

TECHNICAL SPECIFICATIONS

“MEP works of STP”

FOR

‘SUNBREEZE’

AT

SECTOR-69, GURUGRAM

1. SEWAGE TREATMENT PLANT (STP)

1.1 Scope of work

The scope of work for the STP shall be, but not limited to as given herein:

The scope shall include Design, Engineering, Procurement, Supply, Manufacture, Construction and Erection of Mechanical, Electrical, Piping, Painting and Instrumentation works, Storage at site, Testing, Commissioning, Training of owner's personnel, trial runs for 30 days after commissioning, operation & maintenance for 5 years, and handing over of Sewage Treatment Plant to the Owner, as per basic engineering design basis, specifications, equipment lists, tender drawings, liaisoning from state pollution control board for necessary approvals/NOC. Related with STP. etc., all complete.

1.2 SEWAGE CHARACTERISTICS

Parameters	Unit	Domestic
Flow to Sewer treatment plant	KLD	1150
Influent characteristics		
PH		6.5-8.5
Applicable load concentration		
BOD (5 days @ 20 °C.)	mg/l	250-350
COD	mg/l	425-750
Suspended solids	mg/l	250-450
Grease	mg/l	50
Desired Effluent Standard		
BOD	mg/l	Less than 5mg/l
Suspended solids	mg/l	<= 10
Oil & Grease	mg/l	below detectable level
COD	mg/l	Less than 15mg/l
THE STP SHALL BE IN 3 MODULES OF 350 KLD + 400 KLD + 400 KLD (TOTAL CAPACITY 1150 KLD). UNIT WILL BE CAPABLE TO OPERATE WITH A MINIMUM LOAD OF 10-15% OF THE FULL LOAD CAPACITY TO ENSURE EFFICIENT FUNCTIONING DURING LOW OCCUPANCY CONDITIONS.		

1.3 COMPONENTS OF STP PLANT & TREATMENT PROCESS

Screen bar & chamber and Grease Trap:

Screen bar shall be made of stainless steel SS-304 (corrugated perforated screen & frame with suitable lifting arrangement) suitable for handling peak flow of sewage.

Equalization Tank

The incoming sewage after passing through screen bar and grease trap, it will be collected in equalizing tanks. The tank shall be of RCC and raw sewage will be aerated with coarse bubble diffusers. The liquid will be transferred to the MBBR Reactors for further treatment.

Anoxic Tanks

In civil RCC construction of suitable nos. and suitable capacity as per design requirement with 500 mm free board.

Moving Bed Bio Reactor Units

The main STP comprising of a MBBR reactor comprising RCC tanks provided with inlet controls, launders, baffle walls and chequered plate platform with MS railing all-round at top and ladders at convenient locations. The units will have required quantity of structured PVC fill media. The reactors will be aerated as specified below.

Aeration

Following units will be aerated with air supplied from common air blowers

- Equalization Tank with coarse bubble diffusers
- MBBR Reactor Units with fine bubble diffusers
- Sludge holding tanks with coarse bubble diffusers

The aeration will be done by air blowers of required capacity to be based on Consultant design and kept in pump house as indicated on the tender drawing.

Tube Settler Tanks

Aerated sludge in MBBR reactors will be settled in tube settlers using PVC tubes media. Settled sludge will be transferred to the sludge holding tank for further dewatering and disposal.

a) Effluent & Chlorine Contact tank

The clarified effluent from the unit will be transferred to an Effluent & Chlorine Contact tank. The incoming effluent shall be chlorinated and will have a contact period of 30 minutes.

b) Tertiary Treatment of effluent

- The chlorinated effluent will be filtered in pressure filter using multi grade sand gravel filter media. It will be further filtered in an activated carbon filter and final treated effluent will be collected in final effluent RCC tank.
- Ultra-filtration
- Ozonator
- The final effluent will then be stored in treated water tank and pumped to the point of re-use for flushing and gardening as directed by the Engineer-in Charge
- Excess flow, if any from the STP shall be disposed off by pumping into the natural or municipal drainage system as directed by the Engineer-in Charge.

c) Sludge Holding Tank

Sludge from the settling tanks shall be transferred to a sludge holding tank. The tank will be aerated by means of coarse air bubble diffusers system for thickening and disposal through pumps.

d) Excess sludge disposal

Excess sludge from the sludge holding tank will be pumped and further treated in Filter Press to increase its consistency in order to produce cakes to be used as soil conditioner as per the directions of the Engineer-in-Charge. The dewatered sludge (Sludge cakes with moisture contents of not more than 15%) shall be disposed of into designated dumping area.

e) WIFI enabled real time monitoring system

Online WIFI enabled real time monitoring system for TSS, BOD, PH and COD display, record of above parameters and alarm over email & SMS along with necessary electronic and electrical component at the outlet of tertiary treatment complete with wiring and interlocking with remote monitor through WIFI.

f) Ultra-Filtration System (UF)

Ultra-Filtration System (UF) of permeate required capacity to be provided as per approved shop drawing The system should be complete with feed pumps, Back wash pumps , cartridge filter, UF membrane with housing, flushing/cleaning system, complete instrumentation for automation & monitoring, rotameters, pressure gauges, interconnecting pipe in uPVC, valves/solenoid valves,

1.4 EQUIPMENT SPECIFICATIONS

a) Introduction

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to supply install and commission a Sewage Treatment Plant with all accessories as described hereinafter and given in the schedule of quantities and/or shown on the drawings.

b) General requirements

- i. All materials shall be of the best and new quality conforming to specifications and subject to the approval of Engineer-in-Charge.
- ii. All equipment shall be of the best available make manufactured by reputed firms.
- iii. All equipment shall be installed on suitable foundations, true to level and in a neat workmanlike manner.
- iv. Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.
- v. Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.
- vi. All piping, valves and accessories for the entire Plant shall be of material fully resistant to internal and external corrosion using uPVC piping and valves or other types of material recommended by the equipment manufacturer at the time of tender and accepted by the Engineer-in-Charge.

c) Piping

All pipes used will be PVC (Class 10kgcm²) or as specified in the BOQ with matching fittings suitable for 1.5 times the working pressure. No MS or GI pipes shall be used.

d) Main STP Unit (MBBR)

The main Reactor units shall be constructed in RCC and provided with launders, baffle plates, inlet, outlet and all other connections necessary as required. The units will also include a ladder and supports, air distribution piping diffusers, and all other accessories.

