



6.20.7 DETAILED TECHNICAL SPECIFICATIONS (DTS) FOR MECHANICAL WORKS (GENERAL)

Applicability

The following clauses specify general mechanical requirements and standards of workmanship for equipment and installation and must be read in conjunction with the particular requirements for Contract. These general specification clauses shall apply where appropriate except where redefined in the particular required sections of the specification which shall be applicable.

List of Standards

Title of various standards referred to in the specifications is indicated below. This list does not necessarily cover all the standards referred to:

BS 5135	Specification for are welding of carbon manganese steels
BS 5316 Part-2	Specification for acceptance test for centrifugal, mixed flow and axial pumps – Test for performance and efficiency
BS 6072	Method for magnetic particle flow detection
BS 6405	Specification for non-calibrated short link steel chain (Grade 30) for general engineering purposes : Class 1 & 2
BS 6443	Method for penetrate flow detection
ASTM A-36	Specification for Structural Steel
ASTM A-216	Specification for Steel Castings, Carbon suitable for fusion welding for high temperature service
ASTM A-276	Specification or stainless steel and heat resisting steel bars and shapes
ASTM A-351	Specification for castings, Austenitic – Ferric (Duplex), for Pressure containing parts
ASTM A-743	Specification for castings, Iron – Chromium, Iron – Chromium – Nickel and Nickel Base Corrosion Resistant for general Application
ASTM A-744	Specification for castings, Iron Chromium – Nickel, Corrosion – Resistant
IEC – 189 Part 1 & 2	Low frequency cables and wires with PVC insulation and PVC Sheath
AWWA C 501	Cast Iron Sluice Gates
IS 5	Colours for ready mixed paints and enamels
IS 210	Grey Iron Castings
IS 318	Leaded Tin Bronze Ingots and Castings
IS 325	Three Phase Induction Motors
IS 807	Code of Practice for Design, manufacture, erection and testing (Structural Portion) of cranes and hoists
IS 1239	Mild Steel tubes, tubular and other wrought steel fittings
IS 1536	Centrifugally Cast (Spun) iron pressure pipe for water gas and sewage



IS 1537	Vertically cast iron pressure pipes for water, gas and sewage
IS 1538	Specification for cast iron fittings for pressure pipes for water, gas and sewage
IS 1554	PVC insulated (Heavy duty) electric cables
IS 2062	Steel for general structural purposes
IS 2147	Degrees of protection provided by enclosures for low voltage switch gear and control gear
IS 3177	Code of practice of electric overhead traveling cranes and gantry cranes other than steel work cranes
IS 3624	Vacuum and Pressure gauges
IS 3815	Point hooks with shank for general engineering purposes
BS 2910	Methods for radiographic examination of fusion welded circumferential butt joints in steel pipes
BS 3017	Specification for mild steel forged ram shorn hooks
BS 3100	Specification for steel castings for general engineering purposes
BS 3923	Methods for ultrasonic examination of welds
BS 4360	Specification for weldable structural steels
BS 4772	Specification for ductile iron pipes and fittings
BS 4870	Specification for approval testing of welding procedures
BS 4871	Specification for approval the sting of welders working to approved welding procedures
BS 4942	Short chain link for lifting purposes
IS 5120	Technical requirements of roto dynamic special purpose pumps
IS 5600	Horizontal / vertical non clog type centrifugal pump for sludge handling
IS 7090	Guide lines for rapid mixing devices
IS 7208	Guide lines for flocculator devices
IS 10261	Requirements for clarifier equipment for waste water treatment
IS 8413	Requirements for biological treatment and equipment
Part-II	Activated sludge process and its modifications
IS 10037	Requirements for sludge dewatering equipment, sludge
Part-I	Drying beds, sand, gravel and under drains
IS 6280	Specification for Sewage Screens
IS 3938	Electric Wire rope hoists

Further, following codes and standards unless specified herein shall be referred to for pipe lines, pipe work & fittings:

IS: 210	Specification for grey iron casting
IS:290	Specification for coal tar black paint
IS:456	Code of practice for plain and reinforced concrete
IS :458	Specification for pre cast concrete pipes (with and without reinforcement)
IS :516	Method of test for strength of concrete
IS :638	Specification for sheet rubber jointing and rubber insertion jointing
IS :783	Code of practice for laying of concrete pipes
IS :816	Code of practice for use of metal arc welding for general construction in mild steel



IS :1367	Technical supply conditions for threaded steel fasteners
IS :1387	General requirements for the supply of metallurgical materials
IS :1500	Method for Brinnell hardness test for metallic materials
IS :1536	Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage
IS :1537	Specification for vertically cast iron pressure pipes for water, gas and sewage
IS :1538	Specification for cast iron fittings for pressure pipes for water, gas and sewage
IS :1916	Specification for steel cylinder pipes with concrete lining and coating
IS :2078	Method for tensile testing of grey cast iron
IS:3589	Specification for MS Spirally Welded Pipes
IS :3597	Method of tests for concrete pipes
IS :3658	Code of practice for liquid penetrant flow detection
IS :5382	Specification for rubber sealing rings for gas mains, water mains and sewers
IS :5504	Specification for spiral welded pipes
IS :6587	Specification for spun hemp yarn
IS :7322	Specification for specials for steel cylinder reinforced concrete pipes
IS:8329	Specification for DI pipes
IS:9523	Specifications for DI fittings
IS:4984	Specifications for HDPE pipeline
IS:14846	Specifications for valves
IS :783	Code of practice for laying of concrete pipes
IS :3114	Code of practice for laying of cast iron pipes
IS :3764	Excavation work - Code of Safety
IS :4127	Code of practice for laying of glazed stoneware pipes
IS :5822	Code of practice for laying of electrically welded steel pipes for water supply.
IS :6530	Code of practice for laying of asbestos cement pressure pipes.

Materials

All materials incorporated in the works shall be the **most suitable for the duty concerned and shall be new and of first class commercial quality, free from imperfection and selected for long life and minimum maintenance.**

Design and Construction

- a. The plant design, workmanship and general finish shall be of sound quality in accordance with good engineering practice. Design shall be robust and rated for continuous service, at the specified duties, under the prevailing operational site conditions.
- b. The general design of mechanical and electrical plant, particularly that of wearing parts, shall be governed by the need for long periods of service without frequent attention but shall afford ready access for any necessary maintenance.



- c. Similarly items of Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same material specification as the originals.
- d. No welding, filling or plugging of defective work will be permitted without the written permission of the Engineer. All welding spatter shall be removed.
- e. It shall be the responsibility of the contractor to ensure that all the equipment selected is fully compatible, mechanically, electrically and also with respect to instrumentation, control and automation.
- f. It shall be the responsibility of the contractor to ensure his equipment interfaces with any existing equipment correctly. Any interfaces must not affect the integrity of the equipment, or invalidate any warranties or guarantees.
- g. Each component or assembly shall have been proven in service in a similar application and under conditions no less than those specified therein.
- h. The equipment shall be compatible with the civil structure, when installed, with sufficient space for operator access and maintenance procedures.
- i. All materials shall be of the best commercial quality and free from any flaws, defects or imperfections.
- j. Materials shall be selected to eradicate or reduce corrosion to a minimum.

Tropicalization:

Equipment is to be designed for tropical climate suitable for Indian conditions and the city / location where it is to be installed and the following shall apply:

- i. Tropical grade materials should be used wherever possible. Some relaxation of these provisions may be permitted where equipment is hermetically sealed.
- ii. Iron and steel and in general to be painted or galvanized as appropriate in accordance with the specification. Small iron and steel parts (other than stainless steel) of all instruments and electrical equipment, the cores of electro-magnets and the metal parts of relays and mechanisms are to be treated in an approved manner to prevent rusting. Cores etc. which are built up of lamination or can not for any other reasons be anti rust treated, are to have all exposed parts thoroughly cleaned and heavily enameled, lacquered or compounded.
- iii. The use of iron and steel is to be avoided in instruments and electrical relays whenever possible. Steel screws, when used, are to be zinc, cadmium or chromium plated or, when plating is not possible owing to tolerance limitations, shall be corrosion resisting steel. Instruments screws (except those forming part of a magnetic circuit) are to be of brass or bronze. Springs are to be of brass, bronze or other non-rusting material. Pivots and other parts for which non-ferrous material is unsuitable are to be of an approved stainless steel.



- iv. Fabrics, cork, paper and similar materials, which are not subsequently to be treated by impregnation, are to be adequately treated with an approved fungicide. Sleeving and fabrics treated with linseed oil or linseed oil varnishes are not to be used.

Climate

- i. All part and materials used shall in all respects be suitable for the climatic conditions of the city/location where it is to be installed. The following maximum conditions shall be used for all design.

Maximum Ambient Temperature	:	47° C
Minimum Ambient Temperature	:	5° C
Yearly Average Ambient Temperature (Max. / Min.)	:	43° C/15° C
Maximum Ambient Temperature for Design Purpose	:	45 ° C
Maximum Relative humidity	:	100 %

In damp situations and wherever exposed to the weather, precaution shall be taken against corrosion of metal work, cable armour conduit and the like.

De-rating due to the climatic conditions

- i. All electrical equipment including cables shall be de-rated for continuous operation in an ambient temperature of 45 deg C in accordance with the appropriate regulations unless otherwise specified.
- ii. All materials and equipment which are subject to certification by testing authorities etc., shall be certified as being tested at 45 deg C ambient unless other higher temperature specified elsewhere for specific equipment/product.

Packing and Delivery

- a. All part and equipment as necessary shall be packed in first quality containers or packing; no second hand timber shall be used. All packing must be suitable for several stages of handling via sea or air freight, inland transport and movement on site.
- b. Flanged pipes are to have their open ends protected by adhesive tape or jointing and are then to be covered with a wooden blank flange secured by service bolts.
- c. The sleeves and flanges of flexible couplings shall be bundled by wire ties. Cases containing rubber rings, bolts and other small items shall not normally weigh more than 500 Kg. gross.
- d. Precaution is to be taken to protect shafts and journals where they rest on wooden or other supports likely to contain moisture. At such points wrappings impregnated with anti-rust composition or vapour phase inhibitors are to be used of sufficient strength to resist changing and indentation due to movement which is likely to occur in transit. **The form of the protective wrappings and impregnation are to be suitable for a minimum period of twelve months.**
- e. Lids and internal cross battens of all **packing cases are to be fixed by screws and not nails.**

Hoop metal bindings of cases are to be sealed where ends meet and if not of rust less material are to be painted. Contents of cases are to be bolted securely or fastened in



position with struts or cross battens and not with wood chocks, unless they are fastened firmly in place. All struts or cross battens are preferably to be supported by cleats fixed to the case above and below to form ledges of which the batten may rest. Cases are to be up-ended after packing to prove that there is no movement of contents.

Where parts are required to be bolted to the sides of the case, large washers are to be used to distribute the pressure and the timber is to be strengthened by means of a pad.

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Where parts are required to be bolted to the sides of the case, large washers are to be used to distribute the pressure and the timber is to be strengthened by means of a pad.

All stencil marks on the outside of the casings are to be either of a water proof material or protected by Shellac or varnish to prevent obliteration in transit.

- f. Wood wool is to be avoided as far as possible. Waterproof paper and felt linings are to overlap at seams at least 12 mm and the seams secured together in an approved manner, but the enclosure is to be provided with screened openings to obtain ventilation.
- g. Where applicable, indoor items such as electric motors, winch and control gear, instruments and panels, machines components, etc. are to be 'cocooned' or covered in polythene sheeting, selected at the joints and the enclosures provided internally with an approved desiccators.
- h. Bright metal parts are to be covered before shipment with an approved protective compound or coating and protected adequately during transport to site. After erection these parts are to be cleaned by the Contractor.
- i. Each crate or package is to contain a packing list in a waterproof envelope and copies in duplicate are to be forward to the Engineer; prior to dispatch. All items of material are to be clearly marked for ready identification against the packing list.

All cases, packages, etc. are to be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and to indicate the correct positions for slings and are to bear an indelible identification mark relating them to the appropriate shipping documents.

- j. Structural steel work, pipes, valves, encased fittings and metal work shall be similarly marked. In addition, one in every ten repeated articles shall bear the dispatch marks in suitable paint or other approved medium. When in the opinion of the Engineer, the dispatch marks can not be applied satisfactorily to any item, they shall be stamped on a petal label attached to the item they shall be stamped on a metal label attached to the



item or part by means of a piece of wire passing through holes at either end of the label and secured so that it lies flat with the item.

- k. The Engineer may require to inspect and approve the packing before the items are dispatched but the **contractor is to be entirely responsible for ensuring that the packing is suitable for transit and such inspection will not relieve the Contractor for any loss or damage due to faulty packing.**

Finish

Workmanship and general finish shall be of first class commercial quality and in accordance with best practice. All covers, flanges and joints shall be properly faced, bored, fitted, fixed, hollowed, mounted or chamfered as the case may be, according to the best approved practice and all working parts of the plant and other apparatus, shall similarly be well and accurately fitted, finished, fixed and adjusted.

Wrought Steels

Where not otherwise specified wrought steel shall be selected from the appropriate grade of IS : 1570 and be free from blemishes, short or hammer marks.

The Contractor shall submit for the approval of the Engineer-in-charge, the grade number selected for each component.

Castings

All casting shall have an homogenous structure and be free from blow holes, flaws and cracks. Any casting having a thickness in parts in excess of 3 mm to that which it is purported to be shall be rejected. No repairs or patchwork to castings shall be allowed other than that approved by the Engineer-in-charge.

Castings subject to hydraulic pressure shall be tested to 1.5 times the maximum working pressure. Certified copies of Test Reports shall be forwarded to the Engineer as soon as the test is completed.

Steel Castings

Where not otherwise specified, steel castings shall be selected from the appropriate grade of BS. 3100.

Grey Iron Castings

All grey iron castings supplied shall be to the appropriate grade of IS:210. The Contractor shall replace any casting which the Engineer considers is not of first class appearance or is not in any way the best which can be produced, although such a casting may have passed the necessary hydraulic or other tests. No plugging, filling, welding or “burning on” will be acceptable.

Spheroidal Graphite Iron Castings

All spheroidal graphite or modular graphite iron shall be to the appropriate grade of BS-2789.



Bronze

Where not otherwise specified, the bronze used shall be made of a strong and durable zinc free mixture to IS : 318.

Aluminum and Aluminum Alloys

Bars and extruded sections shall be to designation EN 8 or BS. 1474. Aluminum and aluminum alloys shall not be utilized unless alternative materials are considered unacceptable. The use of aluminum requires the approval of the Engineer in all cases.

Aluminum and Aluminum alloy Castings

Castings shall be manufactured from LM5 to BS 1490 and subjected to a chill cast to increase tensile strength. Aluminum and aluminum alloys shall not be utilized unless no other materials is considered suitable. Immersed structures or structures that are periodically immersed shall not be constructed from aluminum or aluminum alloys.

Painting and Metal Protection

All bright metal parts shall be covered before shipment with an approved protective compound and adequately protected during shipment to site. **After erection these parts are to be cleaned.**

All exposed metal parts of the equipment including piping, structures, etc. wherever applicable, after installation unless otherwise surface protected shall be first painted with at least one coat of suitable Zinc rich epoxy primer which matches the shop primer paint used, after thoroughly cleaning all such parts of all dirt, rust, scales, greases, oils and other foreign materials by wire brushing, scraping or sand blasting and the same being inspected and approved by the Engineer for painting. After wards, the above parts shall be finished with two coats of epoxy / coal tar epoxy coating / paint. The quality of the finish paint shall be as per the standards of ISI or equivalent and to be of the colour as approved by the Engineer. The paint shall be suitable for use in industrial corrosive works atmosphere.

All bright metal parts shall be covered before shipment and transportation with approved protective compound and protected adequately during shipment and transportation to the site. After erection, these parts are to be cleaned.

All pipe services wherever applicable are to be painted in accordance with the Owner's standard colour code scheme, by the Contractor.

MS/GI Hand Rails shall be painted with synthetic enamel paint of shade approved by engineer-in charge.

Chromium Plating

All chromium plating shall comply with IS: 1986.



Galvanizing

Where steel or wrought iron is to be galvanized, 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 galvanizing.

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 galvanized. The surface of the steel work to be galvanized 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 grams per square meter of surface galvanized, except in the case of tubes to BS : 1387 when it shall be 460 grams per square meter.

On removal from the galvanizing bath the resultant coating shall be continuous, adherent, as smooth and evenly distributed as possible, and free from gross imperfections such as bare spots, lumps, blisters and inclusions of flux ash or dross, etc. and free from any defect that is detrimental to the stated end use of the coated article. Edges shall be clean and surfaces bright.

Bolts nuts and washers shall be hot dip galvanized and subsequently centrifuged in accordance with IS : 2669. Nuts shall be tapped up to 0.4 mm oversize before galvanizing 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. In order to avoid wet storage staining on Galvanized work, which is to be stored in works or at site, shall be stacked so as to provide adequate ventilation to all surfaces.

Small areas of the galvanized 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 deg C.

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

Fasteners

Bolts, nuts and studs and fasteners with nominal diameters up to and 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 fasteners for use on concrete structures shall be of an approved type 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.

Forgings

Carbon steel forgings shall be manufactured heat treated forgings and tested in accordance with BS: 29.

Foundation and Settings of Machinery

The Contractor shall arrange for the provision of all foundation and plinths required for the plant and shall be responsible and setting for ensuring that all foundations and plinths are constructed and boxed out for Machinery holding down bolts in accordance with the approved drawings.

The Contractor shall provide all necessary templates for suspension of the holding – down bolts during grouting of same.

The Contractor shall visit the site during the course of construction and check the Civil Works to ensure that the foundation and / or plinths are at correct required location and height, for the acceptance of the machinery. When the foundations and /or plinths have been complete and are in a satisfactory condition, the machinery shall be installed as directed by the Engineer's Representative.

The machinery shall be mounted on flat steel packing of a thickness selected to take up variations in the level of the correct foundations. The packing shall be bedded by chipping or grinding of the concrete surface.

Only one packing of selected thickness shall be used at each location, which shall be adjacent to each holding down bolt. The number of shims shall not exceed two at each location and the thickness of each shim shall not exceed 3 mm.

The machinery shall be alighted, leveled and pulled down by the nuts of the holding down bolts with a spanner of normal length, and no grout shall be applied until the machinery has been run and approved by the Engineer for stability and vibration. The Civil Contractor shall then carry out the grouting and building in of the machinery. However, the Contractor shall



take responsibility for the satisfactory nature of this work, and shall have a representative present.

Built In Items

The Contractor shall include in the relevant Schedule of the Specification, details of all the items of equipment to be “Built in” by the Civil Contractor, together items with details of the period in which these items could be delivered to site.

The Contractor shall provide to the Civil Contractor full details of the box outs and plant fixing and foundation requirements for incorporating in the Civil Work. The Contractor shall liaise closely with the Civil Work and shall obtain from him a program of the Civil works, clearly showing the dates when box-out and plant foundation details will be required. The Contractor will be responsible for co-coordinating and program his work schedule with the Civil Work so as to ensure an optimum arrangement with the minimum of disturbance to the progress of the Works as a whole. The Contractor shall deliver all items of equipment that are required to be built in the civil works, as required by the construction program and shall arrange for a representative from the equipment supplier to be in attendance during the progress of such works. The Civil Contractor shall grout up and make good when instructed by the Engineer’s Representative.

Location and Alignment

Where individual items of equipment and mechanically located and coupled, such as alignment motors, gearboxes and similar items depended upon correct alignment for satisfactory operation, each shall be mounted on a common bed plate and when alighted shall be located by means of dowels to ensure that correct re-alignment can be easily achieved when re-assembling the items after removal for overhauls.

Coupling

Flexible couplings shall be Couplings rated at not less than the stalling torque load of the motor. Couplings liable to impregnation by oil shall be of the all metal flexible type.

General Service coupling shall be of the flexible multi-pin and resilient bush type, having not less than six bushes and each bush shall have an inner sleeve to allow rotation on the pin (bushes shall not be in direct contact with the pin). All pins shall have shoulders to allow positive location and securing to the half coupling face.

Flexible couplings shall be supplied in matching balanced sets machined, balanced and marked before leaving manufacturer’s works. The couplings shall be a tight fit on the shafts and secured with hand fitted keys and fully checked for alignment shall be a tight fit on the shafts and secured the hand fitted keys and fully checked for alignment. All necessary equipment for checking alignment shall be supplied by the Contractor.

Where flexible coupling are used, the Contractor shall fully describe the arrangements proposed for ensuring that the desired freedom of relative movement between the shafts is obtained when transmitting a torques corresponding to the continuous maximum rating of the motor.



Solidly bolted couplings shall be subject to accurate alignment and the Contractor's proposed alignment procedure shall be subject to the approval of the Engineer. In particular, the alignment procedures which involve rotating one half coupling only will not be accepted.

Overload release couplings shall not rely on shear pins. Release torque shall be adjustable over a wide range and preferably without the need to change components. The coupling shall be capable of angular alignment of 1 deg. Maximum and 1 mm displacement of shafts.

Hydraulic couplings shall be oil filled with thermal overload protection device. The coupling shall be fully rated to transmit the motor full load power without exceeding normal working temperature and due regard shall be taken to ambient temperatures. An enclosure around the coupling shall be provided to prevent oil spray in the event of operation of the thermal overload device.

Final alignment of all types of coupling shall be checked by the Contractor in the presence of the Engineer's Representative.

Bearings and Lubricators

The size of bearing shall be not less than that calculated for bearings and a minimum L10 basic rating life in accordance with BS:5512 Lubricators Part 1., taking into account all considerations of reliability materials of manufacture and operating conditions. All bearings shall be rated and sized to ensure satisfactory running without vibration under all conditions of operation for a minimum life of 50,000 hours running.

They shall be efficiently lubricated and adequately protected from ingress of moisture, dust and sand and the particular climatic condition prevalent at the site. All bearings shall be to ISO standard SI unit dimensions where practicable.

All ball or roller bearings, except those supplied and "sealed for life" shall be arranged for grease gun lubrication and a suitable high pressure grease gun shall be supplied.

Adequate "Stauffer" screw top pressure grease lubricator with 'tell tale' stems or 'Tat' grease nipples shall be provided for all moving parts. The position of all greasing and oiling points shall be arranged so as to be readily accessible for routine servicing. Wherever necessary, suitable access platform shall be provided.

The type of lubricant and intervals of lubrication, which shall be kept to a minimum (not less than nine days), for each individual item of plant shall be entered on a working schedule, which shall form part of the Operation and Maintenance instructions.

A list of recommended Lubricants and their equivalents Bearings shall be entered in the Operation and Maintenance instructions.

Gearboxes

The Gearboxes shall be totally enclosed dust, water and hose proof. Suitable lifting lugs shall be provided. They shall be robustly constructed and arduous duty.



The gear case shall be manufactured from grey cast iron to IS: 210 and of a grade to ensure high strength and wear resistance. Inspection covers shall be provided together with protected oil level indication , breather, with oil mist prevented, and drain plugs.

The gearboxes shall be designed for operation at the ambient temperatures specified without the assistance of a cooling fan.

The mechanical service factor shall be not less than 1.5 when applied to the rated motor power or higher as recommended by equipment manufacturer.

The gears shall be manufactured from steel to BS: 970 of grade selected by the Contractor and entered in the Schedule of Particulars. The teeth shall be profile ground and lapped to a high standard of accuracy and finish.

Rolling bearings shall be adequately rated to ensure a running life of not less than 50,000 hrs. L10 life.

The input and output shafts shall have oil seals fitted to prevent the ingress of lubricant when the gearbox is mounted in the required orientation. For example, inclined when applied to screw pump installations.

The seals shall also prevent the ingress of dust, sand and moisture.

Lubrication of the gears shall be by a splash or forced system.

An anti-run back device shall be supplied and fitted to all gearboxes involved in screw pump installation.

Each gear unit shall be subjected to a full load test at the inclinations specified for duration of 3.00 hrs during which time temperature, vibration and noise levels together with oil tightness shall be recorded in the presence of the Engineers Representative.

After satisfactory completion of the tests, each unit shall be drained of lubricant. All internal surfaces shall then be coated with suitable preservative.

A metal label shall be securely wired to the gear case to clearly state that the gear case requires to be coated with a suitable preservative.

The gear box shall be securely wired to the gear case to clearly state that the gear case requires to be filled with lubricant, the type and grade of which shall be clearly identifiable.

A metal label shall be securely wired to the gear case to clearly state that the gear case requires to be filled with lubricant, the type and grade of which shall be clearly identifiable.



Steelwork General

The Contractor shall provide and fix all the steel work, including stairways, ladders, hand railing, chequered plate and open mesh flooring frames and curbing as detailed in the specification and / or as shown on the contract drawings or as directed by engineer.

All steel work shall be constructed in mild steel and shall be galvanized after manufacture or shall be provided with finish as specified in the specifications of specific equipment / work.

For all pre-fabricated metal work, including multiple duct covers, external ladders, open mesh flooring, chequered plating, hand railing, staircase, structural steel work and the like, the Contractor shall submit fabrication drawings for the approval of the Engineer prior to the manufacture of any of these items.

Hand railing and Safety Chains

Hand railing

Hand railing shall be of M.S. ERW Medium Class mild steel of circular hollow section and shall comply with the relevant requirements of BS : 1387 BS : 6323 Part I or BS : 4360. Mild Steel toe boards shall be provided, 100 mm high by 3 mm thick positioned above the platform level and fixed securely to the standards. All items shall be painted with epoxy paint & epoxy primer.

Standards shall not be less than 38 mm external diameter and rails shall not be less than 32 mm external diameter.

Horizontal handrails shall be 1000 mm high with an intermediate rail at mid height. Handrail height shall be measured vertically from finished floor level to the hand rail centerline.

Handling and fixings shall be designed to withstand a horizontal force of 740 N/m run without permanent distortion or failure of components. When a horizontal force of 360 N/m is applied at handrail level the deflection at any point on the handrail shall not exceed 1/125 of the distance between the center lines of adjacent standards or 10 mm. whichever is the least.

All mounting flanges shall be of substantial construction, with horizontal flanges drilled for not less than three bolts with two bolts on a line parallel to and on the walkway side of the line of the hand railing and vertical flanges drilled for less than two bolts and line through the bolts being vertical. Fittings shall be screwed or secured with grub screws. The standards shall be set at not more than 1.5 m. centers. When provided in sections, hand railing shall be joined together with purpose made fittings secured by screws or grub screws.

All ladder, stairway or other openings shall be guarded on three sides by hand railing conforming to the requirements stated above.

The Contractor shall ensure that unless specified hereinafter to the contrary, all hand railing shall be of uniform appearance and manufacture.



Safety Chain

Mild Steel Safety Chain shall be 8 mm nominal size grade (M 4) non calibrated Chain Type 1, complying with BS : 4942, Part 2. After manufacture, mild steel safety chains shall be hot dipped galvanized in accordance with BS: 729.

Stainless Steel safety chains shall be manufactured from grade 316S31 steel complying with ISO: 570 Part 1. Chain links shall be welded and have an internal length not exceeding 45 mm and an internal width of between 12 mm and 18 mm. The fins caused by welding shall be removed and the weld shall be smoothly finished all round. When tested in accordance with Clause 7.3 of BS: 4972 Part 2, each chain shall stand a breaking force of 30 kN and a proof force of 15 kN.

Open Mesh and Chequer Plate Flooring

Open mesh flooring and gratings shall generally comply with BS : 4592 except where otherwise specified hereinafter. Such flooring and gratings shall be of rectangular mesh and non –slip and shall be mild steel galvanized.

Flooring shall be provided to span between the supporting members as shown on the Contract Drawings.

Where necessary intermediate support members shall be provided and fixed.

Mild Steel toe plates 100 mm high and not less than 3 mm thick shall be provided and fixed at all cut-outs except where otherwise shown on the approved drawings.

Both the load bearing and transverse bars in rectangular flooring panels shall be obtained systemically around the centre lines of the panels in both directions, so that when the panels are fixed in extensive areas or in long runs, the bars of all panels are in line.

Chequer plate flooring shall be MS and of the non-slip type, not less than 6 mm thick measured excluding the raised pattern. The flooring shall be secured to its frame by stainless steel countersunk set screws.

All flooring shall be designed to carry a loading of 750 Kg. per Sq. meter and the deflection shall not exceed 1/200 of the span or 10 mm whichever is the least.

All flooring shall be removable and set flush in mild steel MS frames. All frames shall be provided with lugs for building in.

Flooring shall be provided in sizes suitable for lifting and removal by one man and with the appropriate cutouts to permits its removal without disturbing or dismantling spindles, supporting brackets, cables or pipe work. Flooring spanning wide openings shall be supported on removable bearers and fixings to provide the required rigidity and these shall be supplied and fitted by the Contractor. These members shall be removable to afford clear access to the openings which includes ducts.



Lifting keys shall be supplied for each location and the type of key shall be such that inadvertent release is avoided.

Stairways

Stairways shall be detailed, fabricated and erected to the dimensions shown on the drawings and in accordance with BS : 449 Part 2 to carry a load of 750 Kg. Per sq. meter. Treads shall be rectangular open mesh fixed to the stringers, not directly to concrete. Sloping hand railing shall be as specified for horizontal hand railing but with the top rail 850 mm vertically above the line of pitch and standards vertical and spaced at not more than 1500 mm., measured parallel to the line of pitch.

Staircases shall be constructed to the size and position shown on the drawings or as instructed by the Engineer. They shall be steel galvanized at works after manufacture and shall comprise stringers supporting the open mesh stair treads and shall be supplied complete with handrails and stanchions conforming to the above except the height which shall be 900 mm above the pitch line.

Ladders

Ladders shall conform to BS: 4211 except where the specified here after. They shall be in mild steel as specified in. The stringers shall be flat section not less than 65 mm x 10 mm spaced 380 mm apart and shall be flanged and drilled for wall fixing at both ends. The stringers shall be radiuses over the top where they shall be not less than 600 mm apart. Ladders over 3.0 m long shall have additional intermediate stays at not more than 2.5 m centers.

Rungs shall be 20 mm diameter round bar at 250 mm c-c distance shouldered at each end and securely riveted into countersunk holes. Rungs shall be not less than 225 mm from the wall.

All ladders shall have safety cages which shall be constructed of three flat vertical strips supported by flat hoops, with a diameter of 750 mm. The hoops shall be at approximately 70 mm centers and the first hoop shall be 2400 mm. above ground or lower platform level.

Where the rise exceeds 6000 mm, an intermediate landing shall be provided.

Multiple Duct Covers and Frames

Multiple Duct Covers and Frames shall be of cast iron, water proof, non-rocking and recessed for filling with concrete or similar material.

They shall be of the type incorporating integral, removable, intermediate beams to given the required clear pit opening as shown on the approved drawings.

A heavy grease seal is to be formed between the cover and frame to prevent ingress of grit.



General Requirements for Pipe work

The Contractor shall supply, deliver and erect all pipe work and fittings within the structures and externally to the limits indicated on the approved drawings and in accordance with each section of specification.

Pipe work and fittings shall be suitable for a safe working pressure equivalent to the maximum working pressure of the system. The safe working pressure of the pumping mains shall be the closed valve head of the pump plus the maximum suction static head. The maximum surge pressure shall be limited to 125% of the maximum working pressure. All pipe work and fittings shall be of adequate strength to accommodate the maximum surge pressure of the system.

The minimum pressure rating of pipe work and fittings shall be 10 Bar, the exception being ductile iron pipe work and fitting which shall have a minimum pressure rating of 16 Bar.

There shall be a sufficient number of mechanical joints to enable mechanical plant and valves to be disconnected from built – in pipe work. Such joints shall be tied and shall not be allowed to sustain the weight of any pipe work.

All pipe work and fittings shall be sized for the required capacity at a velocity limits depending on the nature of the fluid or substance to be conveyed.

All pipe work shall be adequately supported by purpose made fixings. Support shall not be provided by plant or equipment.

The position of any thrust blocks required shall be indicated on the Contractor's details drawing together with the position of any sleeping required through partition walls in buildings. Puddle flanges shall be provided for building at locations in which pipes 80mm diameter and above pass through structural concrete below ground level.

Where pipe work is connected to plant and equipment readily demountable fittings in the form of unions or flanged adapters shall be provided. The flanged adapter on the delivery pipe of pumps shall be located upstream of the reflux valve where appropriate.

Flexible joints shall be provided in all pipe work subjected to linear constraint.

All jointing work including the provision of suitable full face gasket not be less than 5 mm thick for gravity flow and shall be minimum 3 mm thick for pressurised line and galvanized fastenings or fastening as specified shall be included.

Pump suction bell mouths shall be standard castings in either cast iron or ductile iron.

Unless otherwise specified, the pieces shall have a radial branch to enable a more streamlined flow from branch to body. Due allowance shall be made for reinforcement in the vicinity of the branch.



Prior to dispatch, each item of pipe work or associated fitting shall be clearly identified in paint with the Plant/Pumping station item number indicated on the Contractor's arrangement drawing.

Puddle flanges shall be provided on all pipes where they pass through pumping station walls. Each puddle flange shall be continuously welded to the pipe on both sides of the flange.

Pipe jointing surfaces and components shall be kept clean and free from extraneous matter until the joints have been made or assembled. Care shall be taken to ensure that there is no ingress of grout or other extraneous material into the joint annulus after the joint has been made.

The dimensions of gaskets shall comply with BS : 4865 Part I. Gaskets shall be manufactured from material complying with BS : 2494 for Type 1 rings.

Pump suction and delivery manifolds shall be provided with a drain valve where natural drainage does not occur.

Hydraulic testing shall not be carried out until all fabrication has been completed when the pressure applied and sustained without further pumping shall be twice the working pressure.

The Contractor shall be responsible for cleaning the internal surface of all pipes prior to erection particularly the removal of weld deposits. Initial capping of the ends for protection during transport and storage shall not be removed until erection takes place.

Grey Iron Pipe work and Fittings

Grey Iron flanged pipe work shall conform to BS: 4622 – not less than Class 3 with flanges to BS: 4504 Part 1 – table 16.

Spheroidal Graphite Cast Iron Pipe work and Fittings

All spheroidal graphite or modular graphite cast iron pipe work and fittings shall be to the appropriate grade of BS: 4772.

Carbon Steel Pipe work

Carbon Steel Pipe work for pressure purposes shall be to BS: 3601 and assemblies shall be manufactured from pipe to this specification. The type of pipe shall be hot finished seamless steel. The wall thickness shall be not less than that required in BS: 534 – Table – 1.

ABS Pipe work

ABS Pipe work shall be provided and installed for special purposes where hereinafter specified. The pipe work shall conform to BS : 5391 and the fittings to BS : 5392.



Fabrication of Carbon Steel pipe work and Fittings

The Contractor shall fabricate the pipeline by butt-welding without utilizing a backing ring in accordance with BS: 2971 – Class II metal arc welding of carbon steel pipe work. Branches shall be formed in accordance with BS. 2971 (Class I or Class II, depending on operating conditions) and shall be welded before so that at any point along the bend, ovality will not reduce the bore by more than 21%. Radii of hot bends for all pipes shall not be less than five times the outside diameter. Gusseted “Cut and Shut” and wrinkle. All pipe flanges shall be of the wrought steel slip on type conforming to BS 4504 PN 16, welded on in accordance with BS : 2971 (Class I or Class II, depending on operating conditions) No flanged joints shall be located with in a backfilled trench. Flexible joints shall be bolted gland or victaulic coupling as necessary.

Welder Qualification

Before welding work commences on pipe work, the Contractor shall satisfy the Engineer’s Representative that the welders have previously carried out similar welding work within recent months. When instructed by the Engineer’s Representative, the Contractor shall arrange for the welder to produce test welds in accordance with the provisions of BS 2971.

Pipe work Installation

All pipe work, pipe fittings, jointing materials etc., shall be of the best quality free from defects an obtained from a supplier approved by the Engineer. The installation of the pipe work shall be carried out using skilled personnel and pipe work shall be installed according to the drawing approved by the Engineer. Where valves are incorporated in pipe work , the valves shall be provided with their own supports, such that no excess loading is exerted on pipe work. All pipe work materials shall have no excess loading is exerted on pipe work. All pipe work materials shall be off-loaded, stored on site and handled thereafter in such a manner that they are adequately protected for damage or deterioration.

Underground Pipes

Unless otherwise state all underground pipes shall be buried in trenches which have been excavated in accordance with the relevant section of the specification.

Examining Pipes

Before being used, each pipe casting or fitting shall be properly examined and should appear defective in any way, it shall be set apart and not used until it has been examined and passed by the Engineer. All metal pipes which shall be buried in the ground shall, prior to their installation, be slung and sounded in an approved manner. Any pipe found to be faulty by this method, shall be set aside for examination by the Engineer.

Cutting Pipe work

All pipe work shall be cut with proper pipe cutting tools. The use of hammer and chisel for this purpose shall not be permitted. Great care shall be exercised when cutting concrete / bitumen lined spun iron and ductile iron pipes, to ensure that there is no damage to the lining. Should any damage to the lining take place which is to an extent which the Engineer deems to be undesirable, then the pipe shall be rejected. The Contractor shall then prepare another pipe for incorporation into the works. All pipes which have been cut shall have the edges dressed and deburred.



Labels

The Contractor shall arrange for the supply and fitting of engraved identification labels to all valves and items/equipment 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 (“Hindi 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 equipments offered shall be quiet in operation. The noise level within the building shall not be more than 85 dB (+5 percent on this over the audible frequency spectrum measured at mid-band), “A” scale when measured along a contour 3 meters from any single item of plant during starting, running and stopping. The noise level outside the building shall not be more than 60 dB (+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 plant 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.

Trolley and Chain Pulley Block

- a. The chain 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 from forged 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 steel conforming to IS: 2062. The side plate 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 weight of offered pump set / equipment is more than the craned capacity specified, the contractor shall offer the crane capacity 1.5 times higher than the weight of the pump set / equipment.

Pipe and fittings

- a. The cast iron pipes shall generally conform to class B IS: 1537 / IS1536/IS7181 and pipe fittings shall conform to IS : 1538. Ductile Iron pipes shall conform to IS 8329/BS: 4772.
- b. The material for cast iron pipes and fittings shall be of grey cast iron conforming to IS:210, Gr.FG260.
- c. The pipes shall be of uniform bore and straight in axis. Length of the straight double flanged pipes shall be within a tolerance as specified in IS standard.
- d. The flanges of the straight pipes shall be square to the axis of the pipe. The faces of the flanges shall be parallel. The bolt holes in one flange shall be located in line with those in order.
- e. The faces of the flanges of the fittings shall be square to the directional axes. The holes shall be located symmetrically off the centre line. The intersecting axes of the tees shall be perpendicular to each other.
- f. The bolt holes on flanged pipes and fittings shall be drilled with the help of drilling jig. The blank flanges are to be machined and drilled.
- g. The dismantling joints shall be of cast iron with EPDM seal ring.



Ventilation Systems

These specifications are common to all dry well / wet well effluent, sewage and water pumping stations. The scope of ventilation system includes

- a. Supply Air Fans
- b. Exhaust Fans
- c. Associated ducting

Wherever the drawings provided for ventilation system, indicate proposed ventilation fans and the routing of ducting. It is the responsibility of the contractor to study and analyse the adequacy of the system and suggest any improvement at the same time taking into consideration all the requirements of the public authorities including safety orders and Fire Protection Rules & Regulations and IS Code. The necessary permits shall be obtained by the contractor and all payments towards license inspections, etc. paid before starting the work.

Supply Air Fans

Air fans shall be of centrifugal type and fan housing shall be hot-rolled steel of thickness 3/8". End flanged shall be fixed to the casing by continuously welding over the entire circumference. The flanges shall have bolt holes for bolting to inlet bell, companion flanges or ducts as the case may be. Housing shall be continuously welded and shall be expanded by suitable mechanical means to insure concentricity. Motor support shall not be less than 3/9" thick steel plate. Support ring shall be continuously welded to the support plate.

Fan rotor and blades shall be made from cast aluminum with suitable corrosion resistant coating. Belt –driven fans shall have multi V belts on pulleys with suitable guards. V belts shall be 150% of rated HP duty.

The fan rotor shall be whirl-tested to 125% or operating speed and shall be statically and dynamically balanced on fan motor shaper to maximum tolerance in one (1) mil double amplitude at design operating speed.

The fans shall have inlet screen at inlet bell cone and carbon steel bolts for existing discharges cone with flanges on both ends attachment to fan and to discharge ducting.

Fan motor supports shall be of adequate strength, constructed from 1/4" carbon steel angles. All the external fasteners shall be stainless steel.

Motors

Motors selected for the fan shall be of adequate rating with a safety factor of 1.5 or greater. If the fans are belt-driven the motor shall be mounted on slide rails for belt tension and adjustment. The complete assembly shall be mounted on Neoprene Vibration Isolators. The motor shall conform to the relevant latest Indian Standards of British Standards. It shall have permanently lubricated ball bearings. The motor shall be suitable for 415B, 3 Phase, 50 Hz supply.

The bearing life shall not be less than 20,000 hours at design conditions and motor shall be of class 'F' insulation to allow for operation up to 95 rise over the ambient temperature of 45 C.



External copper grease leads for lubrication of motor bearings shall be provided by the manufacturer.

Fan motor shall be standard totally enclosed fan cooled (TEFC) foot mounted squirrel cage induction motor with single speed, single winding, continuous duty variable torque's.

A conduit box shall be mounted on the exterior of fan casing and lead wires from the motor conduit box shall be protected from the air stream by being encased in a tight metal conduit pipe.

The belt drives shall have stainless steel wire cage guards.

Supply air fans in dry well shall have air flow switches and pressure switches fitted in the ducting. The selection of these switches is left to the contractor to suit the fan units being supplied.

Exhaust Fans

Exhaust fans shall be of direct drive, impeller propeller type, having max. speed of 1000 rpm.

All the exposed parts shall be of aluminum, with transparent anodic, anti-salt spray coating, All external fasteners shall be of stainless steel. Hood shall be hinged for accessibility and servicing. Fans shall be complete with aluminum bird screens, Plastic or light weight aluminum back draft compels and electrical disconnecting means beneath the hood and protective grid guard below fan motor.

Motors shall be of relevant Indian Standards or British standards and shall have permanently lubricated ball bearings. The rating shall be adequate with service factor of 1.50 based on rated horsepower. All motor shall be TEFC and be suitable for continuous operation without exceeding a temperature rise of 50° C over ambient.

The motor shall be of constant speed and squirrel cage type, operating on 415 V, 3 phase, 50 Hz Supply. Roof mounted motors shall have electrical disconnects.

Contractor shall submit all catalogues showing the sizing and rating of fans with the size of openings to be provided for approval before proceeding with the work.

Dampers

All dampers shall be of louver type, robust construction, and tightly fitted suitable for the location and service required.

Dampers shall have suitable links, levers and quadrants as required for the proper operations, control or setting in any desired position. Dampers and these operating devices shall be made robust, easily operable and accessible through access doors in the ducts. Every damper shall have an indicating device clearly showing the damper position at all items.



Dampers shall be placed in ducts and every branch supply or return air duct connection whether or not indicated on the drawings for the proper volume control and balancing the system.

Grilles and Diffusers

All grilles shall have vertical and horizontal adjustable bars and controlled from the front of the grill.

Installation

The duct fabrication and installation shall generally conform to IS 655 latest. It is the responsibility of the Contractor to provide and neatly erect all the sheet metal work as shown on the drawings or as required at site to the satisfaction of the Engineer.

All necessary allowances and provisions shall be made by the contractor for beams, pipes or other obstructions in the building, whether or not the same are shown on the drawings. All necessary modifications as required shall be carried out by the Contractor, however maintaining the same area.

All co-ordination with other agencies / contractor working simultaneously at the site to avoid repetition of work shall be the responsibility of the Contractor.

The ducting shall never be hung from the ceiling and only support of beams and columns shall be taken. The ducts shall be rigid and adequately supported and braced with beams or columns. All joints shall be made tight and all interior surfaces smooth bends shall be made with radius not less than one half the width of the duct. All the sheet metal connections, partitions and required to confine the flow of air and through the filters and fans shall be constructed from No. 18 galvanized iron thoroughly stiffened with 25 mm x 25 mm angle iron braces and fitted all necessary doors, to give access to all parts of the equipment. Doors shall be set conveniently where required. At the connection of ducting and inlet / outlet of fans, a double-fiber glass reinforced canvas sleeve shall be used.

All fans shall be protected and painted to avoid corrosion.

Lubrication

All blower bearings shall be provided with adequate facilities for lubrication. Exhaust fan unit bearings shall be sealed lubricated type. All oiling devices, grease fittings shall be readily accessible. All bearings shall be lubricated upon completion of the work using lubricants specified by the manufacturer.

Testing

The Contractor shall adjust, test and air balance the ventilating and exhaust systems and shall submit a report after final adjustments to 5% of designed air quantities.

Operating Instruction

Three (3) copies of an Instruction book giving complete service data on all equipment and system shall be furnished.



SPECIFICATIONS FOR MECHANICAL ITEMS (SPECIAL)

01. SPECIFICATIONS FOR V.T. PUMPSETS

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 :-

1. 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.
2. 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
3. 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.
4. Pump family curve for the VT Pumps should be selected such that impeller of above pumps has operating range (therefore, impeller diameter) selectable to +/- 20 % head variations. Discharge of pump and all other performance parameters shall remain unchanged, 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.
5. **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.**
6. 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 %.
7. 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.
8. **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.**



9. 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 75 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. Where water to be pumped is raw water, it is extracted directly from the river. The pump shall be designed to handle raw water having impurities and turbidity. The MOC of the all the parts like, bell mouth, bowls, impellers, shafts, sleeves, bearings etc. must be selected looking in to the basic profile of raw water as tabulated under:

Sr. No.	Parameter	Value
1	Turbidity	may exceed 5000 NTU at times
2	Total Hardness	Up to 250 ppm
3	TDS	Up to 275 ppm
4	pH	6.5 to 8.5
5	Fly ash content	Yes
6	Residual Chlorine	up to 10 ppm

15. Where water is to be pumped is from booster house, it is drinkable water. The MOC of the all the parts like, bell mouth, bowls, impellers, shafts, sleeves, bearings etc. must be selected looking in to the basic profile of raw water as tabulated under:

Sr. No.	Parameter	Value
1	Turbidity	Up to 10 NTU
2	Total Hardness	Up to 250 ppm
3	TDS	Up to 2750 ppm
4	pH	6.5 to 8.5
5	Residual Chlorine	up to 3.5 ppm

16. **Slow speed testing will not be accepted.** Further, pumps must be tested preferably on job motor, however, if testing is intended to be offered on lab motor, details of lab motor must be got approved prior to testing and approval of department must be taken. In case lab motor is accepted, type test certificate of each category motor duly endorsed by manufacturer must be produced.
17. 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.

18. **The total head from all causes mentioned in the tender is likely to be varying by +/- 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.
19. 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.
20. 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.

2. DRAWINGS:

The manufacturer shall submit the following drawings.

1. Preliminary outline dimensional drawings showing details of pump, motor, civil foundation, clearances, minimum submergence etc.
2. 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.
3. Typical cross sectional drawing showing constructional details with the complete bill of material and relevant standards.

3. EVALUATION OF BIDS :

Evaluation of tender shall be carried out on following basis:

- a. The overall efficiency of the pump set shall be calculated for all tender. The corresponding KW input to motor shall also be calculated. The tender having the lowest KW input to motor at duty point shall be considered as the base. All other tender(s) shall be loaded at the rate of mentioned in the data sheet of pump. **After adding of power loading, evaluation of lowest the bid shall be considered.**
- b. For the purpose of calculating overall efficiency, the following individual efficiencies shall be considered.
 - (1.) Bowl efficiency @ duty point without energy improvement coating.
 - (2.) Transmission losses (Line shaft bearing losses + Thrust bearing losses).
 - (3.) Motor efficiency & its rated KW rating @ duty point.
- c. It should be very clearly noted that duty conditions i.e. discharge and head specified above must be achieved at the available speed of motor running at the full load under specified supply condition mentioned in data sheet. 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 is permitted.**



4. **NAMEPLATE:**

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.

5. **OPERATION AND MAINTENANCE MANUAL:**

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

6. **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 Municipal Corporation 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:

1. The bidder/manufacturer has to guarantee this “actual” duty point parameters and therefore, the testing at works shall be carried out in relation to the “actual” duty point conditions.
1. **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. Expenses for ENERGY AUDIT bourn by the contractor.**
2. 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 (+ or - 20% to duty point Head) on characteristic curve.



3. 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).
4. The penalty against the Non fulfilling the guaranteed “actual” Duty Point parameters shall be maximum 10 % of work order value.
5. **If the pump head is not in defined range i.e. + or - 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.**
6. Other condition(s) regarding delay penalty etc. will separately be dealt with.

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.

7. GENERAL DATA SHEET FOR VERTICAL TURBINE PUMPS,

*** *	General Data	
1	Pump type	Vertical Turbine pump
2	Design Capacity of each pump	As per SOQ
3	Total Bowl Head at design capacity	As per SOQ
4	Number of pumps running in parallel	As per SOQ
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/As per Manufacturer's Design.
10	Speed of the pump	1500 (Synchronous)
*** *	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	Single /As per Manufacturer's 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	Min. 350 mm.dia.



**	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	<u>Spider Must be detachable from the column pipe. (Fabricated spider in column pipe strictly not allowed.)</u>
12	Type of drive	415 V +/- 10 %, 50 Hz +/- 5% AC, solid shaft, and squirrel cage motor as per data sheet.
*** *	Overall efficiency and Price Loading	
1	Price loading on KW input	Rs. 1,49,000.00 per KW
2	Ceiling on Bowl efficiency	As per SOQ
3	Ceiling on Motor efficiency	As per IS-12615-2011 for 4 pole motors & Class IE3
4	Lower side ceiling on total (Line shaft loss, thrust bearing loss etc.) losses	0.25 KW
*** *	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 (S.S.)	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.] 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 Technical bid.

IMPORTANT:

ENERGY LOADING

Cost Loading the efficiency of pump set and power input at duty point at motor terminal must be guaranteed without any tolerance, for evaluation at par; a loading of Rs. 1,49,000/- per excess KW at motor terminals per pump shall be considered. The offer with lowest power input at Motor terminal at duty point shall be taken as base for computing excess KW. Further it is also to be noted that no power loading advantage will be given beyond pump set ceiling efficiency and losses as under:

Details of Pump set	Ceiling on bowl efficiency	Ceiling on motor efficiency	Lower ceiling on total sThrust bearing loss, line shaft loss etc.) losses.
As per SOQ	Max. 83 %	As per IS-12615-2011 for 4 pole motors & Class IE3	Min. 0.25 KW



Please note that characteristic curve of pumps and motors must invariably be attached with technical bid 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.

- Please note that the entire pump shall deliver the water in 300-1000 mm dia. common header line. 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 within Technical bid.
- 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:

No other calculation for deriving Overall efficiency will be considered.

No	Description	Details
***	GENERAL	
1	V.T. Manufacturer's name/ maker's name	
2	Type of pump	Vertical Turbine
3	Length and size of column assembly flanged ended	
4	No. of stage (Quoted by tenderer)	
5	Actual speed of pump in RPM	
6	Size of Suction column and delivery branch (mm)	
7	Shut off head	
8	Max. Power input on performance curve (with full column length)	
9	Maximum power requirement of pump at any point of characteristic curve.	
10	H.P of motor recommended.	
11	Bowl Head (Mtr) H	As per SOQ
12	Bowl Discharge (m ³ /Hr) Q	As per SOQ
13	Bowl Output (Po= H x Q/367.2) KW	
14	Guaranteed Bowl Efficiency (Eb)% (at Motor RPM)	



15	Bowl Input ($P_i = H \times Q / 367.2 \times E_b$)	
16	Thrust bearing loss (TT) KW	
17	Line shaft loss (TL) KW	
18	Motor Output ($M_o = P_i + TT + TL$)	
19	Guaranteed Motor Efficiency at duty point (E_m)	
20	Motor Input power at Terminal on duty point. (M_i)	
21	Overall Efficiency of pump derived from above ($E_o = P_o / M_i$) % (at Motor RPM)	
** *	DIMENSIONS	
22	Pump setting length.	
23	Minimum clearance required from the lowest part of the pump to the bottom of the sump.	
24	Minimum submergence required.	
25	Centerline of pump discharge pipe above floor.	
26	Minimum clearance required for removal of pump parts and motor (including height of sling of lifting tackle used).	

**** No other calculation for deriving Overall efficiency will be considered.**

02. VALVES:

GENERAL

Valves shall be as per relevant IS or internationally recognized standards. Flanges shall be machined on faces and edges to ISO 7005, IS 6392 or BS 4504. Flange drilling should confirm to IS 1538.

Valves shall be double flanged type and the face shall be parallel to each other and flange face should be at right angles to the valve centerline. Back side of valve flanges shall be machined or spot faced for proper seating of the head and nut.

Valve buried or installed in underground chamber, where access to a hand wheel would be impractical, shall be operated by means of extension spindle and/or keys.

Valve shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position.

The valve stem, thrust washers, screws, nuts and all other components exposed to the sewage shall be of a corrosion resistant grade of stainless steel.

Valves shall be free from sharp projections.

The Contractor shall provide Operating platform for easy open / close operation of valves wherever the valves hand wheel is higher than 1.25 mt above floor level.



2.1A SWING CHECK NON RETURN VALVES

A. GENERAL

Cast Iron double flanged non return valves shall be manufactured as per IS 5312 or its latest amendment for pressure rating PN 1.0 in general or higher as required per application. All the parts of the valve shall be designed so as to withstand the test pressure as specified in the standard. Valve shall be free from sharp projections which are likely to get clogged with stringy materials.

The dimensions and shape of the body, door, cover etc. shall ensure that the area for flow passage at any cross section in the valve is not less than the area of the nominal bore of the valve.

The design of the hinges, hinge pin, door, door suspension, etc shall ensure free swinging of the door. The door face shall have close face contact with the body ring in close position. Valves shall be designed for horizontal and vertical mounting position. The minimum thickness of metal for body, door & cover shall be as per directives given in the IS 5312 and shall be maintained throughout any section uniform to avoid strains set up by sudden changes in cross section.

Valve shall be quick closing type with non-slam characteristics. The non-slam characteristics shall be achieved by providing suitable combination of door and hydraulic passages without any external lever / damping arrangement.

B. FEATURES OF CONSTRUCTION

BODY & COVER:

Valve body shall be double flanged. Body of the valve shall be fitted with seat ring securely fixed in machined recesses by proper engineering practice. Rear side of valve flanges shall be machined or spot faced for proper seating of bolt head, washer and nut.

Each reflux valve shall carry an embossed ARROW to indicate the direction of flow.

The internal parts shall be easily accessible for inspection through inspection hole just by removing cover

Valves shall have Gun metal drain plug of required size as per IS to facilitate drain of trapped water from the valve body.

FLANGES:

Valve flange faces shall be parallel to each other and shall be at right angle to the valve centerline. The flanges and their dimensions of drilling shall be in accordance with the requirements of IS 1538, Table IV & VI. The rear side of the flanges shall be machined or shall have spot face to provide proper tightening of Nut & Bolts..



BODY RING:

The inside diameter of the body seat ring shall not be less than the nominal bore of the valves and not more than it by 1.5 mm. The face of the body seat rings shall protrude clear of the surrounding not less than by 1.5 mm. Body seat ring shall be secure riveted over and above sufficient hydraulic press fittings. Seat rings shall be renewable.

DOORS & HINGES:

Doors and hinges shall be designed so as to withstand satisfactorily the repeated impacts likely to occur during service. Door shall be securely bolted to the hinge/s and whole assembly shall be fitted with the help of hinge pin and bushes in the body to keep it in swing position.

ACCESSORIES:

1. Valves above 300 mm size shall be provided with by-pass arrangement as per IS 5312
2. Valves above 300 mm size shall be provided with drain plugs as per IS 5312.

C. MARKING:

The following information shall be embossed on each valve body:

- The manufacturer's name or Trade Mark.
- Pressure Rating of valve.
- The size of valve in mm.
- Direction of the flow
- Heat number of cast.

DATA SHEET FOR SWING CHECK DOOR NON RETURN VALVE

SR. NO.	PARTICULAR	DESCRIPTION
1.0	CONSTRUCTIONAL FEATURES	
1.1	Make	Approved Make
1.2	Mfg. Standard	IS 5312 PART I
1.3	Pressure Rating	PN 1.0
1.4	Size & Quantity	As per BOQ
1.5	Fluid	Water
1.6	Sp Gravity	1.0
1.7	Type	Non slam, Single swing type
1.8	Ends	Flanged. Flat faced and confirming to IS 1538 part IV & VI having off center bolt holes
1.9	Seat	Body :Renewable Disc :Renewable



2.0	MATERIAL OF CONSTRUCTION	
2.1	Body / Cover	C.I. IS 210 GR 260
2.2	Door	C.I. IS 210 GR 260 (M)
2.3	Seat rings	S.S AISI 304 (M)
2.4	Hinge Pin	S.S BS 970 Gr 431 S29 (M)
2.5	Bolts, Studs & Nuts	SS 304
3.0	ACCESSORIES	
3.1	Drain Plug	Required
4.0	TESTING	
4.1	Shell test	15 Kg / Cm ²
4.2	Seat test	10 Kg / Cm ²

NOTE: 01. Manufacturer / supplier shall submit separate data sheet for each duty.

02. For components (marked-M) material certificates shall be furnished

2.1B DETAILS/SPECIFICATIONS FOR BALL TYPE NON RETURN VALVE

Supply, erection, testing and commissioning of the S.G.Iron/D.I./ Cast Steel WCB Grade double flanged heavy duty Ball type Non Return Valve having following material of construction. N. R.V. shall be suitable for 10 Kg. /sq. cm. working pressure.

Body: S.G.Iron/"D.I.Grade 400/12"/Cast Steel WCB Grade Suitable for 10 kg./sq.cm pressure.

Cover: Suitable to Body M.O.C.

Ball: Nitrile reinforced

Cover ring: Nitrile Rubber

Ball seat ring: L.T. Bronze.

Fasteners: Stainless Steel (SS-304)

☐ Contractor should design the Ball type Non Return Valve as per site requirement. Contractor should consider total vertical lifting in this system and design the N.R.V. such that in any case there should be no abnormal slamming during sudden closing operation of N.R.V.

☐ Tests should be carried out as per relevant I.S.

☐ Contractor should have to supply 01 Nos. extra Ball for each of the NRV supplied without any extra cost.

☐ Ball type Non Return Valve must be supported with R.C.C. Block

The body seat rings shall be hydraulically press fitted as well as riveted.

☐ Tests should be carried out at mfg. site as per appv. QAP & relevant I.S.

☐ **DESIGN REQUIREMENTS FOR NON RETURN VALVES:**

☐ The Ball type non-return valves shall be provided with soft seating and designed for minimum head loss. The valve shall be mounted horizontally.

☐ Hydraulic passage shall be designed to avoid cavitations.

☐ It should be without bypass arrangement but rated for PN 1.0 class and confirming to IS 5312:1986 or latest standards.

☐ The net head loss across the Ball type reflux valve at pumps rated flow must be clearly specified.



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 valve. All mill scale, rust, oil, grease, chalk and all other material shall be removed from the interior and exterior surfaces.

PAINTING:

Valves 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 epoxy paint. The resulting coating shall be uniform and smooth and shall adhere perfectly to the surface.

Valves used in pipes carrying potable water, the inside coating shall not contain any constituent soluble in water or any ingredient which could impart any taste or odor to the water.

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 for valves.

TESTS AND INSPECTION:

1. Valves shall be offered for visual inspection and dimension check.
2. Valves shall be tested as per IS 14846 with latest amendments.
3. The hydrostatic testing shall be witnessed by the Municipal Corporation.

2.2 SLUICE VALVE:

A. GENERAL:

Cast Iron Sluice Valves shall be manufactured strictly in accordance with and conforming to Indian standard specification IS : 14846 – 2000 or its latest amendment.

The valves are intended to be used in vertical / horizontal position. Valve shall be Non rising spindle type having pressure rating PN 1.0 in general or higher as required as per application as specified in these specifications and free from sharp projections which are likely to catch and hold stringy materials. Bolts and nuts shall conform to IS 1363: 1967 and IS 4218: 1967. Over all dimension like, face to face distance, height of valve etc shall conform to IS 14846.

B. FEATURES OF CONSTRUCTION:

BODY & BONNET

Body & Bonnet shall be designed so as to withstand the rated test pressure as specified in IS: 14846. Bodies of the valve shall be fitted with seat rings securely fixed in machined recesses by proper engineering practice.

Reasonable clearances shall be provided behind the rear faces of the flanges on body and bonnet to provide free access to use spanners for assembling & dismantling. Rear side of valve flanges shall be machined or spot faced for proper seating of bolt head, washer and nut.



Valves shall have Gun metal drain plug of required size as per IS to facilitate drain of trapped water from the valve body.

FLANGES

Valve flange faces shall be parallel to each other and shall be at right angle to the valve centerline. The flanges and their dimensions of drilling shall be in accordance with the requirements of IS 1538, Table IV & VI. The rear side of the flanges shall be machined or shall have spot face to provide proper tightening of Nut & Bolts..

STUFFING BOX

The gland and stuffing box which come in contact with spindle shall be provided with bushing of minimum 3 mm thickness and of material as specified in IS-14846 or specified in specific requirement of this specifications as anti frictional device. The minimum inside dimensions of the stuffing box shall be in accordance with IS 14846.

Valve shall be provided with back seat bush to facilitate repacking of valves in pressurised condition without disturbing the pump operation.

WEDGES

The Valves shall be with equal tapered solid CI wedge made in one piece. Valves shall have perfect machined and pressed Wedge seat rings securely fixed in to machined recesses. The wedge seat ring shall ride high on the body seat ring to allow for wear, when shut. The minimum wear travel shall be 25 % of the face width of the seat rings as specified in IS.

SEAT RINGS

The dimensions of the body seat rings and wedge seat rings shall conform to IS 14846. The wedge seat rings & body seat rings shall be securely riveted over and above sufficient hydraulic press fittings.

GUIDES & LUGS

All valves shall be provided with the guides and lugs to guide the wedge through its full travel in body. The channel and shoe arrangement shall be secured by non – protruding rigid rivets of non ferrous metals. The clearance between lugs and guides for different sizes of sluice valves shall be as specified in IS 14846.

STEM & WEDGE NUT

Valve Stem shall have a machine cut, single start trapezoidal threads of such length that the wedge can be raised to a position so as to ensure full flow passage through the valve's bore. In fully closed position of the valve the stem shall remain in full contact with wedge nut for its entire length with at least 10 mm projection. The length of the stem particularly



below the collar shall be kept accordingly. The dimensions of stem and wedge nut shall be in accordance with IS : 14846.

The stem of valve shall be so screwed as to close the valves when the cap, hand wheel or crank handle is rotated in clockwise direction. The direction of closing shall be marked on the Cap / hand wheel.

Wherever extended spindle is provided, the valve shall also be provided with suitable headstock.



GEARS

Gears shall be of suitable design (IS 2535: 1978) and workmanship, so as to ensure satisfactory working of sluice valve.

ACCESSORIES:

1. Valves above 300 mm size shall be provided with Repacking arrangement as per IS 14846.
2. The Valves 350 mm size & above shall have spur / bevel gear arrangement as per IS 14846.
3. The Valves 600 mm & above size shall have channel and shoe arrangement as per IS 14846.
4. All Valves shall have valve's OPEN / CLOSE indicator arrangement as per IS 14846.

C MARKING:

The following information shall be embossed on each valve body:

- ISI Certification Mark.
- The manufacturer's name or Trade Mark.
- Pressure Rating of valve.
- The size of valve in mm.
- Heat number of cast.
- Direction to Open/Close.

SUBJECT : DATA SHEET FOR CAST IRON SLUICE VALVE

SR. NO.	PARTICULARS	DESCRIPTION
1.0	Make	Approved Make
2.0	Manufacturing Std.	IS : 14846 – 2000 or latest rev.
3.0	Size range and Qty.	As per SOQ
4.0	Fluid / Specific gravity	Water / 1.0
5.0	Pressure Rating	PN : 1.0
6.0	Stem	Non Rising Spindle
7.0	Ends	Flanged, FF as per IS-1538 having off center bolt holes
8.0	Bonnet	Bolted
9.0	Disc.	Solid wedge
10.0	Operation	Electric Actuator operated
11.0	Seat- Body & Disc	Renewable
12.0	Direction of Closing	Clockwise (marked on HW)
13.0	Repacking /Back Seat Bush Arrangement	Required (above 300 mm size)
14.0	Channel & Shoe Arrangement	Required (600mm & above)
15.0	Gear Box arrangement	Required (350 mm & above)
Material Of Construction		
17.0	Body / bonnet /Disc	C.I. IS 210 GR FG 260
18.0	Stem	SS, AISI – 304 (M)



19.0	Body & Disc seat	SS, AISI – 304 (M)
20.0	Stem nut & Stuff. Box Bush	Bronze IS 318 GR LTB2
21.0	Stuffing box & Gland	CI, IS 210 GR FG 260
22.0	Channel & Shoe lining	S.S. BS 970 Gr 304 S16
23.0	Gland Packing	Greasy Jute Packing
24.0	Bolts, studs & nuts	CS IS 1367 Class 4.6/4
25.0	Hand wheel /Cap	CI
26.0	Details applicable require for Electrically Operated Valve	
26.1	Actuator make / model	Approved Make
26.2	Actuator Torque capacity / RPM	Vendor to furnish detail
26.3	Power supply	3 Phase, 415 V, AC, 50 Hz.
26.4	Valve opening/closing time	Vendor to furnish detail
27.0	Electric Actuator Requirements	Fwd. & reverse integral starter for local & remote mode & cable up to actuator motor with all accessories as per specifications as applicable
28.0	Body/Shell test	15 Kg / Cm ²
29.0	Seat test	10Kg / Cm ²

NOTE:01. Manufacturer / supplier shall submit separate data sheet for each duty.

02. For components (marked-M) material certificates shall be furnished

03. Actuator of MOV shall be as per specifications of Elect. Actuator attached separately.

2.3 BUTTERFLY VALVE

A. GENERAL

Butterfly valve shall conform to IS 13095-1991 / BS EN 593 and to its latest amendments. The flanges of valve shall conform to IS: 1538-1993. The valves shall be rated to PN 1.0 rating unless and otherwise stated specifically. Face to face dimensions of double flanged valves shall be as per the dimensions specified in Table-`1' of IS:13095:1991 or to its latest amendments.

B. FEATURES OF CONSTRUCTION:

BODY

Valve shall be double flanged, short body type, designed to withstand rated pressure and Flanges drilled in accordance with the requirement given in ANNEX – B of IS 13095-1991. Flanges shall be right angles to the axis of the bore and concentric with the bore. Flanges Shall be drilled to IS: 1538:1993 unless & otherwise specified and the bolt holes shall be off centers. Valve 600 mm NB and above shall have integral lifting lugs and valves 1200 mm NB and above size valve shall have integral duck foot.

DISC AND SHAFT

The disc shall be **DUO ECCENTRIC** and mounted to ensure complete shut-off. Shaft shall be designed to withstand the maximum differential pressure across the valve in either



direction of flow. The shaft may be in one or two pieces attached separately to the disc. Proper means of attachment between shaft and disc shall be adopted to preclude Components becoming loose in service and leakage from drive end side.

SEATING

The valve body seat shall be replaceable. When the valve is fully closed, the seal shall seat firmly so as to prevent leakage . The seat surfaces shall be machined smooth to provide a long life for the seal.

BEARINGS

The bearings shall be suitable for the maximum load imposed by the shaft during testing and in service. Valves 350 mm NB and above shall be provided with bearing to take axial thrust. Suitable sealing shall be provided for the shaft where it passes outside the pressure containing enclosure.

OPERATION

The valve shall be capable of being operated at a differential pressure across the disc as marked on the valve.

The valve up to 150 mm NB shall be lever operated with sufficient size to generate required torque to close / open the valve by a single person with normal force. The lever operated valves shall be capable of being locked at three intermediate positions.

The valves 200 mm NB and above shall be with quarter turn worm gear box and hand wheel. All gear operated valves shall be self locking type and shall have suitable stops to prevent movement of the shaft beyond the disc's fully closed position. The Gearbox shall be packed with grease for lifetime operation and shall be totally enclosed from and whether proof for general operation.

OPENING / CLOSING DIRECTION:

Hand wheel / lever / gearbox shall be arranged to turn in a clockwise direction to close the valve. The direction of rotation for opening and closing shall be indicated on the hand wheels /lever.

Valves shall be with an indicator showing the % opening / closing from 0 to 100 % of valves disc.

PACKING:

All valves shall be supplied with the wedge closed. Valves of small diameter may be packed in wooden case. Parts liable to injury in transit shall be wrapped with wood-wool or similar material as a protection.



C. MARKING:

The following information shall be cast on each valve body in raised letters.

1. The manufacturer's name or Trade Mark.
2. The Pressure Rating of valve.
3. The size of valve in mm.
4. Heat number of cast.
5. Direction of the flow

DOCUMENT: TECHNICAL DATA SHEET FOR CI BUTTERFLY VALVE.

SR. NO.	PARTICULARS	DETAILS
1.0	CONSTRUCTIONAL FEATURES	
1.1	Make	Approved Make
1.2	Standard	IS 13095 or BS EN 593
1.3	Size in mm/Qty	As per SOQ
1.4	Location	Indoor
1.5	Fluid	Water with 2-3 ppm FRC
1.6	Sp Gravity	1.0
1.7	Pressure Rating	PN 1.0
1.8	Ends	Flanged, flanges as per IS-1538 Table IV & VI
1.9	Disc.	Duo eccentric
1.10	Operation	Gear Box arrangement
1.11	Other requirements	Valves shall be with HW
2.0	MATERIAL OF CONSTRUCTION	
2.1	Body	C.I. IS 210 GR 260 (M)
2.2	Disc	C.I. IS 210 GR 260 (M)
2.3	Stem	S.S. AISI – 410 (M)
2.4	Body seat (Renewable)	S.S. AISI – 410 (M)
2.5	Disc seal	EPDM Rubber
2.6	Clamping ring	S.S AISI – 304
2.7	Bolts, studs & nuts	CS, IS :1367 Class 4.6 / 4 hot dipped galvanised
3.0	ACCESSORIES	
3.1	Gear Box	Required (150 mm above)
3.3	Support foot	Required (900 mm above)
4.0	TESTING	
4.1	Shell test	15 Kg / Cm ²
4.2	Seat test	10 Kg / Cm ²

M – denotes material test certificate required

Actuator of MOV shall be as per specifications of Elect. Actuator attached separately.

2.4 DOUBLE ACTING KINETIC AIR VALVE

A. GENERAL:

The double acting Kinetic Air Valve shall be manufactured as per IS 14845-2000 or its latest amendment suitable for the specified pressure rating. All the parts of the valve shall be



designed so as to withstand the test pressure as specified in the standard. Valve shall be free from blow hole, flaw burr or other defects and sharp projections which are likely to get clogged with stringy materials.

The valve shall be capable of releasing air from pipe automatically when the pipe is being filled by liquid without generating high air pressure in pipe and shall remain close once the pipe is filled to prevent spillage and loss of liquid and maintain rising main's pressure. Similarly, the valve shall be capable to admit air automatically to prevent development of vacuum while the pipe is being emptied.

B. FEATURES OF CONSTRUCTION:

BODY

Body of the Air valve shall be flanged type and shall have high pressure and low pressure chambers to accommodate high pressure and low pressure float respectively. The chambers shall be designed and have proper guide for small orifice float and guide ribs with minimum clearance to large orifice float so as to allow wobble free upward & downward movement of floats in the chamber when require for releasing or admitting air without any obstruction.

Body shall be designed to avoid prematurely closing of the valve by the air whilst being discharged.

The cone angle of the low pressure chamber shall be such that even at critical velocity of air escaping at 344 m/sec the total impact force on the float is less than the suction force on the annular area between the float and cone. Cone angle and the min. body thickness shall be as per pacified in IS 14845-2000. The low pressure cover shall be designed to withstand full operating thrust in working Conditions.

The seat ring shall be held securely in place under the low pressure cover by a joint support ring to prevent it from sagging when the ball is not sealing the orifice.

HIGH PRESSURE ORIFICE

The high pressure orifice shall be so designed that the orifice is effectively sealed in working condition. The orifice shall be of size not less than 2.5 mm and tapering to 10 mm suitable to release accumulated air within the pipe. The edge of orifice shall be carefully profiled to avoid damage to the float surface. The orifice shall be protected by a Suitable plug of stainless steel.

FLANGES

All valve flanges shall be designed to withstand the stresses to which they would be subjected under hydraulic tests. Flanges shall be machined flat and drilled in accordance with IS:1538, table 4 & 6. Flange bolt shall be drilled off centre.



FLOATS

The float size shall be as per individual design subject to min. as specified in IS 14845-2000. The buoyancy of the floats shall ensure effective sealing of large orifice even at low pressure. The float shall be made of seasoned wood or any other material having bearing strength and equivalent specific gravity. The floats shall be externally coated with vulcanite or rubber having required shore hardness as per IS. The floats shall be non clogging and self sealing type for trouble free operation.

LOW PRESSURE SEAT RING

Low pressure seat ring shall be of natural or synthetic rubber having required shore hardness. The central orifice shall be profiled for maximum discharge in any given condition of pressure differential between the chamber and atmosphere. The float shall make contact with inner profile of the seat ring and seat ring shall withstand the bearing load under working condition without any deterioration in the quality.

JOINT SUPPORTING RING

Low Pressure seat ring shall be held securely in place under low pressure cover by a joint support ring to prevent it from sagging when the float is not sealing the orifice.

COWL

A cowl shall be temper proof and designed to provide protection to low pressure , large orifice chamber, seat ring and float. It shall be designed to prevent direct ingress of foreign matter inside. There shall be sufficient clearance between the orifice and the cowl to ensure easy passage of air under a given pressure differential.

C. MARKING:

The following information shall be embossed on each valve body:

- ISI Certification Mark.
- The manufacturer's name or Trade Mark.
- Type of Valve.
- Pressure Rating of valve.
- The size of valve in mm.
- Heat number of cast.

SUBJECT: DATA SHEET FOR CI DOUBLE ACTING KINETIC AIR VALVE

SR. NO.	PARTICULARS	DESCRIPTION
1.0	Make	Approved Make
2.0	Manufacturing Standard	IS : 14845 – 2000 or latest rev.
3.0	Size and quantity	As per SOQ
4.0	Fluid / Specific gravity	Water / 1.0
5.0	Pressure Rating	PN : 1.0
6.0	Ends	Flanged, flat faced as per IS-1538 having off center bolt holes



	Material Of Construction	
7.0	Body	C.I. IS 210 GR FG 260 (M)
8.0	Body Cover	C.I. IS 210 GR FG 260(M)
9.0	Cowl	C.I. IS 210 GR FG 260(M)
10.0	Small Orifice Nipple	SS AISI 304
11.0	Low Pressure seat ring and face ring	Natural Rubber/ EPDM (M)
	Disc seat	S.S. BS 970 Gr 304 (M)
12.0	High pressure orifice	Bronze IS 318 GR LTB2
13.0	Float (Low Pressure Orifice)	Vulcanite Lined Timber/ Injection Moulded Plastic/SS
14.0	Float (High Pressure Orifice)	Rubber Lined Timber/Injection Moulded Plastic/SS
15.0	Bolts, studs & nuts	SS 304
16.0	Body test	15 Kg / Cm ²
17.0	Seat test	10Kg / Cm ²
18.0	High & Low Pressure orifice seat test (@ 50% pressure)	5Kg / Cm ²

NOTE: 01. Manufacturer / supplier shall submit separate data sheet for each duty.

02. For components (marked-M) material certificates shall be furnished

2.5 ELECTRIC ACTUATOR (APPLICABLE FOR VALVES / GATES)

Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required. The gearbox shall be oil or grease filled, and capable of installation in any position. All operating spindles, gears and head stocks shall be provided with adequate points for lubrication.

The valve actuator shall be capable of producing not less than 1½ times the required valve torque and shall be suitable for at least 15 minutes continuous operation. The operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute.

The actuator starters shall be integrally housed with the actuator in robustly constructed and totally enclosed weatherproof housing. The motor starter shall be capable of starting the motor under the most severe conditions.

The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication, and shall also be fitted with internal heaters so as to provide protection against damage due to condensation. Heaters shall be suitable for single phase operation. The heaters shall be switched “ON” when the starters are “OFF” and shall be switched “OFF” when the starters are “ON”.

In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc shall be carried out without the removal of any actuator covers over an Infra red interface. Sufficient commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage/authorised release. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool.



The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

Commissioning spares shall be supplied with each actuator.

Each starter shall be equipped as follows as a minimum:

- a) A.C. electric motor.
- b) Reduction gear unit.
- c) Torque switch mechanism complete with set of torque switches for “Open” & “Close” position.
- d) Limit switch mechanism complete with set of limit switches for “Open” & “Close” position.
- e) 2 Nos. of Auxiliary limit switches to be provided for each direction in the switch mechanism in addition to the torque/limit switch for travel termination (if specified for any application in scope of work / process description & specifications)
- f) Hand wheel for manual operation.
- g) Hand-auto changeover lever with suitable locking arrangement.
- h) Local control switch / push buttons
- i) Forward/Reverse Integral/External starter
- j) 1 No. Set “Open”, ”close” and “Stop” buttons as applicable
- k) 1 No. Local – Off –Remote switch with padlocking facilities as applicable
- l) Space heater, 220V AC rated
- m) Position transmitter with 4-20mA analogue output for valve open/close position if used as a control valve

The following relays/potential free contact shall be provided:-

- Full open
- Full close
- Torque switch open
- Torque switch closed
- Thermo switch / thermal overload relay tripped
- Selector switch position local-Remote-off
- Single phasing power supply failure
- Remote position feedback In the form of 4-20mA

The actuator shall be suitable for operation in the climate conditions and power supply conditions given in the specification. The actuator shall be capable of producing not less than 1½ time the maximum required torque and shall be suitable for at least 15 minutes continuous operation.



A.C. ELECTRIC MOTOR:

Each motor shall be fully tropicalised and suitable for operation in the prevailing climate conditions. They shall also be suitable for operating satisfactorily under variations of electric supply specified.

MOTORS:

The electric motors shall be of 3 phase, minimum Class 'F' insulated with temperature limited to Class B, high torque low inertia motors of 15 minutes rating, squirrel cage type with 'O' ring seal to provide complete environmental protection during long period of inactivity. The winding shall be impregnated to render them non-hydroscopic and oil resistant. All internal metal parts shall be painted. Motor shall be capable of atleast 60 starts per hour.

MOTOR PROTECTION:

Following motor protection shall be provided:

- a) The motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve.
- b) Motor temperature shall be sensed by a thermostat to protect against overheating
- c) Single phasing protection

MOTOR CONTROLS:

The reversing contactor starter and local controls shall be integral or external for actuator. The starters shall comprise mechanically and electrically interlocked reversing contactor of appropriate rating fed from a 220 V control transformer (120V AC for energization of contactors and 24V DC rectifier supply for local control for integral starter is also acceptable). The common connection of the contactor coils at the transformer shall be grounded. HRC type primary and secondary fuses shall be provided.

Local control shall comprise push buttons for open close and stop operations, and a local / remote selector switch lockable in the three positions as below:

Local control only,
Remote control plus local stop only,
Stop locked off - No electrical operation

Vendor should also make a provision for transmitting the mode selected to control panel and control panel will have corresponding indication lamps.

INTEGRAL STARTER WITH MICROPROCESSOR BASED PROGRAMMABLE CONTROLS:

The starter unit shall be with micro controller based control logic. Entire unit along with basic actuator should confirm to IP 68 standard of enclosure.



The actuator shall be field configurable having inbuilt pushbutton and LCD display to configure the features like inching or non-inching ((hold on) mode etc. Also LCD display of actuator shall be able to show the operational status and fault information in text format. LCD Display shall have min. 32 characters

Isolated 24V DC output shall be available for customer's use and for internal use of actuator.

TORQUE AND TURNS LIMITATION:

Torque and turns limitation to be adjustable as follows:

- Position setting range – multi-turn: 2.5 to 100,000 turns, with resolution to 15 deg. of actuator output.
- Position setting range – direct drive part turn actuators: 90° +/-10°, with resolution to 0.1 deg. of actuator output.
- Torque setting: 40% to 100% rated torque.

Measurement of torque shall be from direct measurement of force at the output of the actuator. Methods of determining torque-using data derived from the motor such as motor speed, current, flux etc are not acceptable

A means for automatic “torque switch bypass” to inhibit torque off during valve unseating and “latching” to prevent torque switch hammer under maintained or repeated control signals shall be provided.

The electrical circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

LOCAL POSITION INDICATION

The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully closed in 1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipe work to ensure that valve status is clearly interpreted. With main power on the display shall be backlit to enhance contrast at low light levels and shall be legible from a distance of at least 6 feet (2m).

Red, green, and yellow lights corresponding to open, closed, and intermediate valve positions shall be included on the actuator display when power is switched on. The digital display shall be maintained and updated during hand wheel operation when all power to the actuator is isolated.

In addition, the actuator display shall include a separate text display element with a minimum of 32 characters to display operational, alarm and configuration status. The text display shall be selectable in English. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator.



MONITORING FACILITIES:

Facilities shall be provided for monitoring actuator operation and availability as follows:
Monitor (availability) relay, having one change-over contact, the relay being energized from the control transformer will de-energise under any one or more the following conditions:

- Loss of main or customer 24V DC power supply
- Actuator control selected to local or stop
- Motor thermostat tripped
- Actuator internal fault

Where specified, provision shall be made for contacts to provide discreet indication of one or more of the following:

Remote selected

- Thermostat trip
- Actuator fault

Actuator text display indication of the following status/alarms:

- Closed Limit, open limit, moving open, moving closed, stopped
- Torque trip closing, torque trip opening, stalled
- ESD active, interlock active
- Thermostat trip, phase lost, 24V supply lost, Local control failure
- Configuration error, Position sensor failure, Torque sensor failure
- Battery low, power loss inhibit

Integral data logger to record and store the following operational data:

- Opening last /average torque against position
- Closing last /average torque against position
- Opening motor starts against position
- Closing motor starts against position
- Total open/closed operations
- Maximum recorded opening and closing torque values
- Event recorder logging operational conditions (valve, control and actuator)

The data logger shall record relevant time and date information for stored data.

Data logger data is to be accessed via non-intrusive IrDA communication. Sufficient standard intrinsically safe tools shall be provided for downloading data logger and actuator configuration files from the actuators and subsequent uploading to a PC. The actuator manufacturer shall supply PC software to enable data logger files to be viewed and analyzed.

WIRING AND TERMINALS:

Internal wiring shall be of grade PVC insulated stranded cable of 650 V and of minimum 1.5 mm² copper for control circuits and of minimum 4 mm² for the power circuit. Each wire shall be number identified at each end. The terminals shall be of stud type and they shall also be identified by numbers. Cable entries shall be suitable for suitably sized PVC cables.

**ENCLOSURE:**

Actuators shall be 0-ring sealed IP68. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed for site for cabling, the terminal compartment having the same ingress protection rating as the actuator with the terminal cover removed.

Enclosure must allow for temporary site storage without the need for electrical supply connection.

START-UP KIT:

Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

COMMUNICATION CAPABILITY (OPTIONAL FOR FUTURE USE / UPGRADE):

The actuator shall be suitable for future upgradation for atleast any one of the following control facilities.

- Modbus
- Profibus
- Foundation Fieldbus
- Device Net
- Pakscan

3.0 CI / MS / GI PIPES & FITTINGS**CI PIPES AND SPECIALS / FITTINGS**

The scope includes manufacture, delivery at site, storage at site, installation, testing and commissioning of double flanged cast iron pipe with fittings, flanges, nuts, bolts and gaskets at suction, delivery & header pipe.

This specification gives the general requirement of pipes/fittings. However, **it is the responsibility of the bidder to take the actual measurement and obtain client's approval prior to the placement of orders** to the main supplier / manufacturer as per site conditions during execution of work.

Quantity shall be verified as per actual site condition. Bidder shall be paid only for installed quantity as per actual measurement at site. In case if pipes/fittings are not used or installed, bidder shall not be paid for the same and bidder shall take back the same without any dispute. In case of tender quantity is less than the actual, bidder has to arrange for the excess quantities and rate for the same shall be as per original tender rate.

All pipes and fittings shall be flanged.



Pipe work

The pipe works for the plant involves manufacturing, supplying, laying and jointing of suitable size cast iron, ductile iron pipes along with matching special etc as required. All piping / fittings within the pump house shall be of cast iron / ductile iron as specified. The specifications for manufacturing, supplying, laying and jointing of pipes shall generally conform to the standard specification.

All pipe work and fitting shall be of class rating in excess of the maximum pressure attained in service including any surge pressure.

The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or other major items of equipments. C.I. dismantling joints which can take radial and axial misalignment of minimum 1 percent of valve nominal size with tie bolts shall be provided. All pipe work shall be adequately supported with purpose-made fittings. When passing through walls, pipe work shall incorporate a puddle flange. Flange adapters and unions shall be fitted in pipe work runs, wherever necessary, to permit the simple disconnection of flanges, valves and equipment.

The Contractor shall be responsible for ensuring that the internal surface of all pipe work is thoroughly clean before and during erection and before commissioning. Cleaning shall include removal of all dirt, rust, scale and welding slag due to Site welding. Before dispatch from the manufacturer's work, the ends of the pipe, branch pipe, etc., shall be suitably be removed until immediately prior to connecting adjacent pipes, valves or pumps. All small bore pipes shall be blown through with compressed air before connection is made to instrumental and other equipment. No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of the Engineer-in-Charge.

CAST IRON PIPING:

Providing and supplying lowering, laying to line, level and slope, cast iron pressure pipes (Class B conforming to IS : 1537 / IS : 1536 with latest amendment) and jointing with specials such as Tees, Bends, Reducers including and other safety provision, cutting the pipes and making joints and hydraulic testing after laying etc. comp.

The Cast Iron pipes shall be Class B conforming to IS:1537 / IS:1536 with latest amendments bearing ISI Mark.

The pipes shall be free from the defects resulting from raw materials, loading, handling, carting and unloading. The pipes shall be free from load, dents or bulges greater than 3 mm in depth and extending over a length in any directions greater than twice the thickness of barrel.

Each lot of pipes supplied by the contractor must be accompanied by the test certificates as specified in IS 1537 / 1536 with latest amendments. The contractors shall have to make arrangement for inspection/testing of the pipes at manufacturer's factory at contractor's own risk and cost.

Each pipe shall have cast, stamped or indelibly painted on it the following marks.

- a) Manufacturer's name, initials or identification mark.



- b) The nominal diameter.
- c) Class reference.
- d) The last two digits of the year of the manufacture.
- e) I.S. Certification mark.

The materials shall be carted to the site by the contractor very carefully. The handling, while carting the pipes, specials, valves etc. shall be done carefully.

In case of heavy pipes, specials etc. lowering shall be done with the help of the chain pulley block.

Caulking:

After a section of convenient length has been leaded, caulking shall be commenced. The lead shall be free from the leading pipe, outside of the socket of the other pipe with flat chisel, and then caulked round 3 separate times with the proper caulking tools of increasing thickness and hammer 4 to 5 lbs. in weight in such manner as to make the joints sound and water tight.

Joints under water shall be made with lead wool inserted in strings not less than 6 mm thick and very thoroughly caulked.

New Flanged Joints:

Flanged joints should be made by painting the facing of the flanges with red lead freely and belting up evenly on all sides.

A thin fibre, of lead wool may be very useful in making the joints water tight, where facing of the pipes is not true.

Where packing must be used, it should be of rubber insert cloth three ply and of approved thickness. The packing should be of the full diameter of the flange with proper pipe hole and bolt holes cut and even at both inner and outer edges.

Where the flange is not fully faced, the packing may be of the dimension of the facing strip only. Its proper placing should be tested before another pipe is jointed on.

Testing:

After each section of the pipe line has been completed, it shall be tested for water tightness before being covered in. This can be done by closing each end by means of a reliable guage. When the pipe is laid on any appreciable gradient, the test should be carried out at the lower end of the section. Any leaking joints should be made good, and the above test reapplied until no further leaks are apparent.

Tyton Joints:

After the pipes are examined for line and levels, the C.I pipes shall be jointed with rubber gaskets (tyton joints) as follows:



The socket and spigot end shall be cleaned with kerosene oil, then grease has to be applied to the spigot and socket ends, duly after inspection of rubber gasket. Then the rubber gasket shall be jacked and fixed in perfect condition such that the gasket will fall in groove correctly and the joint become water tight.

Tyton / Lead jointing shall be carried out after the C.I. pipes and specials are properly laid and approved by the Engineer-in-charge.

The lead shall be more than 99%. It shall be soft bluish grey pig lead free from admixtures of tin or other impurities. The lead shall confirm to the Indian Standard 3114/1965.

The spun yarn shall be clean hemp and soaked in hot tar or bitumen, cooled and dried before use.

The outside of the spigot and the inside of the socket shall be thoroughly cleaned with a brush. The spigot shall be carefully centered in the socket by spun yarn twisted into ropes of uniform thickness. The rope shall be well caulked in to the back of the socket to leave a sufficient depth for lead as directed by Engineer-in-charge. The lead shall be used as specified in Table-1 of Indian Standard 3114/1965.

The proper depth of each joints shall be as specified and tested before running the lead by passing completely around it a wooden gauge notched out to the correct depth of lead.

The leading of joints shall be done by means of ropes covered with clay or a by using special leading rings. The lead shall be melted rendering it thoroughly fluid and each joints shall be filled in one pouring.

After a section of convenient length has been leading pipe outside of the socket of the other pipe, with a flat chisel and then caulked round three separate time with the proper caulking tools of increasing thickness and hammer 2 to 3 kg. weight in such a manner as to make the joints sound shall be left flush neat and even with the socket.

The item includes all materials tools, tackles etc. required to carry out the work including fire wood etc.

After each section of the pipe line has been completed it shall be tested for water tightness. The ends shall be suitably closed with a valve, cap or plug or a blank flange. The pipe line shall then be filled with water, pressure shall then be supplied with a hand force pump up to 7 kg./sq.cm. (above 100 lbs/sq.inch.) or 15% above. If the pipe is laid on an appreciable gradient, the test shall be carried out at the upper end of the section.

Any leaking joints shall be made good and the test repeated until a perfectly leak proof pipe line obtained.

Consumption of lead for jointing of pipe lines:



The purity of lead must be more than 99% and the contractor shall have to furnish the test certificate and get approval from Engineer-in-charge. The consumption of lead and the depth of jointing shall be as per table listed below:

Sr. No.	Size of pipe line for joint	Consumption of lead in kgs.	Depth of lead joint in cm.
1.	80 mm	1.86	5.00
2.	150 mm	3.62	6.00
3.	200 mm	5.00	6.00
4.	250 mm	6.12	7.75
5.	300 mm	7.70	8.00
6.	350 mm	10.45	8.12
7.	400 mm	11.20	8.25
8.	450 mm	14.30	8.40
9.	500 mm	16.25	8.50
10.	600 mm	19.00	9.15
11.	700 mm	21.00	10.00
12.	800 mm	31.50	10.50
13.	900 mm	41.00	10.50

HYDRAULIC TEST:

It shall be incumbent upon the contractor to give a successful hydraulic test of each and every pipe line before filling of the trench. The test shall be carried out in the approved manner by an approved testing machine and pressure gauge to be supplied by the contractor. All the arrangements for such test shall be made by the contractor at his cost including filling the pipe with water etc. and giving a successful hydraulic test.

Testing of the pipe line in the field shall be carried out after the completion of whole length or in parts as directed by Engineer-in-charge. The trenches shall be partially refilled except at the joint before starting the test. In each case, the contractor has to plug the both ends of the section of pipeline to be tested either by providing caps or by sluice valves as per direction of Engineer. No extra payment will be made for providing, fixing and removing caps used for testing purpose. If necessary, both the ends shall be properly anchored by providing 1:3:6 c.c. blocks of required dimensions. Contractors shall provide required number of plug points with ferrules of required diameters to serve as injection points, air relief points etc. No payment shall be made for this work. On the completion of the test these points shall be closed by plugs by the contractors without any extra cost.

Testing will be carried out by the contractors under the guidance of Engineer-in-charge. Contractors shall arrange for required machinery, equipments and technical staff for testing the pipe line. Contractors shall also arrange for labour, other materials and tools required to attend the leakage etc. during the test.



The pipe line shall be subjected for following test:

Leakage Test:

The test shall be conducted after satisfactory completion of the pressure test.

There shall not be any leakage in the pipe or at the joint. A seepage allowance of a 2.5 litres per kilometer per hour per centimeter diameter of the pipe shall be permissible and that quantity will not be considered as leakage.

If the retest is delayed for more than 48 hours after any test has proved unsuccessful the Engineer-in-charge, after giving 24 hours notice, shall have every right to get all defects rectified and carry out other necessary works and take hydraulic test/leakage test to the contractor. Any damage done to the pipes, materials, the other labour cost, etc. incurred there under shall be recoverable from the contractor either from his bill or deposit.

The responsibility of the contractor as specified above in case of unsuccessful hydraulic test shall not cease to exist by his pleading that any materials used by him in the pipe line was having cracked or was otherwise defective, as if he has a reason to believe so, he must refuse to accept such materials right at the stores.

If the first test is not found satisfactory, repeated tests will be taken and procedure mentioned above should be followed for testing till a satisfactory test is given. All testing shall be done at the risk of the contractors and they have to attend be done at the risk of the contractors and they have to attend all defects including repairing bursts, leaks at joints, sluice valve ends, caps etc. removing and replacing cracked pipes etc. These unserviceable articles shall be the property of the contractors and they shall arrange to remove the same from the site as directed by the Engineer.

Any portion of the pipe line that does not stand the specified pressure, shall be rectified by the contractor. Who should make his own arrangement for the water required for the testing.

When the section of the pipe line is tested successfully the contractor shall remove the blank flanges, pump out water from the pipes and back fill the portion as per directions of the Engineer.

CI Double Flanged Pipes / Piping within pump house shall be tested for 150 % of maximum system pressure.

The items include all materials and labour required to carry out the work as detailed above.

CAST IRON FITTING & SPECIALS:

Providing and supplying at site of work C.I. fittings/specials confirming to IS 1538/1993 with latest amendments.

The contractor shall have to procure required cast iron specials such as Tees, Bends of required degrees, reducers, collars, caps, plugs, tail pieces, etc. necessary for completion of this item as per site conditions.



The C.I. fittings and specials shall conform to IS 1538/1993 with latest amendments.

The fitting shall be stripped with all the precautions necessary to avoid warping or shrinking defects. The fitting shall be free from defects other than any unavoidable surface imperfection which results from the method of manufacture and which do not affect the use of the fittings.

The fittings shall be such that they could be cut, drill or machine.

The mass of C.I. fittings/specials shall strictly conform to IS 1538/1993 with latest amendments.

The contractor shall have to procure the required C.I. fittings or specials as per the site conditions and as per direction of Engineer-in-charge.

MS PIPES AND SPECIALS / FITTINGS

MS PIPES

Provide, fabricate, test, paint, supply and installation of M.S. Pipes of specified ID / OD and wall thickness conforming to IS 3589-1981.

Pipes shall be erected on rollers / saddles / supports as required.

All the pipes shall be supplied by the contractor as per actual measurement at site jointly with client's representative.

QUALITY OF STEEL:

Pipes shall be fabricated from steel plates conforming to IS 2062.

MANUFACTURE OF THE PRODUCT:

Pipes shall be made from steel plates or strips by butt welding longitudinally or spirally. The weld shall be continuous. Prior to welding, edges of plates or strips may be prepared suitably where required by the process of manufacture.

ORIGINAL CROSS - SECTIONAL AREA OF THE SPECIMEN:

OUTSIDE DIAMETERS:

The outside diameters of the finished pipes shall be as given below:

Nominal size (in mm)	Outside Diameter (in mm)
200	219.1
400	406.4
500	508.0
600	609.6
700	711.2



900	914.4
1000	1024.0
1200	1224.0
1400	1424.0

Pipes of outside diameter other than those covered in above clause shall be permissible as agreed to between the manufacturer and the purchaser.

TOLERANCE:

OUTSIDE DIAMETER

- a) Pipe Body - The tolerance on the pipe body shall be as shown below :

<u>Nominal Size</u>	<u>Tolerance</u>
Up to 500 mm	0.75 Percent
Over 500 mm	1.00 Percent

Note: Measurements may be made by any suitable instrument, such as outside calipers, diameter tapes, micrometers, etc.

- b) Pipes Ends - The tolerance on outside dia. for distance of 100 mm from the end of the pipe shall be as follows:
 Up to and Including 250 mm + 1.6 mm - 0.50 mm
 Above 250 mm + 2.4 mm - 0.8 mm
- c) Thickness - The tolerance on specified wall thickness shall be as follows:
 Pipe + 10 %
- d) Straightness - Finished pipe shall not deviate from straightness by more than 0.2% of the total length.
 Checking shall be carried out using a taut string or wire from end to end along the side of the pipe to measure the greatest deviation.
- e) Length - Straight pipe shall not vary from the specified overall length by +10 mm or up to 0 mm for length up to and including 6 mt.

THICKNESS OF PIPES:

The pipe shall have minimum specified wall thickness as per mentioned in Table-3.

TABLE - 3
MINIMUM SPECIFIED THICKNESS OF PIPES.

Nominal Size (mm)	Minimum Specified Thickness of pipe mm
Up to 300	4



above 300 to 500	5
above 500 to 600	6
above 600 to 850	7
above 850 to 950	10
above 1000 to 1500	12

HYDRAULIC PRESSURE TEST:

Each pipe shall be hydrostatically tested at the manufacturer's works before the pipe is coated, wrapped or lined at the manufacturer's work.

The Hydraulic test pressure shall be the pressure calculated from the following formula, except that the maximum test pressure shall not exceed 5 Mpa.

$$P = \frac{2 \times S \times t}{D}$$

- P = Test pressure
S = A stress in MPa which shall be taken as 40% of the specified minimum tensile strength.
t = Specified thickness in mm and
D = Specified outside diameter in mm.

Test pressure shall be applied and maintained for sufficiently long time for proof and inspection.

Carbon Steel/MS pipe after installation at site with respective joints, piping shall be tested for joint tightness at 150 % of Maximum working / system pressure it is likely to subject to.

SPECIFICATION FOR INSIDE / OUTSIDE COATING:

The pipe internal and external surface shall be coated with Zinc rich epoxy primer and asphaltic bitumen paint of approved quality. No primer shall be applied without prior approval of the owner. The mix of zinc rich epoxy primer shall be prepared at works site not earlier than 15 min. before applying the same on pipes and special surfaces. One coat of zinc rich epoxy primer shall be applied by spray giving a film thickness of approximately 1 ml. No thinner shall be added to ready mix paints without previous approval of the owner and the finishing coats on top of the primer coat shall only be applied after allowing the film to cure for at least 48 hours.

After application of zinc rich epoxy primer, the surface shall be cleaned by duster and inspected. If during inspection any portion is found rusting the same shall be removed by emery paper and coated with zinc rich epoxy primer. When complete section is checked as above, first coat of Inertol or equivalent shall be applied, when one coat is applied, the date of application of this coat shall be written on either end of section.

The painting shall be done by cross brushing, i.e. one coat shall be given vertically and another coat shall be given horizontally so as to get required thickness, a good looking surface and also to avoid sagging of paint. Every successive coat of paint shall be given only after 48 hrs. of painting the previous coat. Before applying the next coat, the surface shall be properly cleaned by duster. Each coat of inertol 49 W thick or equivalent shall give a film thickness of 3-4 mils.



The painting / coating shall be such that it shall not impart any taste or smell to water. Only Food Grade paint shall be used for painting pipes intended for drinking water supply.

LAYING OF PIPELINE:

The laying, jointing and testing of welded steel pipes conform to latest and relevant IS:5822. Pedestals shall be constructed by the civil contractor before commencing the pipe laying work in any section.

The welded joints shall be tested as per IS 3600 of 1966.

M. S. SPECIALS:

Scope shall include providing, fabricating, testing and installing M. S. Specials suitable to M. S. pipes, valves and other fittings from steel plates. MS Specials shall be confirming to IS 7322 / IS 1538 dimensionally. MS specials and fittings shall be fabricated at site of work tested to specified test pressure and including providing flanges required, painting inside zinc epoxy coating and outside anti corrosive red primer, coated with three coats of anti corrosive water proof paint including freight, loading, unloading, carting, stacking as directed, and including all taxes, insurance etc. The sizes and types of specials shall be as per requirements taking into consideration in tender items like pumps, sluice valves, non return valves, scour valves, expansion joints, dismantling joints etc.

FLANGES:

All MS flanges conforming to IS 6392, PN 0.6 and their dimensions of drilling be in accordance with IS- 1538 / IS 6392 suitable for pressure 10 kg/cm² (specification for M.S. fittings for pressure pipes for water, gas and sewage) or its latest revision. The flanges shall be flat faced with off centre bolt holes. Prior to manufacturing process, the contractor shall have to obtain approval of Engineer in charge for all sizes and types of flange drawings.

JOINTING MATERIAL:

Each valve shall be supplied with all necessary joint ring , nuts, bolts and washers for completing the joints on all the flanges of valve supplied under this contract including those flanges which will be jointed to pipe system. The lengths of bolts shall be assumed to be suitable for jointing M.S. pipes. The cost of all jointing material supplied under the contract shall be included in rates. Joint rings shall be of flat section at least 3 mm. thick. They shall be of rubber in accordance with IS 638-1965.

G.I. PIPES & FITTINGS

All G.I. piping and Fitting shall conform to IS: 1239.

The screwed end of all GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead or Teflon before jointing. The joint shall be made by winding a few threads of hemp round the ends of tubes and then screwing them into sockets to the full depth of threads. Exposed threads shall be coated with approved anticorrosive paint. No pipe shall be bent/offset to save fittings. The offset in GI pipes shall be made only after the permission



of the Engineer-in-charge . If threaded end of pipe is damaged, the contractor shall cut the end with hacksaw and shall prepare new threads confirming to IS 554 to required length .

All fittings shall be malleable galvanised iron approved by the Engineer-in-charge. Fitting in GI line shall include all couplings, elbows, tees, bends, unions, nipples, reducers, flanges with nuts and rubber insertion and all other fittings to make a complete job.

Flanged joints shall be made by painting the faces of the flanges with red lead and bolting up evenly on all sides with compressed asbestos gasket as per piping material specification.

Flanged or screwed valves shall be installed in locations as directed by engineer-in-charge and/or as shown on the execution drawings after placement of order as per specification for screwed or flanged joints. All completed G.I. lines shall be hydrostatically tested to a test pressure of 5Kg/cm²g.

uPVC Pipe

uPVC pipes made of unplasticized polyvinyl chloride shall be confirming to IS: 15328 with socket(s) suitable for elastomeric sealing ring type joints for conveyance of water under pressure. The pipes are intended to be used for buried water mains with ambient atmospheric temperature reaching up to 45 °C and soil surface temperature rising more than 65°C. The stipulations given in this document for uPVC pipe which are not covered by any other code/standard, shall be governed by the provisions of IS 4985. The pipes will be supplied with plain ends or one end plain with chamfer and other end socket suitable for elastomeric sealing ring type joints in accordance with IS: 4985 as per requirement. Each pipe shall be supplied along with one suitable elastomeric sealing ring with 5% extra rings on overall number of pipes.

Material

The material from which the pipes are made shall consist substantially of unplasticized polyvinyl chloride conforming to IS: 10151, to which may be added only those additives that are absolutely needed to facilitate the manufacture of the polymer, and the production of sound, durable pipes of good surface, finish, mechanical strength and opacity. The pressure rating of pipes shall be of class-3 and class-4 in accordance with IS: 4985 with a maximum continuous working pressure at 27°C of 6 and 10 kg/cm².

Dimensions of the pipes and the sockets

The dimensions and tolerances of pipes shall comply with IS: 4985. The tolerance on outside diameter and wall thickness of pipe shall be as per Table given in IS: 4985. The dimensions of the socket for elastomeric sealing ring type joint shall be in accordance with IS 4985. The pipe shall be supplied in straight lengths of 6 m with tolerance of + 20 mm and -0 mm. The effective length of socket pipe shall be considered as shown in IS: 4985.



Physical & chemical properties

The pipe shall confirm to the Clause 10 of IS 4985-2000 for its physical and chemical properties except for the density and ash content provisions which shall be as per the stipulations made above. The colour of the pipes shall be dark grey. Influence on water intended for human consumption shall be governed by IS: 12235. All plastic and non plastic material for components of the uPVC piping system e. g. Elastomeric sealing ring, lubricants, when in permanent or in temporary contact with water which is intended for human consumption, shall not adversely affect the quality of the drinking water.

Mechanical properties

The pipes and integral sealing ring will confirm to internal hydrostatic pressure in accordance with Clause 11.1 and sampling as per annexure D of IS 4985.

4.0 METALLIC EXPANSION BELLOWS

GENERAL DESIGN REQUIREMENT

Expansion bellow shall be designed as per the details furnished in the data sheet and shall be in accordance with the EJMA/ ASME standard.

The bellows shall be metallic corrugated design and shall have double flange. The material for bellow shall be SS 304. Fatigue life expectancy considered for the Expansion Bellows shall be minimum 7000 cycles.

After satisfactory testing of the Bellows, prior to dispatch, all internal and external un-machined ferrous surfaces of the Bellows shall be thoroughly clean, dry and shall be made free from rust and grease before painting.

All exposed machined surfaces 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. The inside coating shall not contain any constituent soluble in water or any ingredient which could impart any taste or smell to water.

DOCUMENT :TECHNICAL DATA SHEET FOR METALLIC EXPANSION BELLOWS

SR. NO.	PARTICULARS	DESCRIPTION
1.0	LIQUID DATA	
1.1	Fluid / Specific gravity	Water / 1.0
1.2	Temperature	ambient
2.0	EXPANSION BELLOWS DATA	
2.1	Make	Approved Make
2.2	Manufacturing Standard	EJMA / ASME
2.3	Size range and quantity	As per SOQ
2.4	Overall length in mm	As per SOQ
2.5	Pressure Rating	PN : 1.0
2.6	Axial expansion in mm	5



2.7	Axial compression in mm	15
2.8	Mode of installation	Horizontal
2.9	Ends	Flanged, FF as per IS-1538 having off center bolt holes
2.10	No of Convolution	Pl. furnish
2.11	Thickness of Weld End	Pl. furnish
2.12	Thickness of internal sleeve	Pl. furnish
2.13	Qty. & Position of Rods	Min. 3 nos @ 120 Deg. interval
3.0	MATERIAL OF CONSTRUCTION	
3.1	Bellows (M)	SS 304
3.2	Internal Sleeves (M)	SS 304
3.3	Flanges (M)	CI / MS
3.4	Lugs	CI / MS
3.5	Rods	IS 1367 VI 1994 CI 4.6
3.6	Hardware	C.S IS 1367
4.0	TESTING	
4.1	Hydrostatic Test pressure	15 kg / sq.cm

M- Denotes material test required

5.0 E.O.T. CRANE:

The crane shall be electrically operated, box / standard ' I ' beam type single / double girder , complete with all accessories including down shop conductor, crane rails and fixtures, starter panel, cable up to starter and shall conform to IS:3177, IS:807 and other relevant approved standards.

The crane bridge shall consist of bridge girders on which a wheeled trolley is to run. The bridge trucks and trolley frames shall be fabricated from structural steel. Access walkway with safe hand railing as required along the full span length of the bridge girder shall be provided. Steel shall be tested for quality conforming to ASTM A36 except that, plates more than 20 mm thick shall conform to IS:2062, BS:4360 or relevant internationally approved standards.

The bridge shall be designed to carry safely the loads specified in IS:807, BS:2573 or relevant internationally approved standards. All anti-friction bearings for bridge and trolley track wheels, gear boxes and bottom sheaves on hook shall be lubricated manually by hand operated grease pump through respective grease nipples.

Wheel base and structural frame of the wheel mounting of the end carriages shall be designed so as to ensure that the crane remains square and prevent skewness. Bridge and trolley track wheels shall be of forged steel and shall be double flanged type. The wheel diameter and rail sizes shall be suitable for the wheel loads confirming to relevant standards.

The crane rails shall be manufactured from wear resistant austenitic manganese steel. Mountings of the wheels shall be designed to facilitate easy removal for maintenance.



Walkways shall be of at least 500 mm clear inside width with a 6 mm thick non-skid steel plate surface. Steel rail stops to prevent rails from creeping and trolley from running off the bridge shall be abutted against ends of rails and welded to the girders. Bridge and trolley stops to match the wheel radius shall be provided before the buffer stops.

All exposed couplings, shafts, gear, wheels, pinions and chain drives etc. shall be safely encased and guarded completely to prevent any hazard to persons working around. All bearings and gears shall have a design life of 10,000 hours. Electro-magnetic and hydraulic thruster brake shall be provided for the main hoist. One electro-magnetic brake shall be provided for each of the cross travel and long travel motions.

Hook shall be solid forged, heat treated alloy or carbon steel suitable for the duty service. They shall have swivels and operate on ball thrust bearings with hardened races. The lifting hooks shall comply with the requirements of IS 8610 or BS:2903 / BS:3017 or relevant internationally approved standards and shall have a safety latch to prevent rope coming off the hook.

Hoist rope shall be extra flexible, improved plough galvanised steel rope with well lubricated hemp core and having six strands of 36 wires per stand with minimum ultimate tensile strength of $1.6 \times 106 \text{ kN/m}^2$ of Right Hand Ordinary (RHO) lay construction. The ropes shall have a 6:1 safety factor on the specified safe working load, and shall conform to IS:2266.

Rope drums shall be grooved and shall be either cast iron or cast steel or welded steel conforming to IS:3177, BS:466 or relevant internationally approved standards.

Gears shall be cut from solid cast or forged steel blanks or shall be stress relieved welded steel construction. Pinions shall be of forged carbon or heat treated alloy steel. Strength, quality of steel, heat treatment, face, pitch of teeth and design shall conform to BS:436, IS:4460 and BS:721 or relevant internationally approved standards.

A SWL plate not less than 150 mm in height showing year of manufacture and rated capacity of hoist in figures shall be placed on each side of the crane girder. The maximum deflection under full load shall not exceed $1/900$ of the span (as per IS: 3177).

All accessory and auxiliary electrical equipment including drive motors, electrically operated brakes, controllers, resistors, conductors, insulators, current collectors, pendant push button station, protective devices, operating devices, cables, conduits, etc. necessary for the safe and satisfactory operation of the crane shall be provided.

Power to the crane shall be provided by down shop conductors manufactured from high conductivity hard drawn copper. Conductors shall be completely shrouded such that they have no exposed current carrying surfaces. Pendant type push button station shall be sheet steel enclosed and shall comprise the following push buttons and indicating lamps:

‘Start’ and ‘Stop’.

Long travel - ‘Right’ and ‘Left’.

Cross travel - ‘To’ and ‘From’.

Hook - ‘Hoist’ and ‘Lower’.



Red indicating lamp for supply 'ON' indication.

Pendant type push button shall be supported independently of the electrical cable and shall be earthed separately, independent of the suspension. Automatic reset type of limit switches shall be provided to prevent over travel for each of the following:

For 'UP' and 'Down' motions of the hook.

Long travel motion

Cross travel motion

Crane structures, motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be earthed. All motors, brakes, limit switches, panels, drum controllers, resistor unit sets shall be provided with two studs for earthing.

Drive motors shall be as per IS:325 in general. Motor shall be designed for frequent reversal, braking, inching and acceleration. Pullout torque shall be 2.15 times the rated torque. Pendant control switch, controllers and resistors, controls, electrical protective devices, cables and conductors, earthing guards, etc. shall be as per IS : 3938. Limit switches shall be provided for over hoisting and over-lowering and of two extreme ends of trolley travel i.e. crosses as well as long travel.

TESTS AND TEST CERTIFICATES:

Overload tests at 125% of the rated load shall be carried out and test certificates shall be furnished for hook, wire rope, brake and complete crane.

FOLLOWING ACCESSORIES SHALL BE PROVIDED WITH E.O.T. CRANE:

- a) Mechanical stoppers for long travel & cross travel shall be provided.
- b) Pendant push button station shall be located at maximum 1.0 Mt. from operating floor elevation.
- c) Earthing terminals shall be provided.
- d) Limit switches for over hoist, over lower, over cross travel & over long travel shall be provided.
- e) Flexible trailing cable system shall be provided with sufficient number of loops for specified cross travel.
- f) The control panel shall be provided.
- g) Isolation on switch to receive the power from Electrical Panel.
- h) M.S. ladder shall be provided by the contractor for maintenance.

Painting:

Steel materials of all structural parts shall be sand blasted or shot blasted to SA 2¹/₂ finish to remove rust, mill scale and grease prior to fabrication and painted as follows:

- (a) After sand blasting or shot blasting – One coat of epoxy paint (primer).
- (b) After partial assembly and inspection at the supplier's works - Two coats of enamel paint.
- (c) After erection at site – One coat of enamel paint.



The final coat shall be golden yellow colour with black zebra marking wherever applicable. All machined parts shall be coated with grease, varnish or other approved protective coats before dispatching from the supplier's works. Interiors of the gear casings shall be painted with one coat of oil resisting paint.

DOCUMENT: DATA SHEET OF ELECTRICALLY OPERATED TRAVELING CRANE

SR. NO.	PARTICULAR	DESCRIPTION
1.0	REQUIREMENT DATA	
1.1	Item	E.O.T. Crane with Electrical Hoist
1.2	Location	Indoor in Pump House
1.3	Quantity	ONE
1.4	Capacity in TON	As per SOQ
1.5	IS Standard	IS - 807 & 3177
2.0	CRANE DATA	
2.1	Make	Approved Make
2.2	Model	Pl. Furnish detail
2.3	Type	Single / Double Girder
2.4	Class of Hoist	Medium Duty CI – II as per IS 3177 with latest amendments
2.5	Lift in m.*	As per SOQ (or as per site requirement)
2.6	Span in m*	As per SOQ (or as per site requirement)
2.7	Bay length in m.*	As per SOQ (or as per site requirement)
2.8	No. of Falls	2/4
2.9	Travel speed in mtr./min. • Longitudinal • Cross	15 10
2.10	Main Hoist speed- m/min.	2 to 2.5
2.11	Creep speed in m./min.	0.5
2.12	Fixed Girder Required	Pl. Furnish detail
2.13	Type of Suspension	Hook
2.14	Track	Min. 40 X 40 mm MS Sq. Bar
2.15	Brakes	Electromagnetic type
2.16	Method of Operation	Pendant Push Button
3.0	CONSTRUCTIONAL FEATURE	
3.1	End Carriage	Pl. Furnish detail
3.2	Bridge	Box Type/Standard I beam Type
3.3	End Stopper	Steel End Stopper on either side of the bridge.
3.3.1	Wheel Base	Pl. Furnish detail
3.4	Gear	Made of EN 24 / EN 9 - precision machined, teeth cutting by hobbing machine & duly hardened.
3.5	Wire Rope	Steel Wire rope 12 mm , 6 X 36 constru. Flex. Steel wire rope as per IS 2266 or as per design
3.6	Hook	Forged steel single shank type – confirming to IS 15560 with thrust brgs., latch & anti-locking arrangement



3.7	Rope Drum & Sheaves	MS Drum with grooving as per IS 3938
3.8	Wheels	Made of Forged Steel confirming to IS 2707 GR- II duty/Steel cast EN – 9, double flanged straight trade type
3.9	Shaft	High Tensile Steel
3.10	Trolley	MS Frame with wheels of Forged steel / EN – 9
3.12	Bearings	All moving parts be supported on SKF/FAG anti fric. Ball/Roller brgs.
3.13	Maintenance Platform/ access walkway	Maintenance Platforms Required
3.14	Painting	Required. Furnish detail.
4.0	ELECTRICAL DETAILS	
4.1	Supply Condition	415 V +/- 10 % variation 50 Hz +/- 5 % variation +/- 10 % Combined variation
4.2	Motor Standard	IS 325
4.3	Control Voltage	110 V
4.4	Class of Insulation / Drg. of Protection	F / IP 55
4.5	Temperature	Ambient- 50 Drg. C
4.6	Make	As per Tender specs.
4.7	Type of Motor	Hoist Duty
4.8	Main Hoisting	Pl. Furnish detail
4.9	L.T.	Pl. Furnish detail
4.10	C.T.	Pl. Furnish detail
4.11	Method of starting	Pl. Furnish detail
4.12	Type of cooling	Pl. Furnish detail
4.13	Total Connected Load-kw	Pl. Furnish detail
5.0	ACCESSORIES & SERVICES REQUIRED	
5.1	Mech. Stopper for LT C.T	YES
5.2	Pendant with hanging chain/rope	YES
5.3	Limit Switches for <ul style="list-style-type: none"> • over hoisting • over lowering • over cross travel • over long travel 	YES
5.4	Trailing cable system	YES
5.5	Control Panel	YES
5.6	Isolation Switch for ele. Power	YES
6.0	WEIGHT	
6.1	Weight of Hoist in kg	Please furnish
6.2	Weight of Bridge in kg	Please furnish
7.1	GA & Dimensional drg. of Crane assembly	Pl furnish
7.2	Data as required by IS 3177-77, Appendix-B, clause 2.2	Pl furnish (In Separate Sheet)
7.3	Complete Electrical circuit	Pl furnish



	Diagram	
7.4	Catalogue of products	PI furnish
7.5	QAP of products	PI furnish
8.0	TESTING	
8.1	Visual inspection and Dimensional Check	Witnessing
8.2	Performance test	Witnessing
8.3	Overload test at 125% load	Witnessing
8.4	Deflection Test	Witnessing
8.4	Material Test certificates	Required

Note: 01. Manufacturer / supplier shall submit separate data sheet for each duty.
02. For components (marked-M) material certificates shall be furnished
03.(*) **Contractor shall visit the site and obtain the data about span, lift, bay length, etc suitable for pump house and shall furnish in data sheet**

6.0 MONORAIL WITH ELECTRIC CHAIN HOIST AND EOT:

The design, manufacture, inspection and testing of Monorail, Electric chain Hoist and Manually / Electrically operated traveling trolley shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. Electrically operated chain hoist shall conform to IS 6547-1972 and shall be designed for duty service Class –II. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted.

IS:6547-1972 : Electric Chain Hoist
IS:2429 : Round steel short link chain
IS:6216 : Short link chain grade 80
IS:8610 / IS 15560 : Points hooks with shank for engineering purposes
IS: 808 : Indian Standard Medium Weight Beam
IS: 210 : Cast Iron castings

Electrically operated chain pulley hoist shall consist of following major components.

- Electrically operated Chain Hoist, motor with motor cable, hoisting block and hooks complete.
- Limit switch to prevent over hoisting and over lowering.
- Erection hardware.
- Pendent control station suspended from hoist.
- Control panel mounted on wall as applicable.

Load chain shall be Grade 80 alloy steel chain as per IS -6216-1982. Chain wheel shall be made from malleable / SG Iron cast confirming to IS 107 / IS 1865 , accurately shaped pockets ensuring smooth operation of load chain.

Chain hoist shall be suitable to Fix with supporting Girder at fix location at the top (for Fixed installation) and bottom hook shall be so designed that it shall be free to swivel in the loaded conditions without twisting the load chain. Hook shall be Forged as per IS 8610 or its latest amendment.



All running shafts and wheels running on fixed axles / pins shall be fitted with antifriction bearings. Necessary provision shall be made for lubrication of all moving parts and bearings. All exposed bearings shall be suitably sealed or shielded.

Electric Chain hoist shall be with limit switch, pendant push button control switch and over load relay.

Electric motor shall be suitable for 415 V , 3 ph. 50 Hz AC electric supply designed for 40 % intermittent duty with high starting torque, TEFC conforming to IS 325.

Hoist shall be designed into two separate independent units, i.e. motor and hoist for easy maintenance.

The load hook shall be swiveling type forged circular shank section and shall be as per IS:15560 with antifriction bearing.

Further, suitable local brake shall be provided as per IS to arrest and sustain loads in all working positions.

The velocity rates, effort on chain required to raise the safe working load and travel and speed shall be within the limit as per IS. Proof load test shall be carried out as per IS:6547.

Cast iron parts, wherever used, shall be of minimum grade 30, IS:210.

Trolley for manual/electric cross travel shall be designed to accommodate a wide range of I-beams and shall be capable of traveling on straight as well as curved monorails with the design being such to maintain uniform distribution of pressure on the flanges.

All gears and pinions shall be of hardened and tempered steel with machine cut teeth in metric modules and shall conform to relevant Indian standard. Surface hardening of steel is not acceptable.

All running shafts and wheels shall be fitted with ball / roller bearings with a rated life not less than 20 years based on equivalent running time as per IS:3938.

Monorail 'I' beam shall be Indian Standard Medium weight Beams (ISMB) as per IS: 808-1989 (Reaffirmed 1999) for steel beam in case of providing the same.

Clear height of the monorail shall be maintained to handle one equipment over other.

Monorails shall be extended outside the building to handle the equipment to ground level. For monorail/hoist routed inside the buildings, suitable machinery well and removable handrail and grating shall be provided on various floors of buildings, as necessary, to handle the equipment.



7.0 SUBMERSIBLE DEWATERING PUMPS

Dewatering pumps shall be of the semi open / open-impeller type, non clog vertically-mounted and close coupled to their fully submersible electric motors.

Dewatering pumps shall be supplied along with starter comprising of SFU / MCCB as isolator and required Thermal Over Load Relay, contactor etc. as per Type 2 co-ordination. Starter panel shall be installed near the pump. Starter panel shall be provided with A/M and/or L/R selector switches as required for manual operation through panel mounted on/off push buttons as well as in auto mode through level switches or other applicable method.

The dewatering pump shall operate in auto mode through Low & High level float switches to be supplied with pump and suitably interlocked with control circuit for turning ON the pump at high level and turning OFF the pump at low level. High- High level float switch shall also be provided along with pump for necessary alarm at control panel. Necessary junction box and cables in required length from level switch up to junction box and from junction box to starter panel & control panel, as applicable, shall be included in the scope of supply of this item.

Pump's shaft shall be sealed with mech. Seal on pump & motor – both side and be provided with safety devices for windings.

Dewatering pump shall also be suitably provided with LCS to START / STOP from operating platform simultaneously along with ON / OFF operation from starter panel located near the pump in manual mode. The pump shall operate through level switches only when selected in auto mode at starter panel.

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 in case of fix installation .

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 25 mm diameter.

Material of Construction		
Impeller		CI, IS 210 GR FG 260
Casing		CI, IS 210 GR FG 260
Shaft		SS410



8.1 SPECIFICATIONS FOR CHLORINATION SYSTEM (FLOOR MOUNTED)

Chlorinator:

Qty. of Chlorinators	:	As specified in BOQ
Capacity of Chlorinator	:	As specified in BOQ
Type	:	Vacuum Type Solution Feed,
Mounting	:	Floor Mounted
No. Of Tonners connected to each Chlorinator	:	As specified in BOQ
Qty. of Booster Pump sets	:	1 No. with each Chlorinator/As specified in BOQ
Cap. Of Booster Pumps	:	As per design / mfr. Recommendation (with Min. 7.5kW Motor recommended as per BOQ or higher size as required shall be provided including required higher rating of starters in electrical panel item without any price implication)
Electric Power	:	415V \pm 10%, 3-phase. 50 Hz

Chlorinator shall be Vacuum Type Solution Feed Floor Mounted Chlorination system consisting of a vacuum regulator, chlorine flow meter with chlorine rate control valve, ejector, vent and vacuum tubing, yoke clamp, etc. complete in all respects and with highest safety standards.

Each Chlorinator set shall consist of following as a minimum:

01. vacuum gauge- 1no
02. Water Pressure gauge- 1no
03. Cl₂ Pressure gauge with isolation valve-1 no.
04. Booster pump -1 set
05. skid for Chlorination system-2 nos
06. 3/4" CS ball valve on gas filter inlet / outlet-2 nos.
07. CS moisture trap - 1 no,
08. 25 mm NB CS gas manifold- 1 No
09. copper tubing 1.5 m length-3 nos.
09. Isolation valves on gas manifold- 5 nos.
10. Auxillary Ton containor valve - 3 nos.
11. 2" NB PP ball valve for Ejector inlet & outlet-2 Nos.
12. 2 " PP NRV on solution line-1 no
13. 65 mm NB Strainer on pump suction-1 no
14. isolation valve on pump on suction & delivery and NRV-2 sets
15. 50 mm NB Diffuser-1 no
16. Valve for diffuser- 1 no

In addition to above chlorinators following shall be supplied in required quantity with chlorinator system to complete the system:



Chlorine and Cl₂ solution piping:

- 25 mm NB schedule 80 Carbon steel Gas manifold with fittings for Chlorine gas line as per requirement.
- Isolation valve (PVC ball valves) of required size & qty. on Inlet/Outlet of Ejector
- NRV of required size and qty. on solution line / outlet of Ejector.
- Inter connecting of uPVC with sealing rubber “O” rings for solution piping.
- 1.5” or higher size as required, uPVC pipes and fittings for chlorine solution in required length to connect chlorinators with diffusers respectively along with all interconnecting valves at both ends
- Chlorine Spray Catcher at each manifold with required inlet & outlet isolation valves in case of common manifold/header
- All std. accessories, sub assembly, lead washers, any other hardware that is required for smooth operation of chlorinator and to complete the system

Chlorine booster pumps

- Chlorine Booster Pumps of adequate capacity/rating of submersible mono-block centrifugal type pump. The pump shall have CI Fg200 Body, bronze/CF8M impellers and stainless steel (SS 410) shaft. Unless specified elsewhere, 1 set of booster pump set shall be supplied along with each chlorinator.
- Strainer of required size shall be provided at suction side of each chlorine booster pump.
- Required piping, NRV & isolation valves, pressure gauges, etc. shall be provided as per BOQ.

Misc. & Safety Accessories

The safety accessories and chlorine leak detectors shall be provided as per BOQ.

Manual covering erection and maintenance instruction, spare parts list shall be provided for each chlorinator.

8.2 SPECIFICATIONS FOR AUTO CHLORINE ABSORPTION NEUTRALIZATION SYSTEM (CHLORINE SCRUBBER)

The chlorine absorption neutralization system shall be suitable for 21 Nos. Chlorine Tonners, 3 Nos. tonners connected to each of 7 nos. chlorinators (3 Nos. (2W + 1S) existing chlorinators and 4 Nos. (3W + 1S) proposed chlorinators) at chlorination building / shed. The general requirements / specifications shall be as under:

1.0 System description

The system should operate automatically in case of chlorine leak from container/tonner which should be covered by FRP hood with sensor. In case of chlorine leaking from the container/tonner, the system should automatically start i.e. blower and pump should start simultaneously. The pump should deliver NAOH from tank through the top of absorption tower and blower which should suck the leaked chlorine from FRP hood should push this sucked chlorine from bottom of absorption tower. Due to counter current flow of NAOH from top and Chlorine from bottom, chlorine gets neutralised. After neutralising chlorine,



chlorine free air will be vented out in the atmosphere. Vendor has to guarantee that at the outlet of the system chlorine content will not exceed than 0.1PPM.

2.0 Scope of Work

The scope includes supply, installation, testing and commissioning of complete neutralizing system including all following main components but not limited to the same and other equipment necessary to make it fully functional as per the scope of work:-

- Suitable FRP hoods/covers for chlorine tonners with 900kgs of chlorine gas in each tonner (for 21 chlorine nos. chlorine tonners)
- Combined ducting with blower of suitable rating for evacuation of chlorine gas from any tonner
- FRP scrubber unit, caustic solution circulation system with piping valves,
- Alkali circulation Pumps,
- Sensors/detectors for leakage of chlorine gas,
- Auto/manual starting of the above system,
- Electrical control panel with necessary cabling i/c cable for power from existing source,

The scope of supply indicated above is a minimum quantity requirement. Any material quantity/service requirement for completing the job in totality will be in bidder's scope and bidder has to fulfill that requirement for completing the in totality without any price implication.

3.0 Scope of Supply

The broad scope of supply but not limited to:-

A. Split type FRP hoods for Chlorine tonners

- a) As per number of tonners in service / as specified
- b) Thickness 5mm(minimum),
- c) Suitable sizing nozzles, as per system design including connection to main header
- d) Sliding Window for tube connection and operation,

B. Caustic Storage Tank

- a) Fluid handled capacity is 20%w/w caustic solution at operating temperature 80 deg C
- b) MOC is FRP + PP, Thickness as per system design
- c) Vertical cylindrical with flat bottom Type Design ,
- d) Capacity of tank is adequate for absorption of chlorine leaked from no of completely filled chlorine tonners in service + 20% margin, 300 mm Free Board.

C. Scrubber Column

- a) Fluid handled capacity is 20%w/w(maximum)caustic solution and chlorine gas.
- b) MOC is FRP + PP, Thickness as per system design
- c) Vertical cylindrical packed column type
- d) Capacity is Adequate for absorption of chlorine leaked from no of completely filled chlorine tonners in service in one hour(maximum),

D. Centrifugal Blower

- a) 2 Nos. (1w + 1s) For Each location



- b) Suitable to handle Chlorine gas from chlorine tonner
- c) Capacity to suck chlorine gas leaked from no. of completely filled chlorine tonners in service in one hour (maximum),
- d) Body and impeller MOC is PP+FRP
- e) Shaft MOC is EN-8
- f) Necessary Accessories like Common base frame, suction filter, discharge damper, belt guard etc.

E. Circulation Pump

- a) 2 Nos. (1w + 1s) For Each location
- b) Suitable to handle 20% Caustic Solution
- c) Capacity to neutralize chlorine gas leaked from no. of completely filled chlorine tonners in service in one hour (maximum),
- d) Body and impeller MOC is PP
- e) Shaft MOC is EN-8
- f) Horizontal Centrifugal Type
- f) Necessary Accessories like Common base frame, Valves, Coupling Guard etc.

F. Connection Piping & Valves,

- a) Duct Line MOC is uPVC (Sch.40),
- b) Caustic Line MOC is uPVC (Sch.40)
- c) Valve, Strainer, NRVs MOC is PP.

G. Instruments

All Necessary instruments to be considered by Bidders as mentioned below :

- a) Level Switches
- b) Level Indicators
- c) Temperature Indication
- d) Chlorine Leak Detectors (To be supplied separately as per BOQ)

H. Electrical Panel

- a) Local control panel (Relay based) for Blower, Circulation pumps, instruments etc.
- b) AUTO/MANUAL Selection
- c) Chlorine leak detection alarms (audio-visual)
- d) Necessary Push Button, Indication lamps needs to be consideration
- e) Suitable to Plant PLC/DCS Communication

9.0 GENERAL REQUIREMENT FOR ALL ABOVE ITEMS:

A. DRAWINGS SUBMISSION:

All drawings/datasheets/tech. catalogues/documents for various piping & mechanical work/items shall be submitted by bidder as under:

- (a) In Two sets in hard copy along with technical bid for review/evaluation.
- (b) In five sets by successful bidder in hard copy for review & approval including revisions, if any.
- (c) In six sets by successful bidder in hard copy and two sets in soft copy (on two separate CD) of as-built drawings



- (D) In six sets by successful bidder in hard copy and two sets in soft copy (on two separate CD) of O&M manual.

In general, the document submission for various items shall be as described below:

CENTRIFUGAL PUMP:

The following drawings shall be submitted by the Bidder for review and approval prior to manufacturing:

- 1 Preliminary outline dimensional drawing showing the details of pump and motor, Suction, discharge connections and foundation details.
- 2 Performance curves showing capacity v/s total head, efficiency, NPSH-Required and KW requirements ranging from run out to pump shut off for min., max. and rated impeller dia of offered pump.
- 3 Typical cross sectional drawing showing internal features of pump, parts and their material.
4. Torque – Speed curve of the pump.
5. Catalogues showing type of construction.

The following documents shall be submitted along with supply of pumps:

1. 3 set of Operation & Maintenance manual.
2. 3 set of Tested Curves and records
3. 3 set of As built drawings / Documents.

SPARES AND SPECIAL TOOLS

Vendor shall furnish following Lists:

1. The list of mandatory spares required for commissioning.
2. The list of recommended spares for two years normal operation.
3. The list of special tools and tackles required to assemble/dismantle the equipment.

VALVES (SV / NRV / BFV / AIR VALVE)

The following drawings shall be submitted by the Bidder for review and approval prior to manufacturing:

1. General outline dimensional drawings.
2. Cross sectional drawing showing constructional details with part list with their qty & MOC confirming relevant standards.
3. QAP of the product.
4. Catalogues showing type of construction.

In addition to above following documents shall be furnished for review and approval when valves are required with Electric Actuator for Operation.

1. Actuator Data sheet.



2. G.A. & wiring Drawing
3. Valve Torque Calculations.

The following documents shall be submitted along with supply of Valves:

1. 3 set of Operation & Maintenance manual.
2. 3 set of Test Certificates

EXPANSION BELLOWS

The manufacturer shall submit the following drawings.

- Preliminary outline dimensional drawings.
- Data Sheet
- Typical cross sectional drawing showing constructional details with the complete bill of material, MOC and relevant standards.

EOT/HOT CRANE / CPB / HOT-MONORAIL

The manufacturer shall submit the following drawings in 5 sets (hard copies) for review and approval prior to manufacturing:

- Data Sheet
- Preliminary outline dimensional drawings.
- Wiring Diagram of panel

B. INSPECTION AND TESTING AT MANUFACTURER'S WORKS:

Inspection & testing of mechanical equipments at manufacture works shall be conducted in presence of engineer-in-charge / client's representative OR third party inspection agency appointed by client.

All the charges for third party inspection shall be included under the scope of contractor. Inspection and testing at manufacturers' works' shall be carried out as specified below / applicable IS.

All instrument and equipment required for such tests shall be provided by the Contractor The instruments shall be calibrated and certified by an approved independent testing authority not more than three months prior to the test.

All the tests shall be carried out as per the relevant standard & codes. Brief description of tests to be carried out for various equipments is as follows:

CENTRIFUGAL PUMP:

HYDROSTATIC TEST:

- A standard hydrostatic test shall be conducted on the pump casing with water at $1\frac{1}{2}$ times the maximum discharge pressure on the head characteristic curve or 2 times the rated pressure whichever is higher.
- Unless otherwise stated in Data Sheet, the hydrostatic test on casing shall be conducted for minimum duration of 30 minutes.



MECHANICAL BALANCING:

- Major rotating components of the pumps like impellers, shaft, shaft sleeve etc., shall be individually statically as well as dynamically balanced at rated speed.
- Necessary test certificates shall be furnished by vendor for purchaser's approval.

PERFORMANCE TESTING:

Pump shall be tested for its full operating range in accordance with the applicable standard and approved data sheet.

Test shall be carried out with minimum NPSH as available at site for rated discharge and maximum discharge. Each pump shall be tested at its rated speed with shop motor for its entire working range.

At least one pump shall be dismantled for internal material and undue rubbing marks verification at the time of inspection in the presence of client's representative.

During pump testing, readings to the extent possible shall be taken to correspond to the net effective lift specified in the Data Sheet, and cover its full working range from its closed valve condition to run out condition i.e. when delivery valve is fully opened. Head-flow, Power-flow and efficiency-flow curves shall be drawn based on test readings. The curves produced shall be used to determine the capacity of pump sets to meet guaranteed performance at site at rated speed.

MATERIAL TEST CERTIFICATE

Material test certificates for the various pumps components shall be furnished for purchaser's review & approval as stated in the Data Sheet.

VISUAL INSPECTION:

Pumps shall be offered for visual inspection by the manufacturer, before dispatch. The components of the pumps shall not be painted before inspection.

WITNESSING OF PERFORMANCE TESTING OF PUMP

Pump Rating	Pump performance Testing to be witnessed for each duty and type (Also see Note below)
upto 15 kW motors	Performance witnessing Not Required. Vendor to submit test certi. For review/approval and dispatch clearance as per Note Given Below prior to dispatch.
> 15 kW upto 75 kW motors	25 % Qty. or min. 1 No whichever is higher per duty / type .
> 75 kW upto 160 kW motors	50 % Qty. or min. 1 No whichever is higher per duty / type .
>160 kW	100 % Qty. to be Witnessed



Note: (1) Manufacturer shall test all the pumps internally and shall provide their Internal test records along with Dynamic balancing, material test certificates for all major parts as per Tender, Hydrostatic test certificate, Dimensional check certificates, etc as per approved QAP & DS of each pump for review, record and dispatch clearance prior to dispatch of material.

VALVES (SV / NRV / BFV / AIR VALVE)

Valves shall be tested at manufacturer works for visual inspection, hydro test, operational test and dimensional check as per relevant standard.

Manufacturer shall offer valves for testing & inspection as per approved QAP and shall furnish all relevant certificates including material test cert. for review and approval.

SLUICE VALVE

Closed End Test of All C.I. sluice valves shall be carried out in presence of Engineer in charge / client's representative at manufacturer works & testing certificates shall be furnished along with each lot of supply.

Valve shall be subjected to hydrostatic tests as described in appendix B of IS: 14846 for 2 minutes duration minimum.

KGV

Body & gate of valve shall be subjected to hydrostatic tests conforming to AWWA C-520 / MSS SP-81 1995 for 2 minutes duration minimum.

BUTTERFLY VALVE

Body & Disc of valve shall be subjected to hydrostatic tests as described in IS 13095-1991 / BS EN 593 for 2 minutes duration minimum.

AIR VALVE

Valve shall be subjected to hydrostatic tests as specified in IS 14845-2000 for Body test, High pressure orifice seat test and low pressure orifice seat test for minimum 2 minutes duration.

VISUAL INSPECTION:

Valves shall be offered for visual inspection and dimensional check before dispatch. The components of the valves shall not be painted before inspection.

Valve shall be dispatched only after visual inspection and clearing instruction for dispatch.

EXPANSION BELLOWS

Each Bellows shall be subjected to following tests:

- Hydrostatic tightness test for 10 kg /cm² pressure for 5 minutes duration minimum.
- Compression and expansion test as per data sheet.

VISUAL INSPECTION:

Bellows shall be offered for visual inspection and dimensional check before dispatch. The components of the Bellows shall not be painted before inspection.



WITNESSING OF PERFORMANCE TESTING OF VALVES/EXPANSION BELLOWS

Size of Valves / Expansion Bellows	Performance Testing to be witnessed for each size / rating and type (Also see Note below)
upto 300 mm dia.	Performance witnessing Not Required. Vendor to submit test certi. For review/approval and dispatch clearance as per Note Given Below prior to dispatch.
> 300 mm dia. upto 600 mm dia.	10 % Qty. or min. 1 No whichever is higher per size / rating and type .
> 600 mm dia. upto 900 mm dia.	25 % Qty. or min. 1 No whichever is higher per size / rating and type .
>900 mm dia.	100 % Qty. to be Witnessed.
Note: (1) Manufacturer shall test all the valves/Expansion Bellows internally and shall provide their Internal test records for Hydrostatic test along with material test certificates for all major parts as per Tender, Dimensional check certificates, Actuator internal test records for valve, etc as per approved QAP & DS of valve type/expansion bellows for review , record and dispatch clearance prior to dispatch of material.	

EOT/HOT CRANE / CPB / HOIST / HOT-MONORAIL

EOT/HOT Crane/CPB / HOIST / HOT monorail shall be tested for overload tests at 125% of the rated load, speed of lifting and deflection check at manufacturer works. All required test certificates shall be furnished for hook, wire rope, brake. etc. and complete crane/hoist/CPB/monorail.

WITNESSING OF PERFORMANCE TESTING OF EOT/HOT CRANE/CPB/HOIST/HOT-MONORAIL

Type of Material Handling Equipment	Witnessing for each type & capacity
(Ele./Manual) CPB/HOIST/HOT-monorail/Chain Hoist	Performance witnessing Not Required. Manufacturer shall test all the CPB / Hoist & HOT internally and shall provide their Internal test records along with material test certificates for all major parts as per Tender, Dimensional check certificates, etc as per approved QAP & DS of CPB / Hoist & HOT for review, record and dispatch clearance prior to dispatch of material.
EOT / HOT Crane	100 % EOT / HOT Crane shall be witnessed at manufacturer works for performance test as per approved documents / QAP

MS/GI/CI/DI PIPES & FITTINGS

MS/GI/CI/DI Pipes and fittings shall be offered for inspection and testing as per applicable standards. Pipes and fittings shall be subjected to Hydrostatic test, Mass/weight check and dimensional check as per approved QAP & Bill Of Material.

WITNESSING OF PERFORMANCE TESTING OF CI / DI PIPES & FITTINGS:

Size, Class & Type of Pipes	Performance Testing to be witnessed for each size / Class and
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/ Fittings	type of pipe & Fittings (Also see Note below)
upto 300 mm dia.	Performance witnessing Not Required.
> 300 mm dia. upto 600 mm dia.	10 % Qty. or min. 1 No whichever is higher per type size / class / length and type.
> 600 mm dia. upto 900 mm dia.	25 % Qty. or min. 1 No whichever is higher per type size / class / length and type.
>900 mm dia.	100 % Qty. to be Witnessed.
Note: (1) Manufacturer shall test all the pipes & Fittings internally and shall provide their Internal test records for Hydrostatic test along with material test certificates, Mass/weight check statement, Dimensional check certificates, etc as per BOM and as per approved QAP for review, record and dispatch clearance. prior to dispatch of material.	

C. PAINTING REQUIREMENT

PUMPS

All pumps shall be provided with following painting specification.

Surface preparation : Blast clean to near white metal finish.
 Priming : 1 coat of red oxide primer before and after shop testing.
 Finish painting : 2 coat of epoxy grey paint, minimum 200 micron DFT inclusive of priming.
 Colour Code : RAL 7030 or equivalent IS

SV / NRV / AIR VALVE

COATING:

After satisfactory testing of the valves, prior to dispatch, all internal and external un-machined ferrous surfaces of the valves shall be thoroughly cleaned, dried and shall be made free from rust and grease before painting.

All exposed machined surfaces shall be painted with one coat of aluminum oxide primer confirming to IS 5660 followed by two coat of black Japan confirming to Type B of IS 341 or paint confirming to IS 9862 / IS 2932 shall be applied by brush / spray for exterior application . The coating shall be such that it shall not impart any taste or smell to water.

BFV / KGV

PAINTING :

All valves shall be painted following requirement/specification.

Surface preparation : Blast clean to near white metal finish.
 Priming : 1 coat of red oxide primer before and after shop testing.
 Finish painting : 2 coat of epoxy paint, minimum 200 micron DFT inclusive of priming.
 Colour Code :RAL 5009 or equivalent IS - AZURE BLUE shed

The painting shall be such that it shall not impart any taste or smell to water when the valve is offered for potable water.



EXPANSION BELLOWS:

PAINTING:

All Expansion Bellows shall be painted following requirement/specification.

Surface preparation	: Blast clean to near white metal finish.
Priming	: 1 coat of red oxide primer before and after shop testing.
Finish painting	: 2 coat of epoxy paint, minimum 200 micron DFT inclusive of priming.
Colour Code	:RAL 5009 or equivalent IS - AZURE BLUE shed

EOT/HOT CRANE / CPB / HOT-MONORAIL

PAINTING:

Steel materials of all structural parts of Cranes shall be shot blasted to SA 2 $\frac{1}{2}$ finish to remove rust, mill scale and grease prior to fabrication and painted as follows:

Prior to Fabrication	: One coat of epoxy paint (primer).
After partial assembly and inspection at the supplier's works	: Two coats of enamel paint.
After erection at site	: One coat of enamel paint.
Colour Code	: RAL 1017 or equivalent IS

The final coat shall be Saffron yellow Colour with black zebra marking wherever applicable. All machined parts shall be coated with grease, varnish or other approved protective coats before dispatching from the supplier's works. Interiors of the gear casings shall be painted with one coat of oil resisting paint.



TESTING, ERECTION, AND COMMISSIONING

TESTING - GENERAL

Tests of the plant at the manufacturer's premises will be required in accordance with the conditions of contract. All inspection, examination and testing shall be carried out in accordance with appropriate standards.

Testing & inspection at manufacture works of all major items viz.: pumps, motors, valves, sluice gate, grit mechanism, EOT crane. shall be conducted at manufacturer's work in presence of third party inspection agency appointed by client/ or engineer-in-charge representatives of Client.

All the charges for third party inspection shall be included under the scope of contractor. All instruments used for such tests shall be calibrated and certified by an approved independent testing authority not more than 3 months prior the test in which they are used. The engineer's representative reserves the right to impound any instrument immediately after test for independent testing. A certificate shall be produced by the contractor prior to carrying out every test showing the readings obtained, calculations and full details of the calibration certificates referred to.

If the engineer's representative witnesses a test he shall be given a copy of the test results and certificates immediately. Whether he witnesses a test or not, copies of test certificate shall be sent to the engineer's representative. No item of the plant shall be forwarded to the site until its test certificate has been approved writing by the engineer's representative. Six copies of the test certificates shall be supplied in suitable folders with proper index.

Certificates shall be clearly identified by serial or reference number where possible to the material being certified and shall include information required by the relevant reference standard or specification clause.

INSPECTION AT MANUFACTURER'S PREMISES

The inspection of all equipment required to be supplied to complete the works shall be done as detailed in this specification. Only defect free and sound material meeting the technical requirements of this specification and in accordance with a high standard of engineering would be acceptable to the engineer's representative.

For meeting these requirements of inspection, testing (including testing for chemical analysis and physical properties) shall be carried out by the contractor and certificates submitted to the engineer's representative who will have the right to witness or inspect the above mentioned testing/inspection at any stage desired by him. Calibration certificates or test instruments shall be produced for the engineer's consent in advance of testing and if necessary instruments shall be recalibrated or substituted before the commencement of the test. Items of



plant or control systems not covered by standards shall be tested in accordance with the details and program agreed between the engineer and contractor.

If during or after testing, any item of the plant fails to achieve its intended duty or otherwise prove defective it shall be modified or altered as necessary, retested and re-inspected as required by the engineer.

At least 21 days notice shall be given to the engineer before the specified tests are carried out.

No material is to be delivered to site without the above described inspection having been carried out or officially waived in writing by the engineer's representative.

One pump of each rating shall be tested with shop motor at rated speed in the presence of client's representative. Shop motor efficiency and rating shall be submitted to client for approval prior to inspection call.

TESTS AT MANUFACTURER'S PREMISES

SEWAGE / WATER PUMPSET:

Pump testing and inspection shall confirm to the latest standard

(a) Hydrostatic testing

A standard hydrostatic test shall be conducted on all the pressure parts of the pumps at 1.5 times the shut-off head of the pump or twice the rated head whichever is higher. The hydrostatic test shall be conducted for a minimum duration of 30 minutes.

(b) Balancing Test

Impeller and pump rotating assembly shall be dynamically balanced.

(c) Performance Test

Each pump shall be tested for full operating range individually to BS : 5316 : Part 2. Test shall be carried out for performance at rated speed with minimum NPSH as available at site.

MOTORS

Motors shall be offered for routine and type tests in accordance with IS :996-1979 and IS : 325-1978 at the manufacturer's works. Test certificates shall be endorsed to the effect that the motors are properly balanced and free from vibration. In addition, a test shall be required to establish the maximum transient starting current.

PIPEWORK

Testing of pipes/fitting shall be carried out in accordance with relevant standard.



VALVES

- (a) All valves shall be hydrostatically tested close ended. Body, seat/door and back seat-test pressures shall be 15 bar, 10 bar and 6 respectively.
- (b) Valves shall be tested with associated actuators for general performance.

HOISTS/CPB

- (a) The hoist shall be completely assembled in the contractor's or sub-contractor's works and shall be subjected to the tests as specified in IS : 807/ IS : 3177. The contractor shall provide the test weights.
- (b) In addition a vertical deflection test shall be carried out with the 'Safe Working Load' suspended from the hook with the crab in the centre of the span. The ratio of deflection to span shall not exceed that specified in IS 807. Manufacturer's test certificates for mechanical items shall be furnished.

GATES

- (a) Seat Clearance Check

With the gate fully closed, the clearance between seating faces when checked with thickness gauge, shall not exceed 0.1 mm.

- (b) Movement Test

Each gate shall be shop operated three times from the fully open position to the fully closed position and return to fully open, under no flow conditions to demonstrate that the assembly is workable.

- (c) Leakage Tests

With the gate in the closed position design pressure shall be applied for a period not lesser than 10 minutes to the unseating side of the sluice gate and the leakage shall not exceed the maximum leakage permissible as per AWWA C-501, for the head applied on the unseating side.

- (d) Hydrostatic Tests

Finally a differential of one and half times the design pressure shall be applied to the unseating side of the gate. Under these tests no part shall show any deflection or deformation.

ERECTION - GENERAL

The contractor's staff shall include at least one competent erection engineer with proven suitable, previous experience on similar contract to supervise the erection of the works and



sufficient skilled, semiskilled and unskilled labour to ensure completion of the works in time. The contractor shall not remove any representative, erector or skilled labour from the site without the prior approval of the engineer's representative.

One erection engineer who shall be deemed to be the contractor's representative shall be conversant with the erection and commissioning of the complete works. Should there be more than one erector, one shall be in charge and the contractor shall inform the engineer's representative in writing which erector is designated as his representative and is in charge. Erection engineer is to report to Project Manager.

The contractor's erection staff shall arrive on the site on date to be agreed by the engineer's representative before they proceed to the site, however, the contractor shall first satisfy himself, as necessary, that sufficient plant of his (or his sub-contractor's) supply has arrived on site so that there will be no delay on this account.

The contractor shall be responsible for setting up and erecting the plant to the line and levels of reference given by the engineer in writing, and for the correctness (subject as above mentioned) of the positions, levels dimensions and alignment of all parts of the works and for provision of all necessary instruments, appliances and labour in connection therewith. The checking of setting out of any line or level by the engineer or engineer's representative shall not in any way relieve the contractor of his responsibility for the correctness thereof.

Erection of plant shall be phased in such a manner so as to obstruct the work being done by other contractors or operating staff who may be present at the time. Before commencing any erection work, the contractor shall check the dimensions of structures where the various items of plant are to be installed and shall bring any deviations from the required positions, lines or dimensions to the notice of the engineer. Plant shall be erected in a neat and workmanlike manner on the foundations and at the locations shown on the approved drawings. Unless otherwise directed by the engineer, the contractor shall adhere strictly to the aforesaid approved drawings. If any damage is caused by the contractor during the course of erection to new or existing plant or buildings or any part thereof, the contractor shall, at no additional cost to the employer, make good, repair or replace the damage, promptly and effectively as directed by the engineer and to the engineer's satisfaction.

During erection of the plant the engineer will inspect the installation from time to time in the presence of the contractor's site representative to establish conformity with the requirements of the specification. Any deviations and deficiencies found or evidence of unsatisfactory workmanship shall be corrected as instructed by the engineer.

RECORD, PROCEDURES AND REPORTS

The contractor shall maintain records pertaining to the quality of installation/erection work and inspection, testing, compliance with all technical requirements in respect of all his works as described in the previous paragraphs. The reporting formats shall be in the approved formats. The contractor shall submit such records to the engineer after the completion of any particular work before submitting the bill of supply/progress of work. Such report shall comprise of shop inspection reports, shop testing reports, material test reports, based on



which dispatch clearances are provided, all the quality control reports of welding, erection and alignment records.

All the above mentioned records shall be submitted in the final form duly countersigned by the engineer's representative attesting conformity to specifications and is approval of installation and duly incorporating all the additions, alternations and information as required by the engineer, on the basis of preliminary reports giving the progress of the work. Such records notwithstanding any records submitted earlier with bill of supply/progress etc. shall be duly bound and submitted to the engineer in six copies by the contractor on his notification of the mechanical completion of erection.

COMPLETION OF ERECTION

The completion of plant under erection by the contractor shall be deemed to occur, if all the units of the plant are structurally and mechanically complete and will include among other such responsibilities the following:

- (a) Plant in the scope of the contractor has been erected, installed and grouted as per specifications.
- (b) Installation checks are completed and approved by the engineer.
- (c) The erected plant are totally ready for commissioning checks.

At the stage of completion of erection, the contractor shall ensure that all the physical, aesthetic and workmanship aspects are totally complete and the plant is fit and bound to undergo commissioning checks/tests on completion.

Upon achieving the completion as described above, the contractor shall notify the engineer by a written notice intimating such mechanical completion of units and notify the engineer for inspection and acceptance of mechanical completion. The engineer/engineer's representative shall proceed with the inspection of such units within 14 days of such a notice.

Thereafter:

- (a) The engineer shall certify completion when there are no defaults in the works and the plant is acceptable or
- (b) The engineer shall inform the contractor list of deficiencies for rectification hereinafter referred as Punch List and the contractor shall complete the rectification work within a jointly agreed period before tests on or approval of the same before proceeding with the Tests on Completion or
- (c) The engineer may inform the contractor that the works are accepted with the 'punch' list (Items which do not hamper operability, safety or maintainability) and allow the contractors to proceed with the pre-commissioning checks followed by Test on Completion when the contractor undertakes to complete such outstanding works within an agreed during Defects Liability Period.

Taking over shall be based on rectification of all deficiencies as advised by punch lists.



The erection period indicated by the contractor would be deemed to cover all the activities upto completion as stipulated in previous paragraphs, notice of completion by the contractor, inspection by the engineer for completion, and contractor rectification of all deficiencies as noticed by the deficiency/punch list, and acceptance by the engineer of such rectification, prior to Test on Completion.

Minor defects, which in the opinion of engineer which do not hamper operability and maintainability will not be taken in to account for deciding mechanical completion. Such defects shall be rectified concurrent to commissioning checks before Test on Completion. However, the engineer's decision in this regard is final.

The commissioning period as notified by the contractor shall be deemed to occur beyond the date of completion and shall include all period of pre-commissioning, trials and Test on Completion.

It is in the contractor's interest to offer the sections/units/systems, progressively under identified milestones within overall erection period, duly completed for inspection by the engineer's representative, obtain his 'punch' list, for rectification of any deficiencies pointed out by the engineer and to achieve mechanical completion before undertaking the Test on Completion within the specified erection period. The engineer also reserves a right to withhold the cost as estimated to be equivalent to the rectification of deficiencies pointed out to the contractor until such a time such deficiencies are rectified to the satisfaction of the engineer.

SETTING TO WORK

On completion of erection the contractor shall request the engineer's representative to carry out the installation inspection.

After the plant has been set to work the contractor shall continue to operate the plant for a period of one week.

INSTALLATION INSPECTION

In addition to the progressive supervision and inspection by the purchaser the contractor shall offer for inspection to engineer, the completely erected plant/part of plant on which tests are to be carried out. After such inspection by engineer, each equipment/sub-system shall be tested by the contractor in accordance with the applicable standards in the presence of engineer. Such tests shall include but not be limited to the tests specified in following clauses.

PUMPS, PIPING AND VALVES

- (a) The erected pipe work shall be subjected to a hydraulic test at 1.5 times the maximum pressure or twice the working pressure whichever is higher to test the soundness of the joints. Provision of the necessary pumps, gauges, blank flanges, tappings etc. for carrying out these tests shall be include in the contract.
- (b) Leakage tests shall be carried out on all erected pipe work, pumps and valves immediately after erection and where possible before being built in.



- (c) Operating tests shall be conducted on valves.
- (d) The pump set shall be tested for satisfactory operation. The vibration and noise level shall be checked to be within the specified limits.

PUMP MOTORS

Condition of winding insulation be tested and insulation values shall be restored to required level by suitable heating arrangements locally.

HOISTS

The hoist and lifting tackle shall be tested to 125 % of the safe working load. The contractor shall arrange the test load.

SCREEN Deleted

SLUICE GATE

- (a) Leakage test shall be performed by the contractor after installation of the sluice gates.
- (b) Under the design seating head and unseating head the leakage shall not exceed the limit specified in AWWA C501/IS : 13349, class 1 for shop testing.

INSTRUMENTATION

Performance of the instrumentation shall be checked as per the design requirements.

COMMISSIONING

SCOPE

At the time of commissioning, the engineer will appoint his representative as commissioning engineer. The contractor shall carry out commissioning tests in the presence of the commissioning engineer. Though the mechanical completion may have been checked and clarified by the site engineers, the commissioning engineer may verify any mechanical completion checks to satisfy himself that the plant is fit and sound, if such checks had not been witnessed by him. It will be the responsibility of the contractor to make all arrangements for carrying out these tests. The evaluation of test results and decision passed by the commissioning engineer regarding the test results will be final and binding on the contractor. Any additional tests or repetition of tests to establish satisfactory operation of any equipment shall be carried out by the contractor at no extra cost.

MISCELLANEOUS

Completion checks and commissioning tests on items not covered under above, shall be carried out by the contractor as per the instructions of the engineer's representative.



TAKING OVER

No item of plant will be certified for taking over by the purchaser unless it has successfully passed all the tests called for under the contract. If nevertheless the employer uses any part of the works, that part which is used shall be deemed to have been taken over at the date of such use.

Taking Over Certificate for plant shall not be issued unless the following documentation are duly compiled and submitted in final formats in duly bound volumes.

- (a) A compilation of all shop inspection results/reports of the plant/machinery with due attestation that the plants have been manufactured to specified standards (5 copies).
- (b) All erection/construction quality control checks in appropriate approved formats for all installation works with attestation that installation has been carried out as per acceptable/stipulated standards (6 copies).



TENDER / CONTRACT DRAWINGS - MECHANICAL

SR. NO.	DESCRIPTION	DRGS TO BE SUBMITTED	
		WITH BID	AFTER AWARD OF WORK
1.0	Outline dimensional drawing & Data sheet		
(a)	Pump – motor Set	*	*
(b)	Butterfly valve		*
(c)	Non Return Valve		*
(d)	Sluice Valve		*
(e)	Kinetic Air Valve		*
(f)	Expansion Bellows		*
(g)	EOT crane		*
2.0	C/S Drawing with Materials of Construction		*
(a)	Pump – motor		*
(b)	Butterfly valve		*
(c)	Non Return Valve		*
(d)	Sluice Valve		*
(e)	Kinetic Air Valve		*
(f)	Expansion Bellows		*
(g)	P&ID of Chlorination system		*
3.0	Pump (Q vs H, P, Eff. & NPSH) Pump performance Curves	*	*
3.1	ISO efficiency curve of Pump		*
4.0	'As built' GA drawing		
5.0	Instrumentation Diagrams		*
6.0	Quality Assurance Plans for		
(a)	Pump – motor Set	*	*
(b)	Butterfly valve		*
(c)	Non Return Valve		*
(d)	Sluice Valve		*
(e)	Kinetic Air Valve		*
(f)	Expansion Bellows		*
(g)	EOT Crane		*
(h)	Pipes & Fittings		*
(i)	Chlorination System		*

Note : * Indicates the document required to be submitted.



APPROVED VENDOR LIST FOR MECHANICAL EQUIPMENT

ITEM DESCRIPTION	APPROVED MAKE
VERTICAL TURBINE PUMP	JYOTI, KIRLOSKAR, WORTHINGTON (WPIL), MATHER & PLATT, VOLTAS, FLOWMORE
CENTRIFUGAL / CENTRIFUGAL NON-CLOG PUMPS	KIRLOSKAR / KSB / PULLEN / M&P / CALAMA / AQUA / JYOTI.
SLUICE VALVES	KIRLOSKAR/IVC / IVI / AUDCO / R&D MULTIPLE / KEYSTONE / FOURESS / VAG / DURGA
NON RETURN VALVES (SINGLE / MULTI DOOR)	KIRLOSKAR / IVC / IVI / R&D MULTIPLE / FOURESS / KEYSTONE / DURGA
BALL TYPE NON RETURN VALVE	KIRLOSKAR / IVC / IVI / FOURESS / NORMAX / KISHOR
BUTTERFLY VALVES	KIRLOSKAR / IVC / IVI / AUDCO / R&D MULTIPLE/ FOURESS / HI-TECH / VAG / DURGA
KINETIC AIR VALVE	KIRLOSKAR / IVC / IVI / AUDCO / R&D MULTIPLE/ FOURESS / HI-TECH / VAG / DURGA
HOT/EOT CRANE AND CHAIN PULLEY BLOCK / CHAIN HOIST	MORRIS / INDEF / SAFEX / W H BRADY / ANKER / JAPS
PVC / UPVC / CPVC PIPES	ASTRAL / SUPREME / PRINCE / DUTRON/ ASHIRVAD/ TULSI
M.S. / C.S. / G.I. PIPES	JINDAL / ZENITH / TATA / WELSPUN / SAMSHI / ASIAN / SAIL/GST/AMBIKA/TATA/MAHALAXMI/ TISCO
BEARING FOR ALL EQUIPMENT	SKF / FAG / NBC / RHP / ABC
FASTENERS	PRECISION TAPS, FIT TIGHT, F.E. DARUKHANAWALA, GKW, SUNDARAM FASTNERS, AEP, & CO., TATA, CHUNILAL & CO., STEEL & ALLIED, PRECISION ENGG.
MECHANICAL SEALS	EAGLE SEALS (SEALOL) / DURAMETALLIC / BURGMAN
ELECTRIC ACTUATOR	ROTORK / BEACON / AUMA / LIMITORK / MARSH
MS / GI PLATES & SHEET	ESSAR / TATA / JINDAL / SAIL / ZENITH / ASIAN
EXPANSION BELLOWS	DHRUV / BELOFLEX (B.D. ENGINEERS) / D. WREN / PRECISION / PRECISE ENGG. / SUR IND. / ATHULYA
PAINT	ASIAN PAINTS / SHALIMAR / BERGER / DULUX
CHLORINATOR	METITO, USA / PENNWALT (EVOQUA) / CHLOROTECH / BANACO/JASCO/REGAL
CHLORINE LEAK ABSORPTION SYSTEM (CHLORINE SCRUBBER):	
CAUSTIC TANK, ABSORPTION TOWER	SUPREME PLASTIC, NU FEB-ANKLESHWAR, CHLOROTECH
CENTRIFUGAL BLOWER	CHLOROTECH, PATEL AIR FLOW, NU FEB-ANKLESHWAR
CAUSTIC CIRCULATION PUMP	ANTICO, INVESTA, KBL, M&P
CHLORINE LEAK DETECTOR	SIEMENS, GRUNDFOS (ALLDOS), CHLOROTECH,



	HDI
PRESSURE GAUGE, TEMP. GAUGE	WIKA, FORBES MARSHALL/ H. GURU, BELLS, AIR MASTER
LEVEL GAUGE, LEVEL SWITCH	FLOW TECH, PUNE TECHTROL, NIVELCO
PP BALL VALVE	PARTH, UNP POLY VALVES



6.20.8 DETAILED TECHNICAL SPECIFICATIONS (DTS) FOR ELECTRICAL WORKS

A GENERAL REQUIREMENTS

General Requirements

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.

The equipment shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

Completeness of Supply

It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering, design and workmanship. The following shall be considered in the scope of work as a minimum.

Any material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble free operation and maintenance of the equipment shall be furnished without any extra charge.

SITC of Electrical Equipment with all necessary erection accessories and materials, all steel members (angle, channel, plate, steel sheet, etc.) for installation of electrical equipment, GI pipes, GI conduits, bends, clamps, nut, bolts, ladder type cable trays, tray installation materials & accessories, cable supporting structures, flexible metallic hoses, sealing materials for openings/conduits, single/double compression cable glands, cable lugs, cable tags, cable fasteners, insulating tapes, ferrules, RCC slabs/checker plates, GI/RCC pipes for protection of cables at road crossings and other places, cable markers, cable jointing & termination kits and materials, earthing strips of different sizes, junction boxes, pull boxes, heat resistance paints and all consumable materials for complete laying & termination of cables, earthing system and erection of electrical equipment etc.

Obtaining license / certificates / clearances etc. from appropriate Govt. statutory authority/body for installation and energizing the complete electrical system and necessary liasoning work for the same (Necessary statutory fees only shall be paid by client).

The quantity / no. of items, weight and length of cables/earthing strips, etc. mentioned in tender document are expected use but the payment will be given as per actual items installed, works done and actual length of cable/earthing strips, etc. actually used and installed.



Submission of all engineering documents, drawings, data sheets, earthing system, layout, etc. for review and approval All manuals, catalogues, characteristic curves, etc. for various electrical equipment/components shall be submitted.

Contractor shall verify the quantity of cable or such material required as per site condition against quantity specified in BOQ/SOQ prior to procurement and place order as per actual site requirement.

All Drawings / Datasheets / Tech. Catalogues / Documents for various electro-mechanical work / items shall be submitted by bidder as under:

No. of copies for Submission for various Drawings / Documents shall be as under:

- a) In Two sets in hard copy along with technical bid for review/evaluation.
- b) In five sets by successful bidder in hard copy for review & approval including revisions, if any (The approved drawings for execution purpose shall be retained in Two Sets by Client, One Set by Client's Consultant and Two Sets shall be returned to Contractor as office and site copy).
- c) In five sets by successful bidder in hard copy and two sets in soft copy (on two separate CD) of as-built drawings
- d) In three sets by successful bidder in hard copy and two sets in soft copy (on two separate CD) of Operation & Maintenance (O&M) manual including manufacturer's O&M and preventive maintenance schedule, recommended spares list, etc.

All above final documents and drawings incorporating modifications, if any, done during erection / commissioning shall be furnished.

SITE / AMBIENT CONDITIONS

All electrical equipment and installation shall be for the tropical climatic conditions and be suitable continuous operation under the site conditions as described below:

Maximum ambient temperature:	50°C
Minimum ambient temperature :	5°C
Design Ambient temperature:	50°C(Unless otherwise specified for Specific Components/equipment in the Tender)
Relative humidity :	95 %
Climate :	Tropical, Dusty, Corrosive

If not specifically mentioned, an altitude not exceeding 1000m above mean sea level shall be taken into consideration for design purpose.

Where the equipment is installed outside and exposed to direct sun, these shall be suitable for operation at higher ambient temperature and rigorous weather conditions under which they are required to operate.



CODES & STANDARDS

The electrical equipment and complete installation offered shall comply with the relevant Indian Standards / Codes of Practices, this specification, statutory regulations and sound engineering practices.

The complete system shall conform to the latest revisions of the following:

- The Indian Electricity Act & Rules
- The Indian Electricity (Supply) Act, 1948
- Regulations laid down by local statutory authorities and CEA / Electrical Inspectorate.
- The requirement of Gujarat State Electricity Board.
- Fire advisory Committee Insurance Act / Fire Insurance Regulations
- Indian Petroleum rules and any other regulations laid down by the Chief Controller of Explosives
- The factory act and any other regulations laid down by factory inspectorate

Wherever Indian Standards do not exist, the relevant IEC, British or German (VDE) / IEEE / NEMA standards shall apply. Any other Standard which is considered equivalent to or superior than applicable Indian Standards may also be acceptable. The bidder however, shall have to substantiate equivalence or superiority.

- Applicable standards govern the materials and workmanship in the manufacture of all equipments / items of Electrical Equipments:

Codes	Description
IS: 731, BS:137, IEC:383	Pin & Disc Insulator
IS: 2544, IS:5350, BS:3297, IEC:168	Porcelain post insulators for systems with nominal voltage greater than 1000V
IS 5621	Hollow insulators for use in electrical equipment
IS: 398 (Part-I&II) 1996	ACSR conductor
IS : 9920 : Part 1 to 4 : 2002	Specification for High Voltage Switches for rated voltage above 1 kV and less than 52 kV (First Revision)
IS 9921	Alternating current disconnectors (isolators) and earthing switches for voltages above 1000 V
IS : 9385- 1983	Governing spec. for GOAB switch



IS 3070	Lighting arresters for alternating current systems
IS 15086	Surge arresters
IS 8828	Electrical Accessories -Circuit Breakers for Over Current Protection for Household and Similar Installations
IEC 60529	Enclosure degree of protection IP-5X
IS 3231	Electrical relays for power system protection
IS-4047, IEC-408	Air Break Switches
IS-2208, IEC-259-1	Fuses
IS1248	Direct acting indicating analogue electrical measuring instruments and their accessories
IS 2419	Dimensions for panel mounted indicating and recording electrical instruments
IS 2705	Current transformers
IS 3156	Voltage transformers
IS 2026 , IEC 60076	Power transformers
IS 11171	Specification for Dry-Type Power Transformers.
IS 335	New insulating oils
IS1180 (Part-1) 2014	Outdoor Type Oil Immersed Distribution Transformers Up to and including 2500kVA, 33kV Specification
IS 8468	On-load tap changers
IS 2099	Bushings for alternating voltages above 1000 Volts
IS 6600	Guide for loading of oil immersed transformers
IS-4237	Switchgear General Requirements
IS 13947 IEC 60947-1 and IEC 60947-2	Low-voltage switchgear and control gear
IS-375	Panel Wiring
IS 3427	A.C. Metal Enclosed Switchgear and Control gear for Rated Voltages Above 1 kV and Up to and Including 52 kV
IS – 2516	Moulded Case Circuit Breakers
IS 3842	Application guide for electrical relays for ac systems
IS 13925	Shunt capacitors for ac power systems having a rated voltage above 1000 V
IEC 61921	Power capacitors -Low-voltage power factor correction banks
IS-2959, IEC-158-1	Contactors



IS-1822, IEC-292	Starters
EN 50081-1, 50082-2 & 60204-1	Microprocessor Soft Starter
IEC 61800 and/or IEEE 519-1992	Harmonics Control & Reactive Compensation Of Static Power Converters
IEC 721-3-3, class 3C1	Max. Corrosion Level of the Cooling Air
IEC 721-3-3 Class 3C2	Max. Corrosion Level of the Chemical Gases
UL 508C	Solid state thermal protection of AC Drive
IS 722	Specification for AC Electricity Meters
IS 12615: 2011	Energy efficient induction motors-three phase squirrel cage.
IS 325	Three phase induction motors
IS 12065	Permissible limits of noise level for rotating electrical machines
IS 2253	Designation types of construction and mounting arrangement of rotating electrical machines
IS 8789	Values of performance characteristics for three phase induction motors
IS 9283	Motors for submersible pump sets
IS 9334	Electric motor operated actuators.
IS 8130	Conductors for insulated electric cables and flexible cords
IEC : 228	Conductors of Insulated Cables.
IEC : 230	Impulse tests on cables and their accessories
IEC : 502	Extruded solid dielectric-insulated power cables for rated voltage from 1 kV up to 30 kV.
IEC : 540	Test methods for insulations and sheaths of electric cables and chords
IEC : 229	Test on cable over sheaths which have special protective functions and are applied by extrusion.
IEC : 287	Calculations of continuous current rating of cables (100% load factor).
IEC 60751	Industrial platinum resistance thermometers and platinum temperature sensors
IEC 61537	Cable management -Cable tray systems and cable ladder systems
IS : 7098 (Part II)	Cross-linked polyethylene insulated PVC sheathed cable for voltage from 3.3 kV up to 33 kV.
IS : 5831-1984	PVC insulation & sheath of electrical cables.
IS 694	PVC Insulated cables for working voltage up to and including 1100 V.



IS 1255	Code of practice for installation and maintenance of power cables up to and including 33kV rating
IS : 3975	Mild steel wires, formed wires and tapes for armouring of cables
IEC : 885(2) – 1987 (Part-II)	Electrical test methods for electric cables partial discharge test.
IS : 10810	Methods of test for cables.
IEC : 811	Common test methods for insulating and sheathing materials of electric cables.
IEC : 230	Impulse test on cables & other accessories.
IEC : 859	Cable termination for gas insulated switchgear.
IS: 7098 Part I	XLPE Insulated electric cables (heavy duty)
IS: 3961	Recommended current ratings for cables.
IS 1554	PVC insulated (heavy duty) electric cables
IS 3043	Code of practice for earthing
IS 2629	Recommended Practice for Hot-Dip Galvanizing of Iron and Steel
IS 2633	Methods for testing uniformity of coating of zinc coated articles
IS 1897	Copper strip for electrical purposes – Specification
IS 2309	Code of practice for protection of buildings and allied structures against lightning
IS 732	Code of practice for electrical wiring installations
IS : 1646	Code of practice for fire safety of buildings (General) Electrical installation.
IS : 2509	Rigid non-metallic conduits for electrical wiring.
IS : 6946	Flexible (Pliable) non-metallic conduits for electrical installation.
IS 9537	Conduits for electrical installations
IS : 3854	Switches for domestic purpose.
IS : 3415	Fittings for rigid non-metallic conduits.
IS 3837	Accessories for rigid steel conduits for electrical wiring
IS 14927	Cable trunking and ducting systems for electrical installation
IS : 4648	Guide for electrical layout in residential building Indian electricity act and rules.
IS : 1293	3 pin plugs and sockets.
IS 4795	Holders for Indicator Lamps for Electronic and Telecommunication Equipment
IS 3646	Code of practice for interior illumination
IS 1913	1969 General and Safety requirements for Electric lighting fittings
IS:1239, IS:2713	GI Lighting Poles



IS 1944	Code of practice for lighting of public thoroughfare
IS 374	Electric ceiling type fans and regulators
IS 1293	Plugs and socket-outlets of rated voltage up to and including 250 volts and rated current up to 16 amperes – Specification
IS 6665	Code of practice for industrial lighting
IS 8224	Electric lighting fittings for division 2 areas
IS 9583	Emergency lighting units
IS 9974	High pressure sodium vapour lamps
IEC 62305	Protection against lightning -Part 4: Electrical and electronic systems within structures
IS 1271	Thermal evaluation and classification of electrical insulation
IS 1544	Cotton calico
IS 1868	Anodic Coatings on Aluminium and its Alloys – Specification
IS 2190	Selection, Installation and Maintenance of First-aid Fire Extinguishers —code of practice
IS 2546	Specification for galvanized mild steel fire bucket
IS 5572	Classification of hazardous areas (other than mines) having flammable gases and vapours for electrical installation
IS 9677	Guide for limits of temperature-rise of the windings of electrical equipment when tested by different methods
IS 9678	Methods of measuring temperature rise of electrical equipment
IS 10118	Code of practice for selection, installation and maintenance of switchgear and control gear
IS 15652	Insulating mats for electrical purposes – Specification.
IS 5424	Rubber mat
IS 4770	Rubber Gloves -Electrical Purposes – Specification
IS 2551	Danger notice plates
ISO 3046	Diesel Engine
BS : 2613 / IS : 4722	Alternator

DESIGN BASIS

The Electrical equipment system shall be in accordance with project specifications and shall ensure continuity / reliability of supply, flexibility of operation and safety.

The Basic Design Data to be considered as follows:



Incoming Supply Conditions	11kV $\pm 10\%$
Frequency	50 Hz $\pm 5\%$
Voltage and Frequency Combined variation	$\pm 10\%$
Fault Level at 11 kV	350 MVA symmetrical (1 sec)
System Grounding	Effective
Fault Level at 415V (Design)	43.1 kA Symmetrical (1 sec)
Control circuit voltage	230V AC for MCCs tapped from P&N
HV Cabling	3C XLPE, 11 kV (UE)
LV Cabling	Alu. Conductor XLPE / PVC
Earthing	Earth Pit: Cu Plate/ G.I. Pipe electrode as per IS: 3043 / Specification / Drg.
Induction Motor	Energy Efficient Design of IE3 as per IS:12615-2011
Soft starter	DOL starting, Soft starter De-rated current for 50° C operating conditions \geq min.110% of rated motor current, with in-built or external bypass contactor, with in-line contactor & semi-conductor (fast acting) fuse protection, required protection parameters, etc.
Variable Frequency Drive (VFD)	VFD De-rated current for 50° C operating conditions \geq min.110% of rated motor current, with in-line contactor & semi-conductor (fast acting) fuse protection, required protection parameters, etc.

11kV HT Power is obtained from power Supply Company 11kV HT Metering Panel (Torrent) in proposed 11kV three breakers HT Panel by 11kV HT new cable. Power is then transmitted from 11kV HT three breakers panel through 11kV HT cables buried underground/laid in cable trench and terminated to the respective Transformers located in transformer yards.

The proposed transformers are connected by LT Cables / Bus Duct, as applicable, to the Main 415V Motor Control Centre (MCC). This MCC shall in turn feed downstream APFC and LDB, etc. for feeding various loads.

Motors shall be started and stopped by push buttons at Local Control Stations located near respective motors, as per specification / SLD / BOQ. Starters shall be housed in MCCs with STOP / START / RESET Push Button.

In outdoor areas cables shall be mostly buried directly underground with mechanical protection wherever applicable. In indoor areas, cables shall be laid in trenches through G.I. Cable tray / MS fabricated cable trays as indicated in BOQ/SOQ.



Earthing system design and installation shall be generally as per IS: 3043. Earthing system shall be carried out by GI strips, electrodes by GI pipes. All equipment shall have two separate and distinct earth points. Earth resistance shall not exceed one ohm at any point.

Notwithstanding anything mentioned in this tender specifications & Schedule of Quantities (SOQ) / Bill of Quantities (BOQ), contractor shall be responsible to provide all equipment and material to complete the electrical installation in all respects at no extra cost. Bidder is responsible to study the technical specifications/SOQ in entirety and understand the requirements prior to bid submission and shall bid/quote accordingly.

General Instructions to tenderers for all the Items of work:

Unit Rate: The unit rate of all the Items work as per BOQ shall include the following job as a minimum:

- Delivery of the Equipment at site.
- Unloading at site store / proposed area.
- Storage and security of supplied material and equipment till installation at site and handing over to client.
- Power and Control cabling work between equipments.
- Assembling various item as per requirement.
- Checking of operation & wiring before commissioning.
- Testing & commissioning of equipments.
- Supply of necessary spares required for commissioning.

DRAWINGS / DOCUMENTS

Successful bidder shall submit documents, data sheets, etc., all manuals, catalogues, characteristic curves, etc. for various electrical equipment/components for review & approval. Detailed documents to be prepared in line with recommended specifications / details and submitted to client in a timely manner to allow for review and approval.

The bidder shall furnish following required drawings/ **documents** for each Item for review and approval as a minimum:

- a) List of Drives / Loads with Qty. / Rating / Specifications along with power load statement
- b) Transformer, D.G. Set and Capacitor Sizing Calculations
- c) SLD and control diagram of complete electrical system
- d) Wiring / Schematic Drawings for complete electrical system (HT Panels, LT Panels, Lighting Panels, PDBs, etc.)
- e) Overall Cable Layout & Unit Wise Cable Tray layout
- f) Earthing Layout with Earthing Calculations
- g) Internal Lighting Layout with Calculations
- h) External Lighting Layout



- i) Cable Schedule with voltage drop calculation / sizing calculations
- j) Interconnection Schedule
- k) G.A. Drawings for all equipment including sectional drawing wherever necessary, and specifying recommended installation, weight, clearances requirements, etc.
- l) Filled in Data Sheets
- m) Schedule of quantities along with brief specifications
- n) Design / sizing calculations for equipment as applicable
- o) O&M manual for all equipment



VENDOR DATA REQUIREMENT

Following minimum documents shall be submitted by contractor along with the bid / offer for review and approval during detailed engineering, as indicated:

VENDOR DATA REQUIREMENT FOR ELECTRICAL WORK				
Sr. No.	Description	With Bid / offer	For Review / Approval	As-Built
1	Technical details for major equipment	*	*	*
2	List of Recommended Spares	*	*	*
3	Data sheet & B.O.M. for 11 kV HT VCB Panel / Motor / Bus duct		*	*
4	GA Drawings / B.O.M. / SLD / Wiring & Schematic diagram for Power & Control circuit for Transformer / LT Panel / Soft Starter / Bus duct		*	*
5	GA drawing /B.O.M/Technical details for LCS/indoor & outdoor light fixtures /LDB/switch board/safety equipment		*	*
6	Data sheet & BOM for cable tray.		*	*
7	Cable Schedule / Data sheet / BOM for HT /LT Power & Control Cables.		*	*
8	RCC foundation details for various electric equipment.		*	*
9	Inspection Schedule & QAP for major equipment		*	
10	Test Certificates		*	*
11	O&M Manual (If applicable)		*	*



B DETAILED TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

1.0 11kV H. T. SWITCHGEAR PANEL / VCB PANEL

Design Criteria

- The Switchgear system shall be capable of continuous operation at specified rating under the design conditions specified here in.
- The switchgears will be located indoor / outdoor area as per BOQ.
- The de-rating of the Complete panel include Bus bar section shall be done taking 50°C as an ambient design temperature if it is designed at lower temperature. The maximum temperature in any part of the equipment at specified rating shall not exceed 85 deg C considering reference ambient temperatures as 50°C.

Specific Requirements

- The switchgear shall be metal-clad, floor mounted, draw-out type. Enclosure shall conform to the degree of protection IP-5X as per IEC 60529.
- The minimum thickness of sheet steel used shall be 2mm CRCA steel & Gland Plate of 3mm thick
- The switch gear assembly shall comprise a continuous, dead-front, line-up of free standing, vertical cubicles. Each cubicle shall have a front hinged door with latches and a removable back cover. All covers and doors shall be provided with recessed neoprene gaskets. All doors shall have pad locking arrangement. The swing of the door shall be more than 90 degree.
- The design shall be such that failure of one equipment shall not affect the adjacent units.
- Each cubicle shall be separated from adjacent one by grounded sheet steel barrier and bus sealing arrangement.
- The switchgear panel shall be of arc proof version and shall be as per DIN VDE 0670 part 601, IEC-694/IEC-298.
- Bus connection from bus compartment to breaker compartment & breaker compartment to cable compartment and bus compartment to adjacent panels shall be through sealed resin cast bushing assembly.

Bus and Bus Taps

- Bus bars shall be of uniform cross section throughout the entire length of the switch board and suitable for carrying rated current continuously and short circuit current for specified duration without overheating.
- The main bus bar and connections shall be of high quality, high conductivity high strength electrolytic copper only with heat shrinkable sleeve of high dielectric strength in standard colors. **The current density for sizing purpose of copper bus bars shall not exceed 1.4 A/mm².**
- All Bus bars, Jumpers connection shall be fully insulated for working voltage with adequate phase/ground clearances and shall be sleeved with R,Y,B colour coded heat shrinkable sleeves. Bus bars, links, live parts, etc. Shall have non-flammable Epoxy cast-resin shrouds. All jointing hardware shall have nylon caps.
- No paper/cotton based insulation shall be used anywhere in the switch gear.



- Safety shutter, phase barrier, Bus bar seal-off bushing plate, support insulators etc. shall be non-flammable high tracking fibre glass/epoxy insulation system.
- All buses and connections shall be supported and braced to withstand dynamic electro-magnetic stresses due to maximum short circuit current and also to take care of any thermal expansion.

CIRCUIT BREAKER

- Circuit breaker shall be triple pole, single throw, Vacuum type / SF6 type as per BOQ, electrically operated (on/off), Draw out type.
- Circuit breaker shall have SERVICE, TEST and DISCONNECTED (ISOLATED) positions with positive indication for each position.
- Circuit breakers of identical rating shall be physically and electrically interchangeable.
- Circuit breaker shall have manual spring charge as well as motor wound charging facility with Mechanical & Electrical anti-pumping features and shunt trip. Motor wound mechanism spring charging shall take place automatically after each breaker closing operation. The motor shall be suitable for operation with voltage variation from 85% to 110% of rated voltage.
- Mechanical safety interlock shall be provided to prevent:
 - a) The circuit breaker from being raked in or out of the service position when the breaker is closed.
 - b) Raking in the circuit breaker unless the control plug is fully engaged.
 - c) Closing & opening of the breaker in an intermediate position between 'service' & 'test' and between 'Test' and 'Disconnected' position.
- Automatic safety shutters shall be provided to fully cover the female primary contacts when the breaker is withdrawn from service position.
- The manual trip device shall be located on the front door & Indicators with shrouds will be visible from front door even when breaker is closed.
- Each breaker shall be provided with following:
 - a) Auxiliary switch with 6 NO + 6 NC contacts, mounted on the draw-out portion of the switchgear.
 - b) Position/cell switch with minimum 3 NO + 1 NC contacts, one each for TEST and SERVICE position.
 - c) Auxiliary switch, with 4 NO + 4 NC contacts, mounted on the stationary portion of the switchgear and operated mechanically by a sliding lever from the breaker in SERVICE position.
 - d) Trip push button, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator.
- Limit/auxiliary switches & shall be convertible type i.e. facility for changing N.O. contact to N.C. and vice-versa. Switch contact shall be rated 10A A.C. and 2A D.C. at operating voltage.
- Each breaker shall be provided with suitable encased rollers.
- The trip coils shall be operated satisfactorily at voltage between 70 % and 110 % of rated control supply voltage.
- Each circuit breaker cubicle shall be provided with an earthing facility. Earthing facilities shall be fully interlocked to prevent faulty operation e.g. earthing of live parts.



PROTECTION & MEASUREMENT

Protective Scheme Requirement

- All the main protective relays shall be microprocessor based numerical relays.
- Auxiliary relays, timers switches etc. required to make the scheme complete shall be considered as part of the scope of work.
- All CT-PT wires shall be brought to test terminal blocks before connecting to circuits.
- The circuits of various protections shall be connected to master trip relays though aux. relays (flag indicated).
- Aux. relays shall be provided for each transformer fault. Connection of the relay shall be through links to facilitate maintenance.
- Contact arrangement, number of poles/ways in control/selector switches shall be as per the approved drawing /scheme / requirement.
- For control supply distribution, panel to panel separate set of terminal blocks shall be provided. All items/accessories required for above in each panel and in incoming panels shall be provided by the supplier.
- All relays shall be self/hand-reset type with digital/flag indication. NO/NC contacts for relays shall be as per the requirement of approved protection, annunciation & interlock schemes. Wherever required, supplier shall provide aux. relays for contact multiplication.
- Annunciation facia shall be mounted on the switchgear panels and details shall be finalized during drawing approval stage.
- Line PT's shall be provided on all incomers with suitable 110V DC secondary two winding transformer.

Incomer of H.T. Breaker shall be with following as a minimum.

Sr. No.	Relay	Indication and Monitoring	Meter
1	PT fuse failure relay	Breaker On	Ammeter
2	Trip circuit supervision relay	Breaker Off	Voltmeter
3	IDMT & Instantaneous O/C relay	Breaker trip	MFM with Modbus Port
4	IDMT & Instantaneous E/F relay	Spring charge	P.F.
5	Under voltage relay with timer	Service position	
6	Over voltage relay	Trip circuit healthy	
7	Anti pumping relay	Phase indication	
8	Master trip relay with hand reset contact(2 NO & 2 NC Contact)	12 window Annunciation panel	
9	Lockout relay		

Transformer H.T. Breaker shall be with following as a minimum.

Sr. No.	Relay	Indication and Monitoring	Meter
1	Trip circuit supervision relay	Breaker On	Ammeter



2	IDMT & Instantaneous O/C relay	Breaker Off	MFM with Modbus Port
3	IDMT & Instantaneous E/F relay	Breaker trip	
4	Anti pumping relay	Spring charge	
5	Master trip relay with hand reset contact	Service position	
6	Lockout relay	Trip circuit healthy	
7	Aux. relay for Buchholz alarm indication & Trip	12 window Annunciation panel	
8	Aux. relay for winding & oil temp. alarm indication & trip		
9	Differential relay (For transformer rating 2 MVA & above only)		

Outgoing H.T. Breaker Other than X'mer Feeder

Sr. No.	Relay	Indication and Monitoring	Meter
1	Trip circuit supervision relay	Breaker On	Ammeter
2	IDMT & Instantaneous O/C relay	Breaker Off	MFM with Modbus Port
3	IDMT & Instantaneous E/F relay	Breaker trip	
4	Anti pumping relay	Spring charge	
5	Master trip relay with hand reset contact (2 NO & 2 NC Contact)	Service position	
6	Lockout relay	Trip circuit healthy	
7	Annunciation	12 window Annunciation panel	

Relays & Meters

- MFM shall be Microprocessor based numerical and communicable type with RS-485 Port.
- All instantaneous current protection relays shall be of 3 pole type.
- Relays shall be rated for operation on 110V secondary voltage and 1A secondary current. Number and rating of relay contacts shall suit the job requirements.
- All relays shall furnish, install & co-ordinate to suit the protection and interlock requirement of VCB Panel.
- Relay shall be Low burden, provided with RS 485 Computer communication Port for monitoring & operation from Remote location / PLC with suitable Software.

Over current protection relay with below minimum Specification or better as per manufacturer STD:

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

High set: 50% to 1600% in step of 1%

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



Earth fault current protections relay with below minimum Specification or better as per manufacturer STD:

Pick up setting:	5% to 200% in step of 5%
High set:	50% to 1600% in step of 1%
Time setting:	Min 0.05 to 1.0 Sec. in step of 0.05 Sec.

Current Transformer

- Current transformers shall be cast resin type and shall be as per IS/IEC: 60044/1(2003).
- CT's shall have shorting link on secondary side to facilitate insertion of meters on secondary side without opening CT circuits.
- Accuracy class of the Current Transformers shall be:
 - a) Class PS for differential & restricted earth fault relaying.
 - b) Class 5P10 for other relaying.
 - c) Class 0.5 for MFM, Class 1 for relay and ISF < 5 for metering.
- The current transformer shall be capable of safely withstanding the short circuit, stresses corresponding to the fault level as indicated & shall be able to meet the short-time requirement specified.
- All CT secondary shall be earthed through separate switch link on terminal block.
- CT terminals & their polarities shall be clearly marked.

Voltage Transformer

- Voltage transformer shall be provided in separate cubicle.
- PTs, connection, Insulation levels shall be similar to rating of associated breaker.
- VA burden shall be selected based on requirement for meters, closing, tripping & indicating circuit.
- Voltage Transformer shall be cast-resin, draw-out type and shall have an accuracy class 1.0 / 3P. Voltage Transformer mounted on breaker carriage is not acceptable.
- The PTs shall be of shell type single phase construction with HRC fuses at both ends and plug-in connection on primary side.
- High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.
- Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.
- The PTs shall be capable of operating continuously at 110% of the rated voltage, without any damage. When star-star connection is required in non-effectively or under grounded system, the PTs shall be suitable for continuous operation with a persistent phase to ground fault.

Indication & Monitoring Instruments

- Control cabinet, mounted on top of breaker cabinet, provided with suitable anti-vibration facilities & one number heavy duty spring return type TRIP-NORMAL-CLOSE control switch with pistol grip lockable handle.
- Indicating lights in front of compartments as a minimum:



Green	:	Breaker Open
Red	:	Breaker Closed
Amber	:	Auto Trip
Blue	:	Trip Circuit Healthy
Yellow	:	Breaker Test Position
Blue	:	Breaker Service Position

- Indicating Lamp shall be 20ø LED type with series resistance with metal body. Lamp and lens shall be replaceable from the front.
- All indicating instruments shall conform to IS: 1248-1983 and IS: 2419-1979, Shall be capable of withstanding system fault current taking account CT saturation, back connected and located in the upper part of the panel.

Meters

- Indicating instruments shall be mini. 96sq.mm dial flush mounted digital type with accuracy class 1.0minimum.
- Digital type Multi-function Meter shall be of Accuracy Class: 0.5S (for Active)-IEC-687 / CBIP-88 and Suitable for measuring and digitally displaying the following parameters: kVA, kW, kWh, kVAr, A, V, P.F., frequency.
Each meter will be provided with at least two output signals of 4-20mA and communication port (RS 485) for all the above parameters for monitoring & operation from Remote location / PLC with suitable Software.
- Meter selector switches shall maintain firm contact, stay put type with knob handle. Ammeter selector switches shall be four-position type having make before break contacts to prevent open circuit of CT secondary.

Annunciation

- Shall be static type suitable to work on AC supply as specified.
- Hooter and bell for trip and alarm indication respectively.
- Test, accept and reset facilities (with push button) shall be provided on each panel.
- Suitable audio-visual indication shall be provided on DC failure. Audio alarm with reset facility shall be provided. Visual indication shall be panel-wise.
- Spare annunciation points shall be wired up to terminal blocks. 20% spare facia shall be provided
- Sequence shall be as follows:

	VISUAL	AUDIO
On Occurring of Fault	Flashing	On
On Accepting	Steady On	Off
On Reset (Fault Cleared)	Off	Off
On Reset (Fault Persists)	Steady On	Off

- Warning and emergency points shall be as per the list approved during detail engineering stage.



- One common point shall be provided to indicate operation of annunciation system of the complete board (in case of any trouble in the board in tie feeder, bus coupler, incomer, etc.). Remote and annunciation facia window detail shall be finalized during detail engineering.
- A common audible alarm for each switchgear line-up shall be provided to alert the operator that circuit breaker has tripped. Means shall be provided for silencing the audible alarm whilst leaving it free to sound when any other alarm is initiated but the associated alarm indications shall continue until cancelled.

Secondary Wiring

- The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes.
- Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.
- Wiring shall be done with flexible, 650V grade; FRLS PVC insulated wires with stranded copper conductors of 2.5mm^2 for control current circuits and voltage circuits. All power wiring like space heater supply, etc. shall be carried out with min. 2.5mm^2 PVC insulated Copper Conductor wire.
- Each wire shall be identified, at both ends, with dependent & cross addressing permanent markers bearing wire numbers. Trip circuit shall have red colour ferrule.
- Wire termination shall be made with crimping type ring connectors with insulating sleeves. Wires shall not be spliced between terminals.
- The wires shall run preferably through PVC channel with cover adequately supported along its run to prevent sagging due to flexibility or vibration. The control & power wires shall be routed through separate channels.
- Inter-panel wiring PVC channel shall be furnished for wiring between switchgear cubicles. All wiring required for interlocking between the cubicles of any switchgear shall be furnished and installed. Wherever wires are passing through cut outs or openings they shall be protected by providing suitable grommet or gasket around the openings. Inter panel wiring at shipping sections shall be through terminal blocks placed suitably at intersection points.
- **The colour of wire shall be taken as follows:**

AC System	:	Black
DC System	:	Grey
Earthing System	:	Green
CT & PT Wiring System	:	Red, Yellow, Blue, color code

Terminal Blocks

- Terminal blocks shall be 660V grade box-clamp type with 10mm^2 marking strips.
- Terminal for P.T. Secondary lead shall be disconnecting link type. Power wiring circuits and PT secondary wiring circuits shall be terminated by bolt type terminal blocks and rest by screw type terminal blocks.



- Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Multi connection terminal strip to be used if required.
- Wiring shall be so arranged that an external cable can be connected to consecutive terminals.
- Terminal blocks for external / Space Heater wiring shall be separate from inter panel wiring.
- All control wire shall be terminated with ring type insulated lug only.
- The terminal block shall be grouped according to circuit functions and individual terminals in each block shall be serially numbered in accordance with the drawings. Such numbering shall be legible, permanent and indelible.

Cable Termination

- Switchgear shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection with suitable size gland plates with knock out plates for specified HT Cable connection.
- 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 can be adopted.

Ground Bus

- A ground bus of copper rated to carry maximum fault current, shall extend full length of the switchgear in all compartments includes cable compartments etc.
- Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and draw-out P.T. unit shall be grounded through heavy multiple contacts.
- C.T. and P.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.
- All hinged doors shall be grounded using silver plated and braided copper flexible of adequate size.

Name Plates

- Nameplates shall be provided as per standard.

Space Heaters and Plug Sockets

- Each cubicle shall be provided with thermostat controlled space heaters and 5/15A, 6 pin plug socket, panel illumination lamp. Cubicle heater, Plug/socket circuits shall have Individual MCBs.
- 230 V A.C Supply to the HT panel will be made provided by client.

Auxiliary Power & Control Supply

- a) Control Voltage shall be for
 - Closing, Tripping Coil : 110 V DC
 - Indication Circuit : 110 V AC
 - Panel space Heater, 3 pin socket,
& Panel illumination : 230 V A.C.
- b) Bus-wires of adequate (minimum 4sq.mm copper) capacity shall be provided to distribute the incoming supplies to different cubicles.



- c) Isolating MCB shall be provided at the switchgear for the incoming supplies 230 V A.C. supply.
- d) Battery backup Power pack unit shall be provided for each VCB panel for 110V AC / 110V DC for closing and trip CKT suitable for min. Two Successive open & close operations after failure of power.

Tropical Protection

- All equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects & corrosion.
- Screens of stainless steel shall be furnished on all ventilating louvers to prevent the entrance of insects.

Painting

- The HT Panel shall be treated with seven tank process with cleaning of scale, grease rust and foreign adhering matter & chemical de-rusting, sand blasting, degreasing, pickling in acid bath and phosphating as per IS : 6005 and primed.
- After cleaning, the surfaces shall be given 2 coats of epoxy primer.
- After seven tank process and primer coating the HT Panel paint shall be powder coated with **RAL-7035** for inside and outside of the entire HT Panel.

Inspection & Tests

The switchgear shall be completely assembled, wired, adjusted inspected and tested at the factory as per the relevant standards.

➤ Routine Test

The tests shall include but not necessarily limited to the following for switchgear:

- a) Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.
- b) All wiring and current carrying part shall be given appropriate High Voltage test.
- c) Primary current and voltage shall be applied to all instrument transformers.
- d) Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, meters etc.
- e) Power frequency withstands insulation HV test for main circuits, auxiliary & control circuit as per relevant-IS.
- f) Milli-volt drop test across main contacts of each phase of VCB and close and open time test for VCB shall be a part of Routine test.

➤ Test Witness

The manufacturer shall perform factory tests as per IS / Specs., on equipment in presence of customer's representative / TPI agency, at Vendor / Contractor's cost.

➤ Test Certificate

- a) Certified reports of all the tests carried out at the works shall be furnished in Four (4) copies for approval of the Owner.



- b) The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports.
- c) The test report shall furnish complete identification of the equipment such as serial no., rating, equipment designation as per schematic etc. & date of test.

List of Recommended Spares

Manufacturer shall submit a list of recommended spare parts for two (2) years satisfactory and trouble free operation. Necessary consumable spares shall be also indicated specifically.



DOCUMENT: TECHNICAL DATA SHEET FOR H. T. VCB

Sr. No.	Particular	Details	Confirm / Data to be filled by the bidder
1.0	General :		
1.1	Make	As per Approved vendor list	
1.2	Model & Type no.	Pl. furnish	
1.3	Design Ambient temperature	50°C	
1.4	Atmosphere	Corrosive, Humid, Dusty	
1.5	Location	Indoor / Outdoor	
1.6	Degree of Protection	IP-5X	
2.0	Electrical Data :		
2.1	Type of breaker	Vacuum Circuit Breaker	
2.2	Service	Continuous	
2.3	Voltage	11 kV \pm 10%	
2.4	System earthing	Solidly earthed	
2.5	Frequency	50 Hz. + 5% to - 5 %	
2.6	No. of phase	3	
2.7	System fault level	350 MVA	
2.8	Rated short time current	18.37 kA (1 sec.)	
2.9	Max. system voltage	12 kV	
2.10	Auxiliary supply : (Power Pack required)	110V D.C derived from Power Pack connected on 110V AC P.T. supply.	
2.11	Making capacity	46 KA (peak)	
2.12	Bus bar material & current rating	Copper, 400 / 630 A as per BOQ.	
2.13	Cable entry	Bottom	
2.14	Cable size	3C x 240 sq.mm, XLPE armoured cable (UE)	
2.15	Breaker particulars :		
	(a) Operating duty	Pl. furnish/ show catalogue / IS	
	(b) Operating mechanism	Motor charged spring / manual trip & close	
	(c) Spring charging motor	230 V AC, 200 W	
	(d) Trip / Closing coil	110 V DC, 180 W	
	(e) Anti pumping feature/relay	Required.	
	(f) Latching requirement	Trip free	



Sr. No.	Particular	Details	Confirm / Data to be filled by the bidder
	(g) Emergency trip push button	Required.	
	(h) Space heater and cubicle lamp	Required.	
2.16	Constructional requirements		
	(a) Thickness of sheet steel for frame, enclosure, doors, covers and partitions	CRCA sheet - 2 mm, hinge type door with neoprene rubber gasket	
	(b) Colour	Epoxy powder coating RAL 7035 or Two coats epoxy primer & two coats of epoxy paint Shade 631 as per IS:5	
	(c) Earth bus size	50 x 6 mm GI Strip/ Cu	
	(d) Foundation frame	ISM-100, Suitable for three breakers or as per BOQ, with necessary bed plate and foundations bolt.	
	(e) Over all dimension	Provide dimensions	
	(f) Over load of equipment	Provide as per tender	
	(g) Minimum clear space required (i) front side as well as (ii) rear side	Provide dimensions	
2.17	Annunciation Provided	To be Provided as per tender	
2.18	Relays	As per Specifications	
	(a) Relay no. & detail	Shall be as per tender	
	(b) Type of relay	Shall be as per tender	
	(c) Make of relay	Shall be as per tender	
	(d) Model no of relay	Provide details	
2.19	Current Transformer		
	(a) Type of CT	Cast Resin	
	(b) Accuracy class	Provide details as per tender	
	(c) VA burden	Provide details as per tender	
	(d) CT ratio	Provide details as per tender	
2.20	Potential Transformer		



Sr. No.	Particular	Details	Confirm / Data to be filled by the bidder
	(a) Type of PT	Cast Resin	
	(b) Accuracy class	Provide details as per tender	
	(c) VA burden	Provide details as per tender	
	(d) PT ratio	Provide details as per tender	
2.21	Panel Accessories		
1	Toggle switch for space heater and socket	230 V A.C , 6 A	
2	(b) Socket	6 pin 5/15 A with DP MCB	
3	(c) MCB for spring charging motor circuit	6 A , DP MCB	
4	(d) MCB for ON / OFF	Double pole, 16 A, 110 V D.C for D.Cckt. Double pole, 16 A, 230 V A.C for A.Cckt.	
5	Local / Remote selector switch	4 ways, 2 positions, lockable in any position, angular movement, stay put, lever type handle.	
6	Trip – Neutral – Close (TNC) Switch.	6 ways, 3 position, spring return to neutral, angular movement, lockable pistol grip type handle.	
7	Space Heater	230 VA.C , 100 W (LT supply from LT Panel)	
8	Limit switch for test and service position.	Required	



2.0 DISTRIBUTION TRANSFORMER

Scope:

- The scope covers the detailed requirement regarding supply, installation, testing, commissioning and handing over of transformers required for the Indoor / Outdoor installation in sub-station, meeting the requirements specified in the equipment data sheet.
- Associated minor civil works i.e. foundation required for the erection of the transformer are also included in the scope of this contract.

Standards & Compliances:

- The transformers shall comply with IS: 2026 (Part I to V) and as per IS:1180 (Part I) 2014 or latest edition and shall be suitable for service under voltage and frequency fluctuation condition as permissible under Indian Electricity Act rules. Transformers shall meet the requirements specified in specifications of Transformers and capable of being loaded in accordance with IS: 6600.

General Construction & Requirements

- All transformers shall be capable of operating continuously and without adverse effects of overheating under all specified conditions of operation including variation in system of $\pm 10\%$ voltage and $\pm 3\%$ frequency or $\pm 10\%$ combined voltage and frequency unless otherwise specified.
- The transformer shall be indoor or outdoor type as specified. Unless otherwise specified the transformer in addition shall have thermal and dynamic ability to withstand external short-circuit as per clause 9 of 2026 (Part I) 1977.
- Transformer shall be designed for frequent direct on-line starting of motors having an equivalent rating in kVA up to CMR of the transformer and shall be capable of withstanding the forces arising from the starting currents of these motors.
- Transformer shall be supplied with first filling of oil conforming to IS: 335 and 10% extra oil in non-returnable drums. The BDV of oil shall confirm to IS/ IEE standards at the time of delivery at site and at the time of commissioning.
- For transformers rated higher than 2000 kVA, differential Protection shall be provided.
- The Maximum Total Loss & % Impedance without any tolerance for transformer rating up to 2500 kVA shall be as per Energy Efficiency Level 2 as per IS:1180 (Part I):2014. For transformer rating above 2500 kVA the permissible losses shall be as under:

Transformer Rating	Max. Permissible Load Losses with IS Tol.	Max. Permissible No Load Losses with IS Tol.	Max. Permissible % Impedance Voltage with IS Tol.
3000 kVA	32.0 kW	3.20 kW	6.25%
3150 kVA	33.5 kW	3.40 kW	6.25%
3500 kVA	37.5 kW	3.80 kW	7.15%
4000 kVA	42.0 kW	4.40 kW	7.15%



Taps and Tap Change Gear / Device:

- The Tap changing device shall be provided on H.V. side, off circuit type, externally hand operated with necessary indication for tap position and pad locking arrangement at any of the tapping positions.
- Tap changing device shall normally be off circuit type (OCTC) or on load (OLTC) type if specified in SOQ.
- It shall be designed for bi-directional operation and shall be of self-positioning type and shall have the following steps:

$\pm 0.0\%$	$\pm 2.5\%$	$\pm 5.0\%$	-7.5%	-10.0%
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Off Load Tap Change Gear:

- The tap changers shall be off circuit type mechanically rugged and arranged to provide for convenient inspection and maintenance without necessity for un-tanking.
- The position indicators shall be positive and there shall not be any ambiguity resulting into incomplete tap change with respect to the mechanical tap position indication.
- The operating handle of tap exchanger shall be brought out of the tank at the side at an accessible height from ground level. Tap changer operating switch mounted on the top of the transformer tanks will not be acceptable.
- Provision of padlocking the tap changers without interfering with visual tap position indicator shall be provided. The tap changing handle shall have locking arrangement of suitable size.

Fittings

- All Standard & optional fittings shall be provided as per IS: 1180(Part-1):2014.
- Additional fittings shall also be provided as stipulated in the specification of equipment schedule /data sheet.

Accommodation for Auxiliary Apparatus:

- Where specified, such as, for restricted earth fault protection, facilities shall be provided for mounting of a neutral current transformer.

Rating Plates & terminal Plates:

The following plates shall be fixed to Transformer in a visible position.

- a) Rating Plate & Terminal marking plate shall be provided as per IS: 2026(Part:1)/IS:1180(Part:1):2014.

Gas and Oil Actuated (Buchholz) Relay:

- Buchholz Relay shall be provided for transformers of capacity 400 kVA and above.
- The design of the relay mounting arrangements, the associated pipe work shall be such that mal-operation of the relays shall not take place under normal service. The pipe work shall be so arranged that all gas arising from the transformer shall pass through the gas and oil-actuated relay.
- The oil circuit through the relay shall not form a delivery path in parallel with any circulating oil pipe, nor shall it be tied into or connected through the pressure relief vent, Sharp bends in the pipe work shall be avoided.



- All wiring connections, terminal boards, fuses and links etc. connected with gas actuated relays shall be suitable for tropical atmosphere. Any wiring liable to be in contact with oil shall have oil resistant insulation and the bared ends of stranded wire shall be sealed together to prevent seepage of oil entering connection boxes used for cables or wiring.

Cable Box / Bus Duct Box

- Cable box shall not be mounted on the tank covers. It shall be feasible to remove the tank covers for inspection during maintenance etc. without recourse to breaking the joints or disturbing the cables already terminated. Necessary removable links in oil approachable through inspection cover in tank cover etc. after lowering oil shall be provided for test purpose.
- Cable box entry shall be suitable for the size and number of run of cables. Gland plate shall be provided with required number/size of knockouts for cable terminations.
- In case of bus duct, bus duct box of suitable type shall be provided.
- In case of ACSR conductor connection on HT side, vertical bushing of suitable type & size shall be provided

Parallel Operation

- Transformers shall be suitable for parallel operation. For parallel operation of transformers, the transformers shall have the same percentage impedance, same voltage ratio, same vector group, phase sequence etc.

Test

1) Test at Works

- All routine (Impedance voltage and load loss, No-load loss and excitation current, applied voltage, Induced voltage, Resistance measurement, Ratio tests, Polarity and phase-relation, Insulation resistance Leakage etc. tests) and other tests prescribed by IS:1180 (Part:1):2014 shall be carried out at the manufacturer's works before dispatch of the transformer in the presence of client/consultant/Inspecting officer.
- Copies of the test certificates shall be furnished to the department.
- In addition to the prescribed routine tests, temperature rise test shall be invariably done on one transformer of each design.
- A copy of the impulse test certificate done on the same type/design of the transformer shall be furnished in accordance with IS for purpose of record. If no impulse test was done in an earlier unit of the same design and capacity, one transformer will be subjected to impulse test in consultation with the client/consultant/Inspector at the vendor/contractor cost.
- Copies of the certificates for pressure test, Bushings test and type test for short circuit shall be supplied to the client/consultant for review.

2) Tests at Site

- In addition to tests at manufacturer's premises, all relevant pre-commissioning checks and tests conforming to IS code of practice No. 10028 (Part II & III) shall be done before energization.



- The following tests are to be particularly done before cable joints or connecting up the bus bar trunking.
 - a) Insulation test between HV to earth and HV to MV with 5000 volts Megger.
 - b) Insulation test between MV to earth with 500 volts Megger.
 - c) Di-electrical strength Test on oil.
 - d) Buchholz relay operation by simulation test when fitted.
- All test result is to be recorded and reports should be submitted to the department.

Installation and Commissioning

- The transformer shall be installed in accordance with IS 10028 (Part II & III) code of practice for Installation and maintenance of transformer. Necessary support channels shall be grouted in the flooring.
- The transformer shall be moved to its location and shall be correctly positioned. Transformer wheels shall be either locked or provided with wheel stoppers.
- Transformer oil supplied in drums shall be topped up into the transformer after duly testing/filtering up to the correct level required.
- Drying out of transformer winding will be necessary when the dielectric strength of the oil is lower than the minimum value as per IS-10028 or the transformer has not been energized within 12 months of leaving the works or where the radiator assembly is done at site.
- The transformer shall be dried out by one of the methods specified in IS-10028. Drying out with centrifugal or vacuum type filters will, however, be preferred. The contractor shall carry out the process of drying without interruption and shall maintain a log sheet indicating time, oil temperature and insulation resistance.
- All tests specified in these specifications shall be carried out by the contractor in the presence of inspecting officer/consignee free of cost.



DOCUMENT: TECHNICAL DATA SHEET FOR TRANSFORMER

SR. NO.	PARTICULAR	DETAILS	Confirm/DATA TO BE FILLED BY BIDDER
1.0	GENERAL FEATURES		
1.1	Make	As per Tender	
1.2	Rating in kVA	As per SOQ	
1.3	Installation	Outdoor	
1.4	Service	Continuous	
1.5	Climate	Corrosive	
1.6	Type of cooling	ONAN (Oil natural Air Natural)	
1.7	Ambient temperature	Max. 50° C Avg. 35° C	
1.8	Allowable temperature rise	As per IS:1180(Part-1):2014	
1.9	Painting	Epoxy, shade no. 631 as per IS : 5	
1.10	Oil type	Mineral oil	
1.11	Position	Plinth mounted	
2.0	ELECTRICAL DATA :		
2.1	Earthing : L.V. side	Solid	
2.2	No. of windings	Two	
2.3	Phase	3	
2.4	Frequency	50 Hz.	
2.5	Voltage ratio	11 / 0.433 kV	
2.6	Phase connection	Delta – Star	
2.7	Vector group	Dyn – 11	
2.8	Winding insulation class	"A"	
2.9	Terminations :	11 kV(UE), 3CX240 Sqmm	
a)	H.V. side	Al. XLPE Cable ,as per	
b)	L.V. side	SLD / BOQ	
3.0	TAP CHANGER :		
3.1	Tapping	H.V.	
3.2	Tap changer	Off Circuit	
3.3	Tapping range	as per IS-1180 (Part 1):2014	
3.4	No. of steps	as per IS-1180 (Part 1):2014	
4.0	Limit for transformer operation under over load condition as per IS	Pl. furnish	
5.0	ACCESSORIES AS UNDER :	Required	

SR. NO.	PARTICULAR	DETAILS	Confirm/DATA TOBE FILLED BY BIDDER
— — — — — — — — — — — — — — -	Inspection cover. Buchholz relay with alarm & trip contacts Marshalling box Sampling valve with plug or cover plate. Magnetic oil level gauge & Plain oil level indicator with mini. Mark. Conservator & conservator drain valