	Yearly
		2. Overhauling of the gate	
		3. Painting of the gate	
11	Sluice Gate	1. Smooth operation of the gate	Weekly
		2. Noise/Vibrations while Opening or Closing the valve.	
		3. Lubrication of Exposed Moving Parts	
		1. Condition of Spindle & Spindle nut/Yoke sleeve threads	Monthly
		2. Condition of spindle guide & guide support	
		3. Check head stock foundation	
		4. Check and Tightening of all Fasteners	
		1. Check the setting & tightening of wedges	Six Monthly
		1. Condition of Frame Seat Ring/Gate Seat Ring faces-scratches, dent marks, intactness	Yearly
		2. Complete Overhauling of the Gate	
3. Painting of the gate			
12	Belt Conveyor	1. Check Oil Level and Oil leakages through gear box oil seals.	Weekly
		2. Check tightening & alignment of Belt	
		3. Cleaning of Belt Conveyor	
		1. Lubricate all moving parts	Monthly
		2. Replenish oil in Gear Box, If required.	
		3. Check tightening of Drive Chain	
		4. Check Belt alignment mechanism	
		5. Check the setting of scraper assembly	Yearly
		1. Replace Oil in Gear Box	
		2. Complete overhauling of the system	
3. Protective painting/coating apply to all steel surfaces.	Yearly		
13	Belt Filter Press Unit	A. Hydraulic Power Pack	Daily
		1. Check Oil Level	

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency	
		2. Check Suction & return line filter clogging indicators		
		3. Check unusual noise, vibration and rotation of motor shaft		
		4. Check correct actuator/control sequence		
		1. Check condition of return line filter on gauge panel	Weekly	
		2. Check the clogging of High pressure filter		
		3. Check the oil condition for water contamination		
		1. Check oil condition. If found not satisfactory, Replace the same	Yearly	
		B. Belt Press Unit		
		1. Check correct rotation of drive	Daily	
		2. Check Hydraulic system		
		3. Check belt wash & belt tracking system		
		4. Check doctor blade assembly		
		5. Check belt tension		
		1. Clean up the entire unit	Weekly	
		2. Check oil level & leakage in Gear Box		
		3. Check Leakage in hydraulic system		
		4. Check Belt, Wash nozzle & Strainer		
		5. Check pressure of belt wash system		
		6. Check belt condition, if found damage, repair it, if repairable		
		7. Setting of doctro blade assembly		
		1. Check lubrication of all bearings, if required, replenished	Monthly	
2. Check Operation of Roto valve				
3. Check functions of hydraulic cylinders				
4. Check functions of belt tracking system				
1. Change Oil of gear box	Yearly			
2. Complete overhauling of the system				
3. Protective painting/coating apply to all steel surfaces.				
14	Actuator	1. Checking alignment of actuator with its equipment	Weekly	
		2. Check Noise & Vibrations		
		3. Check limit switch & torque switch settings		
		4. General cleaning of Actuator		
		1. Check manual function of actuator	Monthly	
		2. Check tightening of fasteners		
		3. Check moisture in control section		
		4. Check tightening of wire terminals		
1. Lubrication of actuator	Yearly			

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency
		2. Painting of actuator & adaptation kit.	
15	Pneumatic System	1. Air leakage, 2. Working of Solenoid Valve, Connectors, Piping (PU), Niddle valve, Air Dryer, Limit switch, Air Cylinder of valve etc. 3. Compressor air line for its leakage / corrosion	
16	Pump Sets	A. Progressive Cavity Pump Set	
		1. Gland packing check	Monthly
		2. Grease lubrication of Bearings	Quarterly
		3. Inspection of the pumping elements for wear & tear	Yearly
		B.VNC/HNC Pump Set	
		1. Check pressure Gauge Reading	Daily
		2. Check Bearing Temperature	
		3. Check leakage through stuffing box	
		4. Check noise and vibration	
		5. Check voltage and current	
		1. Check alignment of pump set	Quarterly
		2. Check of Delivery pressure	
		3. Check Flow	
		4. Replenish Grease / oil to Bearing	
		1. Over haling (every 5000 Working Hrs.)	Yearly
		C. Self priming pump set	
		1. Check priming time	Monthly
		2. Check pump noise	
		3. Check All pipe connections	
		4. Check suction- strainer (if any)	
		1. Open the pump. check & clean interior parts	Six Monthly
		1. Check impeller	Yearly
		2. Check clearance between impeller and wearing plate (Range:0,25 & 0.35 mm)	
3. Check shaft sleeve. Replace if wearied out			
4. Replace Gland potting			
5. Replace wear plates, if worn out			
D. Submersible Pump Set			
1. Check delivery pressure, current and voltage	Daily		
2. Check Noise and vibrations			
1. Check the oil in the chamber once every 1000 operating hours.	Quarterly		
1. Check the condition of the Mechanical seals	Six Monthly		
1. Check clearance between Impeller and setting plate	Yearly		

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency
		1. Over Hauling (This work is to be done by Autho. personnel only.	Every Three Years
		E. VT Pump Set	
		1. Check Grease in thrust bearing housing (If applicable)	Daily
		2. Check oil level in lub oil tank	
		3. Check pressure Gauge Reading	
		4. Check Bearing Temperature	
		5. Check leakage through stuffing box	
		6. Check noise and vibration	
		7. Check water level, voltage and current	
		1. Change of Grease in thrust bearing housing (If applicable)	Quarterly
		2. Change of Gland packing	
		1. Change of Oil in thrust bearing housing	Six Monthly
1. Over haling (every 8000 Working Hrs.)	Every Three Years		
17	EOT/HOT Crane	1. Check push bottom operations	Monthly
		2. Check limit switch	
		1. Lubricate load chain wheel and load chain	Quarterly
		2. Check brake operations	
		3. Check smooth movement of hook	
		4. Check oil	
		1. Check oil by replaced by new	Yearly
		2. Check Clearance between trolley and runway beam flange (range : 5 to 10 mm)	
3. Check wearing in chain			
4. Seeking safety license / certificate from consultant			
18	Step type Fine Screen	1. Check normal function	Daily
		2. Check abnormal sound from the motor or hydraulic pump if any	
		3. Check leakage of oil from power pack or hydraulic connections. Tighten the connection if necessary	
		4. Check nut tightening of inductive proximity switch	
		1. Clean up screen with pressurised water Jet.	Monthly
		2. Clean the hydraulic unit and conduits	
		3. Tighten all fasteners	
		4. Check the oil level in the hydraulic power pack. Replenish if required	
		5. Lubricate the longitudinal slide bars of plastic inside the slide rail	

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency
		6. Check accumulation of sand / sediments behind the protection / guide plate and remove the same	Yearly
		1. Clean up the mechanism and rest of the part. If any part found abnormal wear, replace it.	
		2. Lubricate the bottom flange of the slide rails and the wheel assembly with oil.	
		3. Apply white grease in between the wedges and flap of mechanism	
		4. Change Hydraulic oil	
		5. Check leakage from piston ends of cylinder. if leakage observed replace the seals	
		6. Clean thoroughly power pack unit including tank both as well as outside	
19	Deep water coarse Bar screen	1. Observe and Check abnormal vibration in operating condition	Daily
		2. Check smooth movement of rake. if any misalignment found, informs it concerned authority.	
		3. Check the bar assembly and rack tines for waste collection. If found malfunctions, inform to concerned authority	
		4. Check Home position limit switch	
		5. Cleaning of operating chain (if regained)	
		1. Check lubrication of chains. (If not well lubricated, lubricate with oil or special VISCOTAKE lubricant.	Weekly
		2. Check the motor temperature (if abnormal, inform to concern authority.)	
		3. Check torque switch and limit switch by pressing for there function	
		4. Check trapped waste material on screen. If found, clean it.	
		1. Check tightening of all fasteners	Monthly
		2. Check tension of chains	
		3. Check chain link and lock condition	
		4. Check the play in rack roller, bearing upper & lower chain sprocket etc.	
		5. Check oil level of gear bar	
6. Check brake's function of motor			
20	Fix type Aerator	1. Check oil level in gear box if required, topping up the same.	Weekly
		2. Check Bearing temperature	
		3. Check vibrating of the unit	
		4. Check oil leakage from oil seals	
		5. Check couplings	

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency
		1. Check tightening of fasteners	Monthly
		1. Change Gear Box lubricant oil	6 Monthly
		1. Aerator cone and drive tube should be provided with necessary surface protection	Yearly
		2. Check fasteners. if corroded may be replace the same	
21	Centrifuge	1. Check lubricating grase of Bearing	Daily
		2. Check temperature of main rotor bearing	
		3. Check vibrating of the unit	
		1. Check V-belt Tension	Weekly
		2. Check return duct for removing of clogging	
		3. Check Control instruments	
		1. Check solids deposit inside of the housing	Monthly
		1. Check oil of fluide coupling	Six Monthly
		2. Check wearing of screw flights	
		3. Check alignment of fluide coupling	
1. Cleaning of Cyclo Gear	Yearly		
22	DG Set	1. Check leakage from Engine fuel system, cooling system & lubrication seals	Daily
		2. Check the altornator for obstruction in the cooling air ventilation screen	
		3. Check the alternator & control box heavy accumulation of dust & dirt	
		4. Check fuel level & coolant level	
		5. Check for any abnormal noise, vibration & high temperature	
		6. Check the control panel functions	
		1. Check the air filter	Weekly
		2. Check the condition of fan & alternator belt & their tension	
		3. Check all hose connection & hose conditions	
		4. Check the engine oil level	
		5. Check battery terminals	
		6. Check the battery electrolyte level	
		1. Cleaning of alternator	Monthly
		2. Greasing of bearings of alternator	
		1. Check all functions of the DG sets	Six Monthly
		2. Clean battery cap vents	
		3. Check all functions of the instrument & control panel	
		4. Tighting of all fasterners of DG set & control panels	
5. Change the air filter if required			
23	Chlorinator (Vacuum feed)	1. Check all the joints by Ammonia for any leakage	Weekly

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency
		2. All the valves on gas line must be operated irrespective of the function	
		3. Cleaning of the chlorinator	
		Note : While replacing the chlorine tonner always use new lead gasket	
		1. Check all the probes on the system	Quarterly
24	Street Light Pole and Luminaire	1. Paintings of pole:- Scrapping, cleaning and coating with red oxide and two coat of aluminum paint	Yearly
		2. Luminaire:- Cleaning and checking for its illumination level	Yearly
		3. Foundation of street light pole:- White wash with necessary civil repairing	Yearly
25	Air Conditioner	1. Cleaning of air filters	Yearly
		2. General cleaning with air blower	
		3. Thermostat Checking	
		4. Compressor checking	
26	Biogas Engine	1. Analyse waste oil	Every 700 Hours
		2. Change Oil [Oil Sump & Cooler]	
		3. Change Oil Filters	
		4. Clean Oil centrifuge filter if necessary	
		5. Clean metallic sponge of Oil Purifier	
		6. Measure crank case pressure	
		7. Adjust Air/Fuel ratio	
		8. Adjustment of Rocker Arm and valve lifters Measure valve height & check valve guide clearances	
		9. Inspection of cylinders with Endoscope	
		10. Change Spark Plugs	
		11. Inspect, Clean & change(As appropriate) the Main Air Filters	
		12. Check Battery acid level	
		13. Check Battery & Starter Connections	
		1. Change filter cartridge on crank case gas circulation system.Clean Recirculation system.	Every 2100 Hours
		2. Measure cylinder compression	
		3. Verify Ignition Timing	
		4. Check High Voltage wires and change if necessary	
		5. Check safety device and connections; Temperature& Pressure Switches	
		6. Check damper Temperature	

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency
		1. Change Main & safety air filters	Every 4200 Hours
		2. Check gaskets in rocker Arm cover & change if necessary	
		3. Dis assemble, clean and adjust all speed & Ignition pick ups.	
		4. ensure exhaust back pressure	
		5. Change coolant	
		1. Recondition cylinder heads	Every 8400 Hours
		2. Check & change if necessary, valve driving system, valve lifters, rocker arms, push rods, ball joints, roller rocker arms and cams	
		3. Measure cylinder liner wear	
		4. Change High Voltage wires	
		5. Recondition turbo chargers	
		6. Clean the intake circuit from Air filter outlet to Inter cooler	
		7. Clean Oil sump.	
		8. Check & clean cooling system, clean pipe bundles, change gaskets on heat exchangers and coolers.	
		9. Check general condition of water pump, change defective parts, if any, change the seal	
		10. Change Oil thermostat [Only V engine]	
		11. Test Thermostat of coolant circuit and change if necessary	
		12. Test control and safety device, Temperatures and pressure switches	
		13. Check the Butterfly valve bearings & change if necessary.	
		14. Grease and check for clearance in ball joints of speed control linkage & change if necessary	
		15. Inspect flexible coupling condition and change if necessary	
		16. Inspection of elastic suspension and alignment	Every 25200 Hours
		17. Check up of electric or pneumatic starting motor, Battery charging alternator etc.	
		18. Analyse the inside damper silicon	
		19. Change Hoses & clamps, if necessary	
		1. Change Pistons	Every 25200 Hours
		2. Change Piston Rings	
		3. Change Cylinder Liners	

Sr. No	Items	Mechanical Preventive Maintenance Required	Frequency	
		4. Change cylinder Head Springs		
		5. Verify the Oil Circuitsafety and regulation valves		
		6. Inspect Oil pump bushings and change if necessary		
		7. Check connecting rods and change if necessary		
		8. Change Con Rod bearings		
		9. Change connecting rod bolts(Max. of three Retightening).Mark number of Retightening on Bolt.		
		10. Change Thermostat of coolant circuit		
		11. Recondition water pumps of coolant circuit.		
		1. Engine Overhaul including its major components and systems		Every 50400 Hours
		2. Inspection of Cylinder Blocks		
		3. Crank Shaft and if necessary, Grinding of Crank Shaft		
		4. Inspection of crank shaft and bushings		
		5. Inspection of Timing Gears and change Ball Bearings		
		6. Inspection of Oil Pump, Check gears and change Bushings		
		7. Change the counterweight Fixing screws.		
		8. Change Damper		
		9. Overall Inspection of coolant, Oil, Gas, intake air, exhaust gas, automation systems, wiring etc, Change if necessary		
		10. Change Turbo Chargers		

Sr. No.	Item		Electrical & Instrumentation Preventive Maintenance Required	Frequency
1	HT Panel (Breaker)	1	Complete Circuit breaker	Once in Year
			Tighten if found loose	
			Clean with Air blower & clean the accessible parts by dry lint free cloth.	
	2	Operating Mechanism	Remove cause and replace the part	
			Clean with Air blower	

			Apply PTFE grease or its equivalent	
	3	Vacuum Interrupter	Apply PTFE grease or its equivalent	
			Do Mechanical setting & replace if req.	
			Vacuum Interrupter should be replaced, if resistance is not OK	

Sr. No.	Item		Electrical & Instrumentation Preventive Maintenance Required	Frequency		
			Vacuum Interrupter should be replaced, if vacuum is not OK or when counter reaches 20,000 operation			
		4	Auxiliary Switch		Re-tighten if found loose Replace if found damaged	
		5	Main Power Circuit		Check contacts and joints. Apply petroleum jelly, if required	
		6	Control Circuit		Check circuit and operation of micro switches and auxiliary switch	
					Replace if required.	
					Replace fuse if required	
		7	Panel cubical		Blow dust by Air blower	
					Re-tighten if found loose	
					Replace if required. Replace if required.	
		8	Measurement of Insulation resistance		Tighten if found loose	
					Clean with Air blower & clean the accessible parts by dry lint free cloth.	
					Remove cause and replace the part	
9	Protection Relay	Clean the relay				
		If not found OK , replace it.				
10	SF6 Gas Medium Interputer	Replace Interputer, if required				
11	Oil medium Interputer	Top up the oil level				
		Sealing of oil leakage				
		Filter the oil & replace if required.				
12	Earth resistance	Take suitable action if earth resistance is high				
		If found damage, replace/repair the earth strip.				
2	LT / Starter Panel	1	Air Circuit Breaker	Tighten if found loose	Once in Year	
				Clean with air blower & clean the accessible parts by dry lint free cloth.		
				Remove cause and replace the part		
				Apply PTFE grease, Beacon Q2 grease or its equivalent		
				Take necessary action if not found OK		
				Take necessary action if not found OK		
				Take necessary action if not found OK		
		Take necessary action if not found OK				
		2	MCCB	Tighten if found loose		Once in Year
				Take necessary action if not found OK		
3	Soft-Starter & its	Tighten if found loose	Monthly			

Sr. No.	Item		Electrical & Instrumentation Preventive Maintenance Required	Frequency		
		cubical	Take necessary action if not found OK			
			Blow dust by Air blower			
			Take necessary action if not found OK			
		4	Contactor		Tighten if found loose	
					Clean the contact by using smooth Emery paper or CRC spray	
					Take necessary action if not found OK	
					Take necessary action if not found OK	
					Take necessary action if not found OK	
					Take necessary action if not found OK	
		5	Auto-Transformer		Tighten if found loose	
					If megger value not achieved, placed for heating & revarnishing if req.	
					Filter the oil & replace if required.	Yearly
					Take necessary action if not found OK	
		6	Capacitor		Take necessary action if not found OK	Monthly
					Replace if not found OK	
					Take necessary action if not found OK	
		7	Panel cubical		Blow dust by Air blower	
					Re-tighten if found loose	
					Replace if required.	
					Take necessary action if not found OK	
					Take suitable action if earth resistance is high	
If found damage, replace/repair the earth strip.	Yearly					
3	Transformer	1	Bushing	Clean the bushing & replace if found damage	Half Yearly	
				Sealing the oil leakage		
				Re-tighten if found loose		
		2	Tap changer Switch	If not found OK replace it.		
				Sealing the oil leakage		
		3	Transformer Oil	Filter the oil & replace if required.	Yearly	
		4	Gasket joint	Sealing the oil leakage	Half Yearly	
		5	Breahter& Silica gel	Replace if found damage		
				The old silicagel may be reactivated. If silicagel is pink replace it by new.		
		6	Winding	If not found OK, do filtration or reinsulating/revarnishing the winding		
Replace fuse/connector if required	Yearly					
7	Earth resistance	Take suitable action if earth resistance is high	Yearly			
		If found damage, replace/repair the earth strip.				

Sr. No.	Item		Electrical & Instrumentation Preventive Maintenance Required	Frequency	
4	Motor	1	Terminal Box	Tighten if found loose	Monthly
			Clean with compressed air & clean the accessible parts by dry lint free cloth.		
			Replace if not found OK		
			Replace if not found OK		
		2	Winding	If megger value not achieved, placed for heating & revarnishing if req.	
3	Earthing Strip	Replace if not found OK			
		4	Heater	Replace if not found OK	
			Take necessary action if not found OK		
5	LT / HT Cable	1	Terminal	Tighten if found loose	Once in Year
		2	Cable Insulation	Take necessary action if not found OK	
		3	Earthing Strip	Take necessary action if not found OK	
6	Outdoor Yard	1	Terminal/ Jumper	Tighten if found loose	Once in Year
			2	Insulator	
		3	GOD switch	Take necessary action if not found OK	
			Take necessary action if not found OK		
		4	Drop out Fuse	Take necessary action if not found OK	
		5	Earthing Strip	Take necessary action if not found OK	
Take suitable action if earth resistance is high If found damage, replace/repair the earth strip.					
7	Flowmeter	1. Physical cleaning, 2. Physical condition of sensor, 3. Display checking of Indicator 4. Gland and cable connection checking	Bi-monthly		
8	LOH / ROF meters	1. Physical cleaning, 2. Physical condition of sensor, 3. Display checking of Indicator, 4. Cable connection checking	Monthly		
9	Level Indicator	1. Physical cleaning, 2. Physical condition of sensor, 3. Display checking of Indicator, 4. Cable connection checking	Monthly		
10	Pressure Transmitter	1. Physical cleaning, 2. Physical condition of sensor, 3. Display checking of Indicator, 4. Cable connection checking	Monthly		

Sr. No.	Item			Electrical & Instrumentation Preventive Maintenance Required	Frequency
11	SCADA Panel			1. Physical cleaning of panel, JB panel 2. Indicating lamps checking, 3. Communication failure checking through display, 4. UPS checking ensuring its online connectivity.	Bi-monthly
12	MCC Panel			1. General Cleaning 2. Cable Lugs Tightening 3. Contactors 4. Fuse Unit 5. Bus bars 6. Meters 7. ON/OFF Switch 8. Check of Earthing	Monthly
13	APFC Panel			1. General Cleaning 2. Cable Lugs Tightening 3. Contactors 4. Fuse Unit 5. Bus bars 6. Meters 7. ON/OFF Switch 8. Check of Earthing 9. Relay operation checking in automode	15 days
14	Variable Frequency Drive (VFD) / Soft Starter			1. General Cleaning 2. Cable Lugs Tightening 3. Bypass Contactor operation checking 4. Fuse Unit 5. Bus bars 6. Meters 7. ON/OFF Switch 8. Check of Earthing 9. Parameter setting	15 days
15	GOAB switch structure			1. General Cleaning 2. Cable Lugs Tightening 3. DO Fuse Unit 4. GOAB Switch alignment 5. Check of Earthing 6. Lightning arrester checking 7. CTPT terminal testing	Monthly
16	Lab Instruments (Major)	1	pH meter	1. General Cleaning 2. Display & Reading Error Checking against measurement range 3. Calibration with 4.0 and 7.0 Standard (Buffer solution)	Monthly

Sr. No.	Item		Electrical & Instrumentation Preventive Maintenance Required	Frequency
	2	TDS meter	1. General Cleaning 2. Display & Reading Error Checking against measurement range 3. Calibration with 500 ppm NaCl Standard	Monthly
	3	Turbidity meter	1. General Cleaning 2. Display & Reading Error Checking against measurement range 3. Calibration with <0.1 NTU, 20 NTU, 100 NTU solution (Cal. Standard)	Monthly
	4	Spectrophotometer	1. General Cleaning 2. Display & Reading Error Checking against measurement range 3. Lamp Intensity through system self calibration check 4. Filter assembly alignment through system self calibration check	Monthly
	5	DO meter	1. General Cleaning 2. Display & Reading Error Checking against measurement range 3. Calibration (Air calibration)	Monthly
	6	Pocket Colorimeter	1. General Cleaning 2. Display & Reading Error Checking against measurement range 3. Calibration with ampules	Monthly
	7	COD reactor	1. General Cleaning 2. Thermostat Checking	Monthly
	8	BOD incubator	1. General Cleaning 2. Thermostat Checking 3. Relay checking and setting 4. Compressor checking	Monthly
	9	Water Still	1. General Cleaning 2. Thermostat Checking 3. Cleaning of heating coil for removal of scale / deposit	Monthly
	10	Online pH meter	1. General Cleaning 2. Reading Error Checking against measurement range 3. Calibration with 4.0 and 7.0 Standard (Buffer solution)	Monthly
	11	Online TDS meter	1. General Cleaning 2. Reading Error Checking against measurement range 3. Calibration with 500 ppm NaCl Standard	Monthly

Sr. No.	Item		Electrical & Instrumentation Preventive Maintenance Required	Frequency
	12	Online DO meter	1. General Cleaning of sensor 2. Reading Error Checking against measurement range 3. Calibration (Air calibration)	Monthly
	13	Online Turbidity meter	1. General Cleaning 2. Display & Reading Error Checking against measurement range 3. Calibration with <0.1 NTU, 20 NTU, 100 NTU solution (Cal. Standard)	Monthly

32. DIRECTIONS TO BIDDERS FOR PRICE-BID

1.1 S.M.C.proposes following works at existing sewage treatment plant at Dindoli.

Design , Construction , Erection , Testing and commissioning of (i) Augmentation of existing Sewage Pumping Station, (ii) Augmentation of existing 66 MLD up to 167 MLD Capacity STP (iii) 40 MLD net Output TSTP to generate Industrial grade Water including operation and maintenance of all the above (i), (ii) and (iii) for 10 Years Period, Under SMART CITY , Surat

1.2 The general scope of work for the proposed augmentation of existing Sewage Treatment Plant under present tender notice includes Design, Construction, Erection, Testing and Commissioning for the augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant with Biogas based power plant and 40 MLD net output capacity TSTP including the cost of all the labour, materials, equipments, instruments, tools required for civil, electrical, mechanical, instrumentation, piping etc. & all other types of works for the total completion of the project on turn-key basis. The detailed scope of work, specifications etc. are described in the Chapter 18 & 19 of Technical Bid of the tender.

The Contract for the work is a complete one for labour, material and workmanship with contractor's overhead and profit including all temporary works and the provision and use of all construction equipments, tools, tackles, etc. The contractor shall make his own arrangements for all the materials and equipments required for the due performance of the contract. Cost of all types of materials/ equipments/ machineries/ tools/ items including cement, steel (reinforcement as well as structural) all types of pipes etc. & all types of labor required for the completion of the project shall be included in the Lumpsum. Tender Amount for the proposed work. Their purchase as per approved vender list given in the tender, their "Testing & Inspection" prior to procurement at site and then construction/ erection/ installation/ laying will be in the contractor's scope.

The lump sum price quoted by the contractor for the turnkey project of the proposed augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant with Biogas based power plant and 40 MLD net output capacity TSTP shall be deemed to have included all the statutory levies / taxes / duties etc. and any other local taxes, sales tax & VAT etc. prevailing for all the goods, items, raw materials, finished goods, machineries, equipments, valves, pipes, instruments, cables or any other materials to be used for the proposed work. If any new taxes / service tax is levied by the Central or State Governmnet during the period of implementation of complete project / contract, it shall be reimbursed at actual to the successful contractor on submission of proof for the same. The service tax on O&M contract only shall be paid separately to the contractors at the prevailing rate during the O&:M period, if applicable at the time of contract.

The Terminal Points of Scope of Work for the tun-key project of proposed augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant with Biogas based power plant and 40 MLD net output capacity TSTP are described in Technical Bid of tender. The tenderer shall acquaint himself with the access to site, other site conditions, availability of local facilities such as transport, materials, labour and shall quote his tender accordingly. The tenderer's lumpsum price shall take into account all the above in this regard for the entire period of the contract.

- 1.3 The drawing enclosed with this tender shows the layout and hydraulics of existing 66 MLD capacity STP. The bidder shall submit the layout plan & flow diagram as per the treatment process / design requirements.

The successful tenderer shall have to prepare and submit all the details, design & drawings for proposed augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant with Biogas based power plant and 40 MLD net output capacity TSTP, after evaluation of tender. Before starting of any construction activities including excavation etc., layout plan, hydraulic flow diagram, P&I diagram & G.A. drawings of all the units of the plant with design calculations shall have to be prepared and submitted by the contractor for approval to S.M.C. After getting the approval for the same from S.M.C., the contractor shall submit structural (RCC/steel) drawings with design calculations for approval to S.M.C.

- 1.4 NOTE: THE BIDDERS ARE ADVISED TO READ THIS CLAUSE CAREFULLY BEFORE QUOTING THE PRICE FOR THIS TENDER.

Turn-key price of the tender is asked for the augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant with Biogas based power plant and 40 MLD net output capacity TSTP. The bidder is required to go through the details of the given treatment process in the Chapter 16 and 17 of the Technical Bid and then looking to the given raw sewage data and required secondary treated sewage parameters as per the tender requirements the tenderer has to submit the tender along with the “PART-B: TECHNICAL BID” with supporting drawings/details etc. For this option, the bidder is required to quote his Lump-sum price in the online Price-Bid.

- 1.5 The general scope of work for the proposed augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant with Biogas based power plant and 40 MLD net output capacity TSTP under present tender includes Design, Construction, Erection, Testing and Commissioning including the cost of all the labour, materials, chemicals, equipments, instruments, tools required for civil, electrical, mechanical, instrumentation, piping etc. & all other types of works for the total completion of the project on turn-key basis. The detailed scope of work, specifications etc. are described in this tender in Technical Bid.

Cost of all types of materials/ equipments/ machineries/ tools/ items including cement, steel (reinforcement as well as structural) all types of pipes etc. & all types of labor required for the completion of the project to be included in the tendered amount for the proposed work. Their purchase as per approved vendor list given in the tender and construction/ erection/ installation/ laying will be in the contractor's scope.

Further, detailed scope of work includes Operation & Maintenance Contract for the augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant with Biogas based power plant and 40 MLD net output capacity TSTP for a period of 10 (Ten) years from the date of commissioning of the plant.

In the Operation & Maintenance Contract of ten years for the augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant with Biogas based power plant and 40 MLD net output capacity TSTP, only electricity as per the requirement will be supplied

from Surat Smart City Development Limited. Rest all the expenses pertaining to the treatment as per the specified parameters described in Chapter 17 of Technical Bid of tender, operation & maintenance of the proposed plants as described in detail in Chapter-29 of Technical Bid, including cost of chemicals, consumables, major and minor spares, repairing, modification and replacement etc. as per the given specifications & required quantity during the period of ten years shall be borne by the contractor.

The tenderer shall have to quote his lumpsum price for the proposed work at the specified places in this volume of the tender (i.e. Price-Bid). The prices quoted must be fixed & firm for the total project period and they should be inclusive of all taxes, excise duty, work contract tax, octroi, VAT and service tax etc. If any taxes is levied by the Central or State Government during the period of implementation of complete project, it shall be reimbursed at actual to the successful contractor on submission of proof for the same. The service tax on O&M contract only shall be paid separately to the contractors at the prevailing rate during the O&M period.

- 1.6 No 'D' or 'C' form will be issued by the Surat Smart City Development Limited and hence as such Sales Tax for all the materials/ items required as per the tender must be included in the prices quoted by the bidder.

1.7 GUIDELINES TO BIDDER :

- 1.8.1. The selected bidder will furnish the payment breakup for individual items of works for milestone payment towards monthly RA bill, for the approval of SMC.
- 1.8.2. The payment for R.A. Bills of civil structures shall be made only as per the terms of payment.
- 1.8.3. For Mechanical, Electrical, Instrumentation, SCADA, online equipments & Piping works, the bidders shall have to submit the detailed break-up alongwith the price-bid offer for facility of verifications of materials / equipments received in piece meal and for payment of R.A. Bills. Total amount for all these items should individually match with the prices quoted in the Price Schedule by the bidder.
- 1.8.4. The drawings attached with the tender documents are tentative and only for the general guidance of the bidder. The bidder shall submit the layout plan & hydraulic flow diagram, as per the treatment process / design suggested by him with the Technical-Bid of the tender.
- 1.8.5. The successful tenderer shall have to submit all drawings pertaining to civil, mechanical, electrical, instrumentation, interconnecting piping, etc. with respect to tender specification for approval. In case of discrepancy between approved drawing and tender specification, tender specification will be superceded. Moreover if the Engineer-in-charge desires any modification required to be done for smooth and efficient running of the plant and considering engineering point of view in overall planning in the system, the contractor is bound to do the same without any extra compensation.
- 1.8.6. The rates shall be quoted only at the specified places in Price-bid.

1.8 EVALUATION OF TENDER (PLEASE READ CAREFULLY):

- 1.9.1. SMC will first open the qualification bids of all the tenderer those are able to submit the tender in time as per the time schedule, in the presence of the bidders or their authorized representatives who choose to attend on the prescribed place, date and time in the tender for tender opening. After opening of the qualification bid, SMC will evaluate the various tenderers for the qualification requirement provided in the tender.
- 1.9.2. Technical Bid will only be opened by Surat Smart City Development Limited after evaluation of Qualification-bids submitted by the bidders. The technical bid of those tenderers will be opened who are qualified for the proposed work as per the qualification criteria provided in the tender. The Technical Bid and Price bid of the tenderers who are not qualified for the job, will not be opened and returned to the tenderer on award of the contract.
- 1.9.3. Price-Bid will not be opened by Surat Smart City Development Limited until evaluation of Technical-bids submitted by the bidders is completed and any conclusion is made. In the evaluation of Technical-bid, all the drawings, details etc., submitted by the bidders will be scrutinized before opening of price bid.

In the process of evaluation of Technical-bid, if there are be some queries regarding the details, data, drawings etc., submitted by the bidders with their Technical-bid then the same will be raised to the bidders and the bidders will have to give the answers / submit more details etc. accordingly. Surat Smart City Development Limited may appoint a consultant or expert in the field for the evaluation of details, data & drawings etc. submitted by the bidders with their Technical-bids. After complete evaluation of Technical-bids submitted by all the bidders and after any conclusion is made by Surat Smart City Development Limited to its' own discretion, Price-bids will be opened. If required, after evaluation of Technical-bids and before opening of original Price-bids, revised Price-bid may be invited by Surat Smart City Development Limited from any / all the bidders in view of changes/amendments suggested / required during the course of evaluation of Technical-Bids / Drawings / Treatment Process etc.

- 1.9.4. The tenderer shall have to quote, the prices as per the Price Schedule given, considering the all tender terms, conditions, specification etc. and no deviation of any kind will be entertained and hence contractor must quote the prices strickly in line with tender stipulations, specification etc. Deviation offered alongwith tender documents will become "Cause of Tender's outright rejection", which must be specifically noted by the bidders.
- 1.9.5. **Evaluation of tenders will be purely on the basis of Total of Lump sum Prices quoted for (I) Capital Cost quoted for Sewage Pumping Station, Sewage Treatment Plant and Tertiary Sewage Treatment Plant on turn-key basis and (II) 10 Years Operation and Maintenance Cost for the proposed works, as quoted by the bidder in the Price Schedules and (III) Energy Cost based on the enegy consumption data excluding Biogas Power Plant energy data as submitted in the technical data sheets and will be solely at the discretion of Surat Smart City Development Limited, without assigning any reasons thereof by tenderer.**

1.9.6. The tenderer shall have to quote price, at the specified places in Price Schedule of the tender, for fixed and variable cost of O&M contract for the base year, i.e. 1st year of O&M only.

The contractor shall be paid price escalation for the O&M contract based on RBI price index (prevailing at particular time during O&M contract). The price escalation formula for O&M contract is provided in this tender hereunder.

Landuse for the proposed STP project shall not be considered for bid evaluation purpose.

Price Escalation Formula for Operation and Maintenance work

After successful commissioning of the entire TTP project under this tender, the operation & maintenance contract will start. As instructed above, the tenderer shall have to quote the price for all the 10 (ten) year period of O&M contract considering the base year as 1st year of O&M (1st year). However, the payment of O&M after 1st year shall be subjected to an annual indexation to reflect the annual increase in the O&M. Such indexation will become applicable and coincide with 31st March every year, following the first financial year post commissioning as per the formula mentioned below.

$$P_n = P_v \times (WPI_n/WPI_1) + P_f \times (CPI_n/CPI_1)$$

Where,

P_n = Total Price of O&M at nth year of contract.

P_1 = O&M Price of the 1st year, which shall be quoted by the tenderer without considering any escalation, i.e. as per the base year – 1st year

P_v = Rates quoted under variable price for the nth year against the total O&M price of nth year

P_f = Rates quoted under fixed price for the nth year against the total O&M price of nth year

WPI_n = Wholesale price index as of 31st march of the year the revision is being made

WPI_1 = Wholesale price index as on 31st march of the year of commissioning

CPI_n = Consumer price index as of 31st march of the year the revision is being made

CPI_1 = Consumer price index as on 31st march of the year of commissioning

The same formula shall also be applicable for the escalation on spares replacement during operation and maintenance for the prices quoted under Point 3 in the price bid. For Spares replacement, consumer price index shall be referred for escalation

Star Rate formula for US dollar rate difference for Membrane Replacement during O&M

The amount payable to the contractor for the work done shall be adjusted for increase or decrease in the rates US dollar as under :

Price variation for Membrane Replacement by the contractor

This clause shall be applicable only if the UF and RO membranes are imported. The contractor shall have to submit an authentic proof of delivery of membrane at any Indian port. In case, if bidder received / procured the membrane through Indian agent / dealer of membrane vendor, then necessary documentary evidence shall be produced towards import of membrane. The star rates for UF and RO Membrane to be brought by the contractor shall be considered as

UF Membrane	Rs. 167400/- per nos.
RO Membrane	Rs. 52500/- per nos.

The fluctuations in rates of US dollar shall be adjusted in the bills payable to the contractors as under:

$$A = B \times (\$_n / \$_0 - 1) \times C$$

- A = Amount payable or recoverable
 B = Basic rate of UF / RO membrane as mentioned in the tender.
 $\$_n$ = Closing Rate of US \$ declared by RBI, as on previous day of delivery of Membrane at any Indian Port.
 $\$_0$ = Closing Rate of US \$ declared by RBI, as on previous day of tender submission.
 C = Quantity of UF / RO membrane actually brought by the contractor on site of work for bonafied use.

The above formula shall be applicable for variation in US dollar rates for UF and RO Membranes only.

1. No ceiling for escalation for difference of UF and RO Membrane will be applicable.
2. This clause shall be operative from the date of issue of work order and up to the expiry of original and extended time limit.
3. This formula shall be used individually for individual item for UF and RO Membrane only for calculating adjustment.
4. If at the time of completion of contract, it is noticed that any membrane brought at site is in excess of requirement (actual Consumption), then amount of escalation if paid earlier on such excess quantity of membrane shall be recovered on the basis of cost indices as applied at the time of payment of escalation or as prevailing at the time of effecting recovery, whichever is higher.
5. If such materials are not found as per the tender specification, the same shall be removed by the contractor for which no claim shall be entertained.

1.9.7. Regarding the energy cost, it is to clarify that the electricity will be supplied free of cost to the contractor for trial run and commissioning and for O&M part only. However, the tenderer shall have to submit the energy consumption details and charts for each equipment for augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant with Biogas based power plant and 40 MLD net output capacity TSTP. The details submitted on energy consumption will be used while bid evaluation and it will be used to verify the same during actual operation. The electricity rate shall be used as Rs. 6/- per kWh for tender evaluation. The excess

consumption over and above as specified by the contractor in this tender shall be deducted from his payment towards O&M at actual.

- 1.9.8. The operation – maintenance cost also includes the cost of operation and maintenance of the augmented 39 MLD SPS, augmented 167 MLD Sewage treatment plant with Biogas based power plant and 40 MLD net output capacity TSTP, PLC/SCADA system.**
- 1.9.9. Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for the award of a contract shall not be disclosed to tenderers or any other persons not officially concerned with such process until the award to successful tenderer has been announced. Any effort by a tenderer to influence the SMC's processing of tenders or award decisions may result in the rejection of his tender.
- 1.9.10. The Surat Smart City Development Limited reserves right to select any offer or to reject any or all offers without assigning any reasons thereof. Surat Smart City Development Limited does not bind itself to accept the lowest offer.

Signature Of The Contractor.

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

33. PRICE SCHEDULE

DESIGN , CONSTRUCTION , ERECTION , TESTING AND COMMISSIONING OF (i) Augmentation of existing Sewage Pumping Station, (ii) Augmentation of existing 66 MLD up to 167 MLD Capacity STP (III) 40 MLD NET OUTPUT TSTP TO GENERATE INDUSTRIAL GRADE WATER INCLUDING OPERATION AND MAINTENANCE OF ALL THE ABOVE (I), (II) AND (III) FOR 10 YEARS PERIOD, UNDER SMART CITY , SURAT

SUMMARY

1. Project Cost (Including Capital and O & M Work)

Package	Project Description	Amount (Rs.)
A	CAPITAL WORKS	
A-1	Augmentation of existing Dindoli Sewage Pumping Station including SITC of new pumps and associated Electrical-Mechanical Works as described under Technical Bid	
A-2	Augmentation of existing Sewage Treatment Plant up to 167 MLD with BNR level treatment and Biogas Based Power Plant including modification in Civil units and SITC of new associated Electrical-Mechanical Works as described under Technical Bid	
A-3	New Tertiary Sewage Treatment Plant with 40 MLD net output capacity	
	Total - Capital Work:	
B	Operation and Maintenance of upgraded Sewage Pumping Station , Sewage Treatment Plant, Bio gas based power plant and Tertiary Sewage Treatment Plant including all Civil, Mechanical, Electrical, Instrumentation and Piping.	
B-1.1	Fixed Cost towards Operation and Maintenance upgraded Sewage Pumping Station, Sewage Treatment Plant, Biogas Power Plant and Tertiary Sewage Treatment Plant per month for 1st Year of O&M including manpower, all major – minor spares with necessary repair and replacement including UF/RO system etc.*	
B-1.2	Fixed Cost towards Operation and Maintenance upgraded Sewage Pumping Station, Sewage Treatment Plant, Biogas Power Plant and Tertiary Sewage Treatment Plant per month for 2nd year and subsequent year (i.e. up to 10th year) of O&M including manpower, all major – minor spares with necessary repair and replacement including UF/RO system etc.*	
B-1.3	Variable Cost per MLD towards Operation and Maintenance of augmented SPS and STP for 167 MLD flow pattern – per MLD.	
B-1.4	Variable Cost per unit (kwh) generated by Operation and	

Package	Project Description	Amount (Rs.)
	Maintenance of Biogas based power generation plant including all Civil, Mechanical, Electrical, and Instrumentation	
B-1.5	Variable Cost per MLD towards Operation and Maintenance of TSTP for 40 MLD net output flow pattern – per MLD.	

* If Biogas power plant is not operated, Rs. 5000/- per day shall be deducted from fixed cost quoted in Point B-1.1 and B-1.2 above. The variable cost towards Biogas Power Plant shall not be paid.

2. O & M Cost of existing STP till commissioning of augmented SPS and STP

Project Description	Amount (Rs.)
Operation and Maintenance of Existing SPS and STP facility with PLC/SCADA/Instrumentation till commissioning of the augmented SPS and STP – per Month**	

** if Biogas power plant is operated during O&M period, the variable cost as quoted under B-1.4 shall be paid additionally to rate quoted under Point 2 above.

Note:

- Please note that whenever '1' is payable, '2' shall not be payable.

3. Additional Costs**

a.	Alkalinity removal for every mg/l of Alkalinity per MLD	
b.	Apperant Color removal for every Pt.Co. of Color per MLD	
c.	TDS removal for every mg/l of TDS per MLD	

** The parameters under a, b and c above shall be measured at the inlet chamber of TSTP

4. Scheduled Spares for Biogas Based Power Plant, Fixed Film Media and Air Diffusers

Project Description	Amount (Rs.)**
(i) Biogas Engine Spares for 1 st Year* (Not to be quoted as it is to be covered under Defect liability period)	N.A.
(ii) Biogas Engine Spares for 2 nd Year*	
(iii) Biogas Engine Spares for 3 rd Year*	
(iv) Biogas Engine Spares for 4 th Year*	
(v) Biogas Engine Spares for 5 th Year*	
(vi) Biogas Engine Spares for 6 th Year*	
(vii) Biogas Engine Spares for 7 th Year*	
(viii) Biogas Engine Spares for 8 th Year*	
(ix) Biogas Engine Spares for 9 th Year*	
(x) Biogas Engine Spares for 10 th Year*	
(xi) Air Diffuser Spares	
(xii) Fixed Film Media replacement	

* The contractor shall have to submit the detail break up of price of spares for bio gas engine and its accessories for each year of O&M contract, before commencement of O&M contract of 10 years, which shall be taken in to consideration for making payment. The contractor shall be paid only for the spares replaced as per manufacturer's recommendations. The spare replacement shall be done in the presence of manufacturer or his local technical representative

and the certificate of manufacturer or his local technical representative for satisfactory replacement of original spares shall be submitted to SMC.

** The tenderer shall have to quote price for the spares, at the specified places in the above schedule of the tender, for all the 10 years period of O&M contract considering the base year as 1st year of O&M (1st year may be taken as year 2019-20). The tenderer shall ensure that while quoting Spares price for each year, no price escalation shall be included in the price for that year. The contractor shall be paid price escalation at actual for the spares supplied based on RBI price index. The price escalation formula for the spares is same as of O&M contract as provided in the tender. Prior to working out price escalation for the above spares, for imported spares, the US dollar / Euro deviation as compared to the date of replacement and date of bidding will be worked out and accordingly, revised price for the spares for respective year will be worked out and then price escalation formula will be applied to that rate for necessary payment.

Signature Of The Contractor.

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

34. COST BREAK-UP FOR CAPITAL WORKS

(A-1) Augmentation of existing Dindoli Sewage Pumping Station including SITC of new pumps and associated Electrical-Mechanical Works as described under Technical Bid.

Break up of (A-1)	% break up of quoted capital cost
Mechanical Works	36%
Electrical Works, Instrumentation / PLC/ SCADA	23%
Rising Main	41%
Total:	100%

(A-2) Augmentation of existing Sewage Treatment Plant up to 167 MLD with BNR level treatment and Biogas Based Power Plant including modification in Civil units and SITC of new associated Electrical-Mechanical Works as described under Technical Bid.

Break up of (A-2)	% break up of quoted capital cost
Civil Works (New and Modification / repairing / alteration / upgradation in existing STP)	32%
Mechanical Works (New and Modification)	58%
Electrical Works, Instrumentation / PLC/ SCADA (New and Modification)	6%
Inteconnecting Piping (New and Modification)	4%
Total:	100%

(A-3) New Tertiary Sewage Treatment Plant with 40 MLD net output capacity.

Break up of (A-3)	% break up of quoted capital cost
Civil Works	12%
Piping Works	7%
Mechanical Works	65%
Electrical Works	7%
Instrumentation / PLC/ SCADA	9%
Total:	100%

Payment terms for the proposed capital works (Turn-key job) shall be as follows:

- [a] Civil works:
 - (i) 100% to be paid for respective civil works completed.
- [b] Mechanical/electrical/instrumentation/piping work:
 - (i) 15% to be paid on equipment / instrumentation / pipe purchase order.
 - (ii) 70% to be paid as and when the complete plant / equipment (alongwith specified spares) is received at site.
 - (iii) 10% to be paid as the plant/equipment is installed.
 - (iv) 5% to be paid after one month satisfactory trial run of the plant.
- [c] In all above payments vide Runnig Bills for [a] and [b] above, 2% S.D. and 5% Retention money shall be retained and released as described under Memorandum

Note:-

- [1] The contractor shall specify in his offer the details of civil, mechanical, electrical, instrumentation, Online equipments, interconnecting piping works together with the cost of break-up for facility of verification of materials received in piece meal. Itemwise breakup of online equipments shall be given separately by contractor with Price-Bid.
- [2] Planning for the procurement of materials / equipments must be done in consultation with Surat Smart City Development Limited for which barchart must be got approved and manufacturer/suppliers must be intimated accordingly. Testing & Commissioning of all the materials / equipments / pipes / valves etc. prior to delivery at site shall be carried out as described in Technical Bid.
- [3] Erection and commissioning of the equipment must be done in presence of manufacturer's representative. Manufacturer's drawing etc. must be got approved prior to supply/erection.

Dy. General Manager and Ex. Engr. (Drainage)
Surat Smart City Development Ltd.

Signature & Seal of Contractor

35. TENDERER'S/CONTRACTOR'S CERTIFICATE

I / We hereby declare that I/We have examined the site condition alongwith existing infrastructure facilities like road transport facility and other utilities available etc. and persued in detail & examined closely the specifications and intents and contents of the tender documents, including all enclosed drawings, annecures, reports, datas etc.

I/ We have examined the conditions of the existing STP facility including all civil, mechanical, electrical, PLC/SCADA, instrumentations system and accordingly, I / We have quoted the price for smooth running of the plant to achieve the desired results as provided in the tender.

I/We agree to be bound by and comply with all tender specifications, terms, conditions, stipulation etc. and confirm that offer given in this tender is strickly in line with the scope of work, specifications & Terms & Conditions of the tender.

I/We certify that I/We have inspected the location of the proposed work before quoting my/our rates. I/We have also inspected the quarries and borrow areas and satisfied myself/ ourselves regarding the quality, quantity, availability and transport facilities for construction materials such as earth, stone, sand, cement, steel, plants and equipments etc. through the network of available roads and path ways required for the work.

Further, in the event of any deviation, I understand that my/our offer will be summarly rejected.

I/We also confirm that in the event of order, I/We will furnish all required technical details, layout, hydraulic flow diagram as per the requirement of Surat Smart City Development Limited.

Signature & seal of Tenderer/Contractor

Name :-

Address :-



Date :-

36. FORMAT FOR BANK GUARANTEE

To,
Chairman,
Surat Smart City Development Limited,
Surat – 395003.

Dear Sir,

GUARANTEE NO. _____

AMOUNT OF GUARANTEE: _____

GUARANTEE COVER FROM:- _____ to _____.

LAST DATE FOR LOGEMENT OF CLAIM:- _____.

This deed to guarantee executed by the Bank of _____,
(hereinafter referred to as “The Bank”) in favour of Surat Smart City Development Limited, Surat.
(hereinafter referred to as “The Beneficiary”) for an amount not exceeding
Rs. _____ (Rupees _____) at the request
of _____ (name of Bidder),
_____ (address) (hereinafter referred to as “The
Bidder”). This guarantee is issued subject to the condition that the liability of the Bank under
this Guarantee is limited to a maximum of Rs. _____
(Rupees _____). The Guarantee shall remain in full force up to under this
Guarantee served on the Bank on or before _____ SUBJECT TO AS AFORSAID,
Surat Smart City Development Limited, Surat.

Whereas, (Bidder) _____ (hereinafter called “The Bidder”) has
submitted his bid Dtd. _____ for the Work of
_____ against Tender Notice no.. GM (Drainage
& SWM)/SSCDL/ABD(6B & 7)/1/2016-2017. (hereinafter call “The Bid”).

KNOW ALL MEN by these present that we, Bank of _____,
(hereinafter called “The Bank”) are bound unto Surat Smart City Development Limited, Surat,
(hereinafter called “The Employer”) in the sum of Rs. _____
(Rupees _____) for which payment well and truly to be made to the said
Employer, the Bank binds, himself, his successors and assigns by these presents sealed with the
common seal of the said Bank this (Date) _____.

THE CONDITIONS OF obligations are:

1. If the Bidder withdraws his Bid during the period of bid validity.
2. If the Bidder, having been notified of the acceptance of his bid by the Employer during the period of bid validity.
 - a) Fails or refuse to execute the Contract Agreement in accordance with tender documents, if required; or
 - b) Fails or refuse to furnish the Performance Security, in accordance with tender documents;

We undertake to pay to the Employer up to above upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or both of two conditions, specifying the occurred condition or conditions.

This guarantee will remain in full force up to, or as it may be extended by the Employer, notice of which extension (s) to the Bank is hereby waived. Any demand in respect thereof should reach the Bank not later than the above date.

Notwithstanding anything-contained hereinabove our liability under this guarantee is restricted to Rs. _____ (Rupees _____). Our guarantee shall remain in full force until Unless a demand or claim under the guarantee is received by us in writing on or before all your rights under the said guarantee shall be forfeited and we shall be relived and discharged from all liabilities there under.

Date:_____.

Signature of the Witness

Name of Witness

Address of Witness

Seal of the Bank

Authorised Signatory of Bank

37. DRAWINGS