The units will also be provided with a 1 m wide access ladder at two locations fabricated with MS epoxy coated tubular sections.

g) Pumps

- **Sewage transfer pump**
Non clog open impeller solid handling submersible type pumps, having CI casing, CI impeller and CI shaft complete with all accessories, motor of required capacity. Epoxy coated delivery header with isolation valve and NRV and by-pass arrangement, lifting arrangement, pressure gauge on delivery line with isolation cock level controller with wiring to control the level of sump automatically
- **Plant room submersible sump pump**
Fully submersible, centrifugal non-clog sewage handling type pump for raw sewage transfer from equalization tank to aeration Tanks. The pump shall have complete CI casing, TEFC induction motor suitable for 415+10% Volt, 3 Phase, 50 Cycles AC Power supply, Mechanical seal, Pump connector unit with rubber diaphragm and bend including pressure gauge, lifting arrangement/lifting device of pull chain/guide rail for the pump
- **Sludge transfer pumps**
Horizontal, centrifugal Sludge disposal pump for the disposal of sludge from tube settler to sludge holding tank. The pumps shall have CI casing, SS Impeller & SS shaft & sleeve with mechanical rotary shaft seal connected by a flexible tier type coupling to TEFC induction motor suitable for 415+10% Volts, 3 Phase, 50Hz, AC Power Supply mounted on a common channel base-plate with coupling guard, 150 mm dia pressure gauge with GM isolation cock, suitable vibration eliminator pads of approved design. Motor to be suitable for including all necessary piping, valves and other accessories and concrete foundation complete as required.
- **Sludge recirculation pumps**
Horizontal, centrifugal Sludge recirculation pump from MBBR-II to Anoxic Tank sludge holding tank. The pumps shall have CI casing, SS Impeller & SS shaft & sleeve with mechanical rotary shaft seal connected by a flexible tier type coupling to TEFC induction motor suitable for 415+10% Volts, 3 Phase, 50Hz, AC Power Supply mounted on a common channel base-plate with coupling guard, 150 mm dia pressure gauge with GM isolation cock, suitable vibration eliminator pads of approved design. Motor to be suitable for including all necessary piping, valves and other accessories and concrete foundation complete as required.

- **Filter feed pumps**
Horizontal, single stage centrifugal pump set with CI casing and CI impellers, CS-shaft as per IEC standards connected to TEFC induction motor suitable for 400/440 Volts, 3 phase, 2900 RPM, 50 Hz A.C. supply.
- **Treated water disposal pumps**
Horizontal/Vertical, single stage centrifugal pump set with CI casing and CI impellers, CS-shaft as per IEC standards connected to TEFC induction motor suitable for 400/440 Volts, 3 phase, 2900 RPM, 50 Hz A.C. supply. Complete with pressure gauge, gunmetal isolation cocks, vibration elimination pads, base and frame, nuts, bolts, resilient rubber neoprene lined style arch vibration eliminators suitable up to pressure 15 kg./Sqcm. and automatic cut in/cut off operation system (the pump shall be on automatically as water reach at low level in tank automatically off as water reach at High level in tank). Pump set will be complete in all respect with following duty
- **Sludge feed pumps**
Centrifugal non clog self-priming pumps complete with valves, suction and delivery header and priming tank of an approved make of suitable capacity capable of handling minimum 7 mm size solids for untreated effluent with fan cooled induction motor with class 'B' insulation, mounted on a common structural base plate, suitable vibration eliminated pads of approved design for pump foundation, motor to be suitable for 415± 10% volts, 3 phase, 50 cycles AC supply with rpm, to suit the corresponding pumps. 304. The pump shall be capable of negative suction requirement as per the design to be approved.

f) Air Blowers

Air blowers shall be of twin lobe type suitable to give constant pressure for aeration in Sewage Treatment Plant and of duties as given in BOQ. It shall be capable of continuous operation.

g) Effluent Filters (Sand & Gravel and Activated Carbon Filter)

Filter shall be designed in accordance with the code of unfired pressure vessel conforming to I.S. 2825. Filter media shall be as specified by the manufacturer to give the required results.

Filters shall be vertical type of required diameter. Pressure rating shall be suitable to withstand a working pressure given in schedule of quantities.

Each filter shall be provided with screwed or flanged connections for inlet, outlet individual drain connections and all face piping, diaphragm valves and all other connections necessary as required. Face piping shall be G.I. Class C

All pressure vessels shall be hydraulically tested at manufacturer's works for a minimum pressure of 1.5 times the working pressure.

Each pressure filter shall be provided with internal distribution network piping and spray nozzles, collecting nozzles and pipe work as per manufacturer's design. Internal pipes, fittings and the spray nozzle shall be corrosive resistant PVC, HDPE or ABS plastic.

Valves on the face piping shall be PVC valves with accompanying flanges, GI nuts and bolts of correct length to suit each valve

h) Chlorinator / Chemical Feed Pumps

Chemical feed and chlorination will be done by approved make of non-corrosive material by separate metering pumps mounted on a 90/100 litres PVC tank.

Two PVC containers with lids of 200 litre capacities for making solutions shall be provided. All suction, delivery and injection piping and fittings shall be corrosion resistant.

i) Painting (Other than STP Units)

Steel work wherever used shall be sand blasted and applied with one coat of primer.

Steel work and equipment in contact with water shall be painted with epoxy paint as per paint manufacturer's recommendation.

Steel work exposed to atmosphere shall be painted with three coats of synthetic enamel paint of approved shade.

j) Ultra Violet Disinfection System

Ultra Violet water disinfection & purification system comprising of stainless steel casing UV chamber both internally & externally electro polished with double side flanges with drain port, quartz glass tubes, high intensity UV lamps rated for 6000 hours operation and fully automatic control unit comprising of power on off switch, warning lamp on lamp failure suitable for 220V A/c single phase supply and fully earth line.

The unit should be suitable for providing 99.9% (> log 2) disinfection of treated & filtered effluent from captive STP. The UV dose shall be 11 millijoules per square centimeter.

k) Instruments

100 mm dia gunmetal "Bourdon" pressure gauge with isolation cock and connecting piping for each pump shall be provided.

Approved type of flow meter on the plant inlet calibrated in litres/ minute shall be installed. Level switches in equalisation tank shall be provided, which shall be interlocked with sewage forwarding pumps to prevent dry running of pumps during no flow conditions and also to prevent flooding during overflow.

1.5 ELECTRICAL WORKS

Electrical equipment shall be suitable for electrical voltage specified in the bill of quantities and as required by local authorities

Motors shall be for heavy duty TEFC compatible for the duties of the pumps. Motors shall be rated 10-15% above the proof terminal box. Each motor shall

be provided with a weather proof terminal. Connections to all motors shall be made with waterproof flexible connections with suitable bushes and terminal lugs.

Starters for motors shall be fully automatic type with push buttons. Direct on line (DOL) for motor up-to 10 HP. Starters for motors above 10 H.P. shall be automatic star-delta starters. Motor control centre for the entire plant shall be dust and vermin proof construction fabricated from corrosion resistant M.S. sheets and comprising of:

- One incoming MCCB.
- Copper bus bar in separate chamber of ample capacity.
- One isolation MCB/ MCCB for each motor.
- One starter of required type for each motor.
- One set of ON/OFF indicating lamps for each motor.
- One voltmeter with selector switch on incoming main.
- One ampere meter for each motor.
- One single phasing preventer for each motor.
- All interconnecting colour coded wiring within the control center.

Any other devices and accessories necessary and required for a complete working system and as required by local authorities.

All power and control cabling from MCC panel to all motors and controls shall be 1100 volts grade with numbers of the cores necessary and required conforming to relevant IS.

Entire electrical installation shall be earthed in accordance with local electrical rules.

Slotted tray running on wall shall be provided for taking cables from MCC to various motors.

a) Cables

Contractor shall provide all power and control cables from the motor control centre to various motors, level controllers and other control devices. Cables & wiring shall conform to I.S. 1554 & 15694 and carry ISI mark.

All power and wiring cables shall be aluminium conductor PVC insulated armoured and PVC sheathed of 1100 volts grade. All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 vol. grade. All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

All cable joints shall be made in an approved manner as per standard practice.

b) Cable trays

Contractor shall provide M.S./ G.I Slotted cables trays at locations as shown on the drawings and of sizes as given in the schedule of quantities.

Cable trays shall be supported from the bottom of the slab at intervals of 30 cms at both ends by welding support rods with insert plates or to reinforcement bars. Cutting of holes in the slab for exposing of reinforcement bars and making good

the same after welding of support rods shall be included in the rate of the tray and no separate payment shall be made on this account.

Cost of clips, bolts, nuts, supports rods and any other materials required to fix the trays in proper manner shall be included in the quoted rates for trays.

c) Earthing

All equipment installed by the contractor shall be suitably earthed by making proper connection by means of insulated copper wires to the main earthing system laid by the electrical contractors or as approved by the Engineer-in-charge.

d) Motor control centres

Switchboard cubicles of approved type shall be fabricated from 16 gauge M.S. Sheet with dust and vermin proof construction. (Switchgear as given in the schedule of quantities). It shall be powder coated of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The panel shall be compartmentalized, having separate compartments for each starters/ switches. The cubicle shall comprise of the following: -

- i. Incoming main MCCB of required capacity.
- ii. Isolation MCB/ MCCB, one for each motor.
- iii. Fully automatic DOL/Star Delta starters suitable for motor H.P. With push buttons one for each motor and on/off indicating neon lamps.
- iv. Current operated single phasing preventer of appropriate rating for each motor.
- v. Rotary duty selector switch.
- vi. Panel type ampere meters one for each motor.
- vii. Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase.
- viii. Neon phase indicating lamps and indicating lamp for each motor.
- ix. Rotary switch for manual or auto operation for each pump.
- x. Fully taped separate copper bus bars of required capacity for normal and emergency supply where specified.
- xi. The panel shall be pre-wired with colour coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switchboard panel.

All switchgears and accessories shall be of approved make.

Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers.

Auxiliary contacts shall be provided on each feeder to integrate the monitoring and operation on BMS.

e) Painting and clean-up

- i. On completion of the installation contractor shall scrub, clean all pumps, piping, filters and equipment and apply one coat of primer.
- ii. Apply two or more coats of synthetic enamel paint of approved make and shade on steel pipes.

- iii Provide painted identification legend and direction arrows on all equipment and piping as directed by Engineer-in-Charge.
- iv On final completion of the work, contractor shall clean-up the site and filter room of all surplus and waste materials.

1.6 Operation of the Plant

The mode of plant operation shall be semi-automatic. Backwash & regeneration cycle for filters (ACF and DMF) as well as service cycle (after backwash/regeneration) shall be initiated manually. The entire operation of the plant and its maintenance shall be as per the operation and instruction manual supplied by the contractor.

The contractor shall carry out minimum 15 days training to the Owner's representative on proper and safe running, operation and maintenance of the STP

Instruments listed below shall be provided as a minimum for the plants. All Instruments specified elsewhere in the tender document shall also be provided. However, any other instrumentation required to make the plant fully operational, safe and complete shall also be included in Contractor's scope of work. All alarms shall be available in the Control Room. All indications regarding feed & treated effluent quality & quantity, tank levels and others as specified in this document or elsewhere in the tender document or as required shall also go to the Control Room.

Pressure Gauge (PG) shall be provided at inlet & outlet of each filter (activated carbon filters, Pressure sand filters), downstream of media trap which are provided at outlet of each filter, and at discharge of each pump and blower. Isolation and drain valves shall be provided as required.

Flow meter shall be provided at the outlet of activated carbon filter to determine the output of the treatment system. The flow meter shall be of digital type to record daily discharge of the plant and cumulative flow of the plant. Digital pH meter shall be provided for equalization cum neutralization tank in order to dose the type of neutralizing agent as required depending on the pH in the Equalization tank.

Digital pH shall also be provided at the outlet of treatment plant after activated carbon adsorption.

For all pumps/blowers/agitators in the plant, both running and stop indication to be provided in Control Room on console. Facility for start & Stop from the STP control system shall be provided along with the local start & stop facility.

All instruments shall be of approved make and shall conform to the relevant codes and standards.

All instruments shall be suitable for corrosive environment.

1.7 Civil and Structural Works

1.7.1.1 Following Civil and Structural works shall be excluded in the scope of work for the SOR Item of STP:

- a) Civil/ RCC works of Screening Pit, Grease trap pit and all RCC tanks.

- b) Civil/ RCC works for necessary foundations for (i) pumps, (ii) air blowers), (iii) panels etc.
- c) Complete Structural works, e.g. pipe racks, cable racks, pipe supports, instrument supports, hand-railing, platforms, stairs, ladders, inserts, cross-overs, etc.
- d) Steel platforms with ladders, steel stairs water storage tanks and hand-railing as specified/required as per specifications and drawings.
- e) Other Civil works including grouting of equipment's shall be as per specifications mentioned elsewhere in the tender document.

1.7.1.2 The input on size of the RCC tanks, pump foundations and pre-fabricated tank foundation shall be provided by the contractor according to process requirements.

1.7.1.3 Location and arrangement of all the equipment's shall be as per approved design and schematic and shall be planned as per the availability of space

1.8 Battery Limit Conditions

Civil Works: All Civil works mentioned in CI No 1.7 above shall be paid separately under respective items.

Electrical: General area lighting in the STP area, Control room lighting, ventilation, etc shall be paid separately under respective item. Power cable shall be provided upto incoming point of STP Control Panel. Cable sizing shall be provided based on the inputs from the STP vendor.

All other electrical works like panels, electrical, electro-mechanical equipment, internal cabling, earthing, terminations etc shall be deemed to be included in the quoted rate of STP item.

Piping: Piping till the inlet of the bar screen chamber shall be paid separately under respective item. Piping from the Inlet of the bar screen chamber to outlet of the treated water tank shall be deemed to be included in the quoted rate of STP Item.

All the works in STP area required to make system complete and functional shall be deemed to be included in the quoted rates of STP item.

1.9 Equipment / Material Supplies

All equipment's / materials will be procured from approved vendor/ approved make list attached. Any item for which approved make list is not provided, contractor shall obtain prior approval of Engineer-In-Charge before placement of order.

1.10 Spares

1.10.1 Mandatory Spares

Mandatory spares for whole plants as and when required during period of 5 years from overall completion of work shall be provided by the contractor. Mandatory spares are to be provided by the contractor within the quoted price for STP item.

1.11 Manufacturer's Warrantee

The item shall include manufacturer's warrantee of minimum five year.

TECHNICAL SPECIFICATIONS FOR SWIMMING POOL

1.0 SWIMMING POOL FILTRATION SYSTEM & ACCESSORIES

1.1 SCOPE

This section comprises of design, supply, installation, testing and commissioning of the complete Filtration Plant and allied accessories for Swimming pool.

All installation work shall comply with the latest rules and regulations.

The work embraced by these specifications covers the design, submission to authorities, supply and delivery on site, installation, testing, commissioning and maintenance of the Water Filtration System of the swimming pool.

The filtration equipment has been considered based on the following recirculation cycles.

- a) Adult Swimming Pool (Residential) : 6 hour/cycle
- b) Children Swimming Pool : 6 hour/cycle

The scope of work shall include the following (list is indicative and not exhaustive):

- All the pipe work between swimming pool balancing tank, swimming pool and the interconnecting pipe work for filtration pumps and other equipment.
- Complete Swimming Pool Filtration system including all equipment such as the filtration pumps, sand & lint filter, chemical dosing units, pipe work, nozzles and swimming pool accessories like suction sweepers, ladders etc.
- Electrical equipment and installation work including necessary wiring, cabling, support structure & earthing etc. for Control panel, pumps & other equipment.
- Painting and labelling of pipe work and equipment;
- Provision of all hold down bolts, spigots struts and the likes required to be built in during construction;
- Provision of all level switches, flow switches and other sensing devices for status indication.

- All interfacing work with other works.
- Testing, commissioning and balancing of complete Filtration system;
- Provision of twelve (12) months maintenance and breakdown services;
- Provisions of operating instructions and maintenance manuals;
- Provision of spare parts;
- Training of the employer's staff for proper operation of the entire systems;
- Liaison with Local Authorities to obtain all necessary certificates and approvals, including the completion of all submission drawings, forms and payment of any fees and charges. All the costs for the tests required by Local Authorities shall be included. To attend to any Authorities inspection regardless of whether this inspection is carried out after the defect liability period;
- All other works and systems as specified in the Contract document and or shown on the drawings.
- All cutting, patching, framing up, furring in, chasing and making good associated with the building construction for the passage of pipes, conduits and the like including providing GI pipes sleeves of required size corresponding to pipe dia, wherever pipes are crossing fire rated walls and floors and sealing with glass wool in between and fire sealant compound on either end. Details on shop drawings shall also be provided.

1.2 FILTRATION EQUIPMENT AND ACCESSORIES

1.2.1 PUMPS

Pumps shall be vertical/ horizontal type, centrifugal, single/multistage directly coupled to motor as per BOQ. The pumps shall have bronze impellers & base of cast iron or as per boq and shaft in SS 304 / 316 (as per boq) shall be made for pumps required in swimming pool re-circulation system. Impeller shall be hydraulically balanced and keyed to shaft. Pump shall be mounted on a concrete foundation, projecting at least 15 CM above finished floor level. The pumps base shall be set on a vibration elimination pad. The pump shall be lubricated in strict accordance with the manufacturer's instructions and shall be factory aligned prior to shipment. All motors and bases shall be painted with approved finish shop coat of paint. The pump shall be selected for the lowest operating noise level and shall be complete with flexible

connections, valves, and pressure gauges. The pumps shall include cost of foundation and M. S channel complete.

1.2.2 FILTER

1.2.2.1 FRP COMPOSITE VESSEL

The filter shall be constructed of FRP material with inner shell of integrated polyethylene, polypropylene and other material as per manufacturer's standard.

The inter distribution system and the under bed draw off system shall be of Hub & Lateral type of polypropylene material. The filter shall be provided with manhole cover, hand hole, flanged outlet for piping / valve connection and adequate tripod with skid self-supporting structure for making the installation completed. The filter shall also be provided with vacuums breaking connection / accessories to avoid any collapse of internal lining. All filters shall be provided with lifting lugs, multi-port valve fitted on top or side with face piping etc. The filter bed depth shall be 600 mm.

1.2.2.2 FACE PIPING

Each filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash complete with valves/ multi-port valve.

1.2.2.3 ACCESSORIES

Each filter shall be provided with following accessories:-

- a. Air release valve with connecting piping.
- b. 100 mm dia, bourdon type, gunmetal, dial type pressure gauges with brass isolation ball valve and connection piping on inlet and outlet.
- c. Sampling valves (ball valves) on water inlet and filtered water outlet.
- d. Individual drain connection with brass full way ball valve for each filter.

1.2.2.4 FILTER MEDIA

The filter media shall comprise of gravel / silica of various grade in varying thickness. The cut-section of the filter along with filter media detail shall be subject to approval by the owner.

1.2.3 POOL MAINTENANCE KIT:

Providing and fixing pool maintenance equipment comprising of the following:-

- a) Extensive telescopic Handle for cleaning attachment in anodized aluminium
- b) Plastic Vacuum house
- c) Surface net polypropylene/white polyester netting butterfly connected.
- d) Deep bag net made in polypropylene white polyester netting
- e) Curved brush
- f) Anodised Aluminium Vacc Head
- g) Test kit for PH and chlorine

Detail of equipment with technical literature shall be supplied with the tender.

1.2.4 ALUM / SODA ASH DOSERS

All dosers shall be of electronic metering plunger type conforming to the requirements specified in the Bill of Quantities. They shall be complete with low level switch, low level alarm, tank and interconnecting piping.

1.2.5 SWIMMING POOL NOZZLES

Nozzles shall be constructed of unalterable UV resistant ABS plastic & shall be designed for low noise and smooth flow at desired rate. The nozzle shall be suitable for three adjustable set positions and shall be connected to puddle flange and to G.I water supply pipe positioned on the swimming pool wall.

1.2.6 SUCTION SWEEPER

Suction sweeper shall consists of centrifugal pump directly coupled through flexible coupling to 400/440 volts, 3 phase 50 cycles motor and both units mounted on a

trolley complete with suitable starter, 30 meters (appx.) of cable terminating with a three pin plug with 600 mm wide suction sweeper head with wheels, spring loaded brush and towing rope, 20 meters length of internally armoured hose with necessary coupling and floats. Contractor to submit the technical detail and catalogue of the suction sweeper, model along with the bid for the review & approval of the client engineer.

1.2.7 Pool Drain: Pool Drain grating shall be UV protected ABS/SS drain grating shall

Be fixed with the help of gasket & screws drain grating to be anti-vortex grille.

1.3 WATER QUALITY

The technical tolerances for water after filtration for swimming pool shall be as follows:

S.No.	Characteristic	Tolerance
i.	PH value	7.5 to 8.5
ii.	Total alkalinity (as CaCO ₃), mg/1, Max	50 to 500
iii.	Aluminium (as Al), mg/1, Max	0.1
iv.	Total residual chlorine, mg/1 a. At inlet, Max b. At outlet, Min	0.5 0.2
v.	Oxygen absorbed in 4 hours at 27 deg.C mg/1, Max	1.0
vi.	Chloride (as Cl), mg/1, Max	500
vii.	Iron, mg/1, Max	0.1
viii.	Heavy metals (as pb), mg / 1, Max	0.1
ix.	Colour, Hazen units, Max	10
x.	Turbidity, NTU, Max	10
xi.	Odour	Odourless

1.4 PIPING

Pipes for suction and delivery shall be galvanized (heavy duty) conforming to I.S:1239 up to 150mm dia and as per I.S:3589 for dia 200mm and above or as

specified in bill of quantities and IS: 1879 (Part 1 to 10) for malleable cast iron fittings.

1.4.1 G.I. PIPE & FITTINGS

All pipes shall be galvanized steel tubes conforming to I.S. 1239 of class specified. When class is not specified they shall be Heavy Class.

Fittings shall be malleable iron galvanized fittings, of approved make. All fittings shall have manufacturer's trade mark stamped on it. Fittings for G.I. pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes. Fittings shall be of I.S:1879.

JOINTS

Pipes and fittings shall be joined with screwed fittings. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. Genuine red lead with grumet and a few strands of fine hemp shall be applied. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. Pipes may be run under the ceiling or floors and other as shown on drawings

1.4.2 CAST IRON PIPE & FITTINGS

Cast iron pipes shall be centrifugally spun iron pipes conforming to I.S: 1536-1967. Quality certificates shall be furnished.

Fittings

Fittings used for C.I. drainage pipe shall conform to I.S: 1538-1967. Wherever possible junction from branch pipes shall be made by a 'Y tee'.

Laying

All cast iron pipes and fittings shall be jointed with best quality drip seal or tightened

Joints. Depth of joints shall be as given in I.S. code.

The spigot of pipe or fittings shall be centred in the adjoining socket with the tightened rubber gasket or by caulking. Sufficient turns of tarred gasket to leave unfilled the required depth of socket for depth of 45mm when the gasket has been caulked tightly home. Jointing ring shall be placed round the barrel and against the face of the socket. Drip seal shall then be filled the remainder of the socket. This shall then be done by hand filling.

Testing

All lengths of the pipes shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. All pipes shall be subjected to a test pressure of at least 5.0 metre head of water. The test pressure shall, however, not exceed 5.0 metre head at any point. The pipes shall be plugged preferably with standard design rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head. The tolerance figure of two litres per centimetre of dia per kilometre may be allowed during a period of ten minutes. Subsidence of the test water may be due to one or more of the following causes.

- (i) Absorption by pipes and joints
 - (ii) Sweating of pipe or joints
 - (iii) Leakage at joints or from defective pipes
- a) Trapped Air

Allowance shall be made for (i) by adding water until absorption has ceased after which the test proper should commence. Any leakage will be visible and the defective part of the work should be cut out and made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.

- b) The Contractor shall give a smoke test to the entire pipe length at his own expense and charges, if directed by the Engineer-in-Charge.
- c) A test register shall be maintained which shall be signed and dated by Contractor, Engineer-in-Charge and representative of owner.

1.4.3 PIPE CLAMPS AND SUPPORTS

1.4.3.1 All pipes shall be adequately supported from ceiling or walls by Structural clamps/ supports fabricated from M.S. Structural e.g. Rods, Channels, Angles and Flats. All clamps/ supports shall be painted with one coat of red lead and two coats of black Enamel paint.

1.4.3.2 The Contractor shall fix the clamps and supports with the help of the anchor fasteners. Anchor fastener shall be fixed to walls and ceilings by drilling holes with Electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

1.4.4 PIPE PROTECTION - PAINTING

All pipes shall be painted with one coat of Red Oxide Primer and two coats of Synthetic Enamel paint of approved shade and quality. Pipes shall be painted as per standard colour code specified by IS.

1.4.5 UNIONS

Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each Gunmetal Valve, Stop Cocks, or Check Valves and on straight runs as necessary at appropriate locations as required and/or directed by Engineer-in-Charge.

1.5 GUNMETAL VALVES

Valves 65mm dia and below shall be heavy Gunmetal Full way Valves or Ball valves conforming to I.S. 778-1971 of 20 Kg/cm² class. Valves shall be tested at manufacturer's works and the same stamped on it.

All valves shall be approved by the engineer-in-charge before they are allowed to be used on work. However the final responsibility of the quality of material lies with the contractor.

1.6 UPVC PIPES

1.6.1 Definition

uPVC pipe means plasticised Polyvinyl Chloride pipe , confirming to IS: 4985.

It has density of Approx. 1.43 g / Cm³ as such it is less then 1/6 th the weight of C.I. and steel pipes, therefore easier to handle during installation and transportation.

1.6.2 The uPVC Pipes to be used for Portable water to be odourless and hygienic, and should have inside surface mirror smooth.

1.6.3 The Pipes should have high corrosion resistance and should be immune to chemical electrolytic and galvanic action.

1.6.4 These Pipes should be longer lasting because of corrosion resistance property.

1.6.5 Handling guidelines

Pipes should be kept on an even surface while storing. They should be properly supported and should not be stacked for heights more then 1.5 meters for longer duration.

1.6.6 Jointing

1.6.6.1 Jointing Instructions

The uPVC Pipes are of two types i.e. Selfit and Ringfit.

1.6.6.1.1 The following procedure may be adopted while jointing the Pipes : -

Selfit Pipes

- a) Cut the Pipes as square as possible and ensure fitment of Pipes with socket of fitting is correct. Total length of insertion of sockets to be marked from the Pipe.
- b) The Pipe and the socket should be clean and dry. Dust, Oil, water, grease etc. should be wiped out with dry cloth or cleaner from the surfaces to be coated with Solvent Cement.
- c) Roughen the outside of Pipe and inside of Socket using sand Paper up to the entry mark. Stir adhesive i.e. Solvent Cement thoroughly.
- d) Apply thick coat of Solvent Cement using a flat clean brush evenly on the inside of the socket mouth for full length of insertion and then outside of the Pipe end up to the marked line.
- e) After application of Solvent Cement, insert the Pipe within one minute in to the Socket. Hold the Joint for few seconds and ensure that the Pipe does not come out of the fittings. Wipe off extra cement and allow it to dry for at least 24 Hours. The PVC Pipe with joint is ready for use.

1.6.7 Consumption of Solvent Cement

Diameter of Pipe (mm)	20	25	32	40	50	63	75	90	16	160	200	250	315	400
Approx. No: of joints which can be made per litre of Solvent cement	324	270	225	180	130	125	63	79	54	27	15	9	5	2

Ring-fit Pipes

- a) Clean the inside of Socket. Remove all traces of mud, dirt, grease, gravel and also clean sealing ring.
- b) Form the EPDM ring into heart shape by pinching a portion of ring inside. Insert it into the socket and release to seat in to the groove.
- c) Mark the insertion depth on spigot portion of the pipe. Clean and apply lubricant to insertion depth before pushing in to the Socket. Ensure that no sand or dirt adheres to the lubricated surface of the Pipe.
- d) Push the Spigot into the Socket until it reaches the depth of entry mark, taking care not to over insert. This can be done manually. Make sure that the insertion of Spigot end inside the socket should be at correct angle. The Pipe and Joint are ready for use.
- e) In case of large diameter Pipes if crow bar does not give sufficient leverage, use of jointing jack may be helpful.

Precautions:-

1. uPVC Pipes and Fittings should not be cleaned by Solvent Cement.
2. For large diameter and Higher class Pipes (6 kgf/cm² & above), use heavy duty Solvent cement.
3. uPVC pipes and fittings to be used of same Brand and Manufacturer.

1.7 SUCTION STRAINER

Suction strainer shall be of C.I., conforming to I.S:4038 - 1979, as specified in bill of quantities.

1.8 VIBRATION ELIMINATORS

Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer's details.

1.9 VALVE CHAMBERS

Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 12 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box as approved or as specified in Schedule of Quantities and in drawings including excavation, back filling complete.

1.10 TESTING

1.10.1 All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 15 kg/cm² in any case whichever is higher or with the consent of Engineer-in-Charge.

Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

1.10.2 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the pool or pumping system or mains. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of

fittings, to the building, furniture and Fixtures shall be made good during the defects liability period without any extra cost.

1.10.3 After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

1.11 MEASUREMENT

1.11.1 Pipes

Pipes shall be measured per linear meter and shall be inclusive of all fittings e.g. couplings, tees, bends / elbows, unions, and flanges. Deduction for valves shall be made.

1.11.2 Valves & Fittings

Puddle flanged gunmetal valves, cast iron valves, air and scour valves and all other similar items mentioned in the schedule of quantities shall be measured by number and shall include all items mentioned in the specifications.

1.11.3 Swimming Pool pumps sump pumps shall be measured by sets / or numbers as specified in bill of quantities and shall include all items as given in the bill of quantities.

1.11.4 Motor control panel and level controllers shall be measured by numbers.

1.11.5 Pipes for suction and delivery header and mains shall be measured per linear metre along the centre line of the pipe and shall be inclusive of all fittings.

1.11.6 Cable trays and cables shall be measured per linear meter.

1.11.7 Structural clamps including hangers shall be measured by weight calculated from sections used. No separate payment shall be admissible for bolts, anchor bolts, rawl plugs etc.

1.11.8 No separate payment shall be made for making connections of the existing service lines to the pumps. Vibration eliminator pads are included in the scope of this work.

1.12 **DISINFECTION**

1.12.1 After completion of the work Contractor shall flush clean the entire system with the city's filtered water after connection has been made.

- i. After the first flushing, commercial bleaching powder is to be added to achieve a dosage of 2 to 3 mg/l of water in the system added and flushed. This operation should be performed twice to ensure that the system is fully disinfected and usable.

1.13 **PRE COMMISSIONING:**

1. 13.1 Ensure that all pipes are free from debris and obstructions.

1. 13.2 Check all valves for effective opening and closing action. Defects should be rectified or valves replaced.

1.13.3 Ensure that all Connections to Branches has been made.

1.13.4 Ensure that mains have been connected to the respective pumps and tank.

1.13.5 All main line Valves should be closed.

1.14 COMMISSIONING

1.14.1 Fill swimming pool with the help of quick fill line.

1.14.2 Fill balancing tank with the water supply connection.

1.14.3 Open all valves in the line. Observe for leakages or malfunctions, check pressure & flow in the line. Remove and rectify defects if noticed.

1.14.4 All pool nozzles to be set and balanced to get the equal discharge.

1.14.5 The entire water supply system should be disinfected with bleaching powder and system flush cleaned.

1.15 GUARANTEE

1.15.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

1.15.2 The form of warranty shall be as approved by the Engineer-in-charge.

1.15.3 The warranty shall be valid for a period of one year from the date of commissioning and handing over.

1.15.4 The warranty shall expressly include replacement of all defective or under capacity equipment, Engineer-in-charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

1.16.5 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-charge.

1.17 RESPONSIBILITY

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.

2.0 ELECTRICAL

2.1 **CABLES**

2.1.1 Contractor shall provide all power control cables from the motor control center to various motors, level controllers and other control devices.

2.1.2 Cables shall conform to I.S: 7098 Partt-II.

2.1.3 Wiring cables shall conform to I.S 694.

2.1.4 All power and wiring cables shall be XLPE of 1100 volts grade.

2.1.5 All control cables shall be copper conductor PVC insulated armored and PVC sheathed 1100 Volt grade.

2.1.6 All cable joints shall be made in approved manner as per standard practice.

2.1.7 **Medium Voltage Cables**

Medium cables shall be aluminium conductor XLPE insulated; XLPE sheathed armoured conforming to IS 1554/7098. Cables shall be rated for a 1100 Volts.

Current ratings shall be based on the following conditions.

- | | |
|----------------------------------|---------|
| a) Maximum conductor temperature | 70° C |
| b) Ambient air temperature | 45° C |
| c) Ground temperature | 30° C |
| d) Depth of laying | 1000 mm |

Short circuit rating of cables shall be as specified in IS 1554 Part-I.

Cables have been selected considering conditions of maximum connected loads, ambient temperature, grouping of cables and allowable voltage drop. However, the contractor shall recheck the sizes before cables are fixed and connected to service.

2.1.8 LAYING OF CABLES

Cables shall be so laid that the maximum bending radius is 12 times the overall diameter of the cable for medium voltage cables and 15 times the overall diameter for 11 kV cables. Cables shall be laid directly on walls/cable trays /ducts as elaborated below. Cables of different voltages and also power and control cables shall be laid with adequate separation. Where more than one cable is laid side by side, cable marker tags of approved type inscribed with cable identification details shall be permanently attached to cables.

2.1.9 On Trays/Walls

- 2.1.9.1 Wherever so specified, cables shall be laid along walls/ceiling or on cable trays. Cable shall be secured in position and dressed properly by means of suitable clamps, hooks, saddles etc. such that the minimum clear spacing between cables is diameter of the cable. Clamping of cables shall be at minimum intervals as below.

Type of cables	Size	Clamping by	Fixing intervals
MV	Upto and including 25 sq mm	Saddles 1 mm thick	45 cm
MV & HV	20 sq mm to 120 sq mm	Clamps 3 mm thick 25 mm wide	60 cm
MV & HV	150 sq mm and above	Clamps 3 mm thick 40 mm wide	60 cm

Note : The fixing intervals specified apply to straight runs. In the case of bends, additional clamping shall be provided at 30 cm from the centre of the bend on both sides.

2.1.9.2 Cable trays

Cable trays, of sizes as per schedule of quantities and drawings shall be of perforated doubled bend channel or of ladder design as specified in BOQ. Cable trays shall be fabricated from sheet steel of thickness as per BOQ and shall be complete with tees, elbows, risers, and all necessary hardware.

Trays shall have suitable strength and rigidity to provide proper support for all the contained cables. Trays shall not have sharp edges, burrs or projections injurious to cable insulation. Trays shall include fittings for changes in direction and elevation. Cable trays and accessories shall be painted with two coats of red oxide zinc chromate primer after proper surface preparation and two finishing coats of synthetic enamel paint of approved make or as specified in BOQ. Cable trays shall have side rails or equivalent structural members.

Cable trays shall be mounted on support structure as specified by means of specified size of threaded rods and suitable fasteners. Spacing of the support structure shall be such that the cable trays shall remain perfectly horizontal/ vertical without buckling when fully loaded with cable runs. The support structure shall be suspended from ceiling slab or grouted to walls in an approved manner. Width of the horizontal arms of the support structure shall be same as the tray width plus length required for threading /bolting /welding to the vertical supports. The length of vertical supporting members for horizontal tray runs shall be to suit the number of tray tiers required. Trays shall be erected properly to present a neat and clean appearance. Trays shall be installed as a complete system. Cable trays shall be erected so as to be exposed and accessible. Cables shall be fixed to the tray by cable tie. The cables shall be dressed properly so as to provide minimum one cable diameter clearance between adjacent cables and from tray ends. Cable trays shall be earthed by 2 runs of 25 mm x 3 mm GI strips through out their lengths.

2.1.10 Routing of cables

Before cable laying work is undertaken, the route of the cables shall be decided with the Project Manager. While shortest practicable route shall be preferred.

2.1.11 Cable Identification Tags

Wherever more than one cable is laid/run side by side, marker tags as approved by the Project Manager, inscribed with cable identification details shall be permanently attached to all the cables.

2.1.12 TERMINATION/JOINTING OF CABLES

Soldered jointing/termination shall be totally avoided. Solder less terminations by using Dowel crimping tools and suitable legs shall be adopted for all cable terminations. Any terminations may without use of proper crimping tool is shall be liable to be rejected. In the case of aluminium conductors, it is to be ensured that the conductor oxidation is cleaned by means of emery paper and then a thin coat of tin is applied before pinching into any equipment. Heat shrinkable Raychem type or approved equivalent terminations shall be provided for High Voltage cables and Siemens make or approved equivalent make brass double compression glands shall be provided for Medium Voltage cable terminations. Straight through jointing of Medium Voltage or High Voltage cable shall normally be totally avoided. If absolutely unavoidable, such jointing shall be carried out as per procedure to be got specifically approved from Project Manager and without cost.

2.1.13 MEASUREMENT OF CABLE

The cable runs shall be measured upto the outer end of the boxes without any allowances for over lap in joints. The rate shall include all the above mentioned material, labour etc for laying as required.

2.1.14 BONDING OF CABLES.

Where a cable enters any piece of apparatus it shall be connected to the casting by means of an approved type of armoured clamp or gland. The clamps must grip the armouring firmly to the gland or casting, so that in the event of ground movement no undue stress is placed on to the cable conductors.

2.1.15 TESTING

- All cables before laying shall be tested with a 500 V megger for 1.1 kV grade or with a 2,500/5,000 V megger for cables of higher voltages. The cables cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armour and insulation resistance between conductors.
- All cables shall be subject to above mentioned test during laying, before covering the cables by protective covers and back filling and also before the jointing operations.
- After laying and jointing, the cable shall be subjected to a 15 minutes AC/DC pressure test. In the absence of facilities for pressure testing, it is sufficient to test for one minute with 1000 V megger for cables of 1.1 kV grade and with 2500/5000 V megger for cables of higher voltages.

2.2 SWITCHGEAR

2.2.1 Moulded Case Circuit Breakers

Moulded case circuit breakers (MCCB) or fuse free breakers, incorporated in switchboards wherever required, shall conform to IS 13947: 1993 in all respects. MCCBs shall be suitable either for single phase 240 Volts or 3 Phase 415 Volts AC 50 HZ supply.

MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip - free type. Operating handle shall have suitable ON, OFF and TRIPPED indicators. Three phase MCCBs shall have a common handle for simultaneous operation and tripping of all the three phases. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermal/magnetic type provided on each pole and connected by a common tripe bar

such that tripping of any one pole causes three poles to open simultaneously. Thermal/magnetic tripping device shall have IDMT characteristics for sustained over loads and short circuits.

Contact trips shall be made of suitable arc resistant sintered alloy. Terminals shall be of liberal design with adequate clearances.

MCCBs shall be provided with following accessories, if specified in drawings/schedule of quantities

- Under voltage trip
- Shunt trip
- Alarm switch
- Auxiliary switch

MCCBs shall be provided with following interlocking devices for interlocking the door a switch board.

- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent door being opened when the breaker is in ON position
- Deinterlocking device to open the door even if the breaker is in ON position.

MCCBs shall have rupturing capacity as specified in drawings/schedule of Quantities.

MCCBs shall be designed to prevent access to live parts when the cover is removed, means main current path of the circuit breaker should be isolated from auxiliary section i.e MCCB shall offer class– II front face.

2.2.2 Metering, Instrumentation And Protection.

Ratings, type and quantity of meters, instruments and protective devices shall be as per drawings and schedule of quantities.

Current Transformers

CTs shall conform to IS 2705 (part -I, II and III) in all respects. All CTs used for medium voltage application shall be rated for 1 kV. CTs shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be class 0.5 to 1 and for protection class 10. CTs shall be capable of withstanding magnetic and thermal stresses due to short circuit faults of 31 MVA on medium voltage. Terminals of CTs shall be paired permanently for easy identification of poles. CTs shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT shall be provided with rating plate indicating:

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated voltage
- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Measuring Instruments

Direct reading electrical instruments shall conform to IS 1248 or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 1.5 for ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -10o C and +50oC. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from outside. Direction of deflection shall be from left to right. Selector switches shall be provided for ammeters and volt meters used in three phase system.

Ammeters

Ammeters shall be of moving iron type. Moving part assembly shall be with jewel bearings. Jewel bearings shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. Ammeters shall be manufacture and calibrated as per IS 1248

Ammeters shall normally be suitable for 5 A secondary of current transformers.

Ammeters shall be capable of carrying substantial over loads during fault conditions.

Voltmeters

Voltmeters shall be moving iron type range of 3 phase 415 volt voltmeters shall be 0-500. Volt meters shall be provided with protection MCB.

Relays

Protection relays shall be provided with flag type indicators to indicate cause of tripping. Flag indicators shall remain in position till they are reset by hand reset. Relays shall be designed to make or break the normal circuit current with which they are associated. Relay contacts shall be of silver or platinum alloy and shall be designed to withstand repeated operation without damage. Relays shall be of draw out type to facilitate testing and maintenance. Draw out case shall be dust tight. Relays shall be capable of disconnecting faulty section of network without causing interruption to remaining sections. Analysis of setting shall be made considering relay errors, pickup and overshoot errors and shall be submitted to Project Manager for approval.

Over current relays

Over current relays shall be induction type with inverse definite minimum time lag characteristics. Relays shall be provided with adjustable current and time settings. Setting for current shall be 50 to 200 % insteps of 25%. The IDMT relay shall have time lag (delay) of 0 to 3 seconds. The time setting multiplier shall be adjustable from 0.1 to unity. Over current relays shall be fitted with suitable tripping device with trip coil being suitable for operation on 5 Amps.

Earth fault relay

Same as over current relay excepting the current setting shall be 10% to 40% in steps of 10%.

2.3 EARTHING

2.3.1 GENERAL

All the non-current carrying metal parts of electrical installation shall be earthed properly. All Motors, Motor control centre, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing shall be in conformity with Indian Electricity Rules.

The Earthing System shall in totally comprise the following:-

- a) Earth Resistivity Test
- b) Earth Electrodes
- c) Earthing Leads
- d) Earth Conductors

All three phase equipment shall have two separate and distinct body earths and single phase equipment shall have a single body earth.

2.3.2 EARTHING MATERIAL

Materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall be as specified in the schedule of quantities and shall comply to the following requirements:

- Copper - When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 98% conductivity when annealed, conforming to Indian standard specifications.
- Galvanised Steel - Galvanised steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in IS 2309:1969.
- The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

2.3.3 EARTH ELECTRODES

- **Plate Earth Electrode**

The plate electrodes shall be of copper/ GI as called for in the schedule of quantities. The minimum dimensions of the electrodes shall be 600 mm x 600 mm. Thickness of copper electrodes shall not be less than 3 mm and of GI electrodes not less than 6 mm.

The electrode shall be buried in ground with its face vertical and top not less than 4 meters below ground level.

- **Earth Electrode Pit**

Method of Installing Watering Arrangement

In the case of plate earth electrode, a watering pipe of 20 mm dia of medium class G.I. Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300 mm. A cast iron/M.S. frame with cover having locking arrangement shall be suitably embedded in the masonry enclosure. A suitable test link shall be provided in the earth chamber.

Location of Earth Electrode

The following guidelines shall be followed for locating the earth electrodes

An earth electrode shall not be situated less than 3 metres from any building.

The excavations for electrode shall not affect the column footings or foundations of the buildings. In such cases electrode may be further away from the building.

The location of the earth electrode shall be such where the soil has reasonable chance of remaining moist, as far as possible.

Entrances, pavements and road ways shall not be used for locating the earth Electrode.

Number of Earth Electrodes

In all cases the relevant provision of rule 33, 61 & 67 of the Indian Electricity Rules 1956 as amended shall be complied with.

Metallic covers or supports of all medium apparatus or conductors shall, in all cases be connected to not less than two separate and distinct earth electrodes.

2.3.4 EARTHING LEADS

The strip earthing leads shall be connected to the Earth Electrode at one end and to the metallic body of the main equipment at the other end. The earthing lead shall connect to the earthing network in the installation.

- **Earthing Lead Sizes**
Strip earthing leads shall be of copper/GI and as per BOQ.
- **Earthing Lead Installation**
The length of buried strip earthing lead shall be not less than 15 metres and shall be buried in trench not less than 0.5 m deep.

If conditions necessitates use of more than one earthing lead they shall be laid as widely distributed as possible preferably in a single straight trench or in a number of trenches radiating from one point.

2.3.5 EARTHING CONDUCTORS

Earthing conductors shall form the earthing network throughout the installation for earthing of all non- carrying metal parts.

- **Connection Of Earthing Conductors**
 - Main earthing conductors shall be taken from the earth connections at the MCC to all other Motors in the network.

- **Earthing Conductor Installation**

The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size.

Joints shall be riveted and brazed in approved manner.

Sweated lugs of adequate capacity and size shall be used for termination. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned.

- **Sizing Of Earthing Conductors**

All fixtures, outlet boxes and junction boxes shall be earthed with bare copper wires as specified.

All 3 phase switches and distribution boards up to 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper/6 mm dia GI wires. All 3 phase switches and distribution boards up to 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper/8 mm dia GI wires. All switches, bus bar, ducts and distribution boards of rating 200 amps and above shall be earthed with a minimum of 2 Nos. separate and independent 25 mm x 3 mm copper/25mm x 6 mm GI tape.

2.3.6 PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system.

2.3.7 RESISTANCE TO EARTH

No earth electrode shall have a greater ohmic resistance than 3 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be upto 5 ohms. The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate circuit breakers, and shall not exceed 1 ohm.

2.4 CONTROL PANELS / STARTERS

2.4.1 Switch board cubicles of approved type shall be fabricated from 16-gauge M.S. sheet with dust and vermin proof construction. It shall be painted with powder-coated finish of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the followings: - (Switch gear as given in the bill of quantities).

- a) Incoming main isolation MCCB of required capacity.
- b) Fully Aluminium taped Bus Bar of required capacity.
- c) Isolation MCB/ MCCB for each motor.
- d) Fully automatic as specified D.O.L/Star Delta starters suitable for motor H.P. with push buttons one for each motor and on/off indicating neon lamps. (DOL upto 7.5 HP and Star Delta from more than 7.5 H.P)
- e) Single phase preventer of appropriate rating for each motor.
- f) Panel type ampere meters one for each motor with selector switch.
- g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase-to-phase.

- h) Neon phase indicating lamps for incoming main and on/off indicating lamps for each motor.
- i) Rotary switch for manual or auto operation for each pump (manual/auto off).
- j) Fully taped separate aluminium bus bars of required capacity and with required outlets.
- k) Space for liquid level controllers as specified + 1 extra space.
- l) The panel shall be pre-wired with colour-coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switchboard panel.
- m) Provision of main incoming cables from the top of the panel.

2.4.2 All switch gears and accessories shall be of approved make specified in list of approved make.

2.4.3 Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers. All floor-mounted switchboard shall rest on minimum 225mm high platform. The contractor shall provide the shop drawings for base and panels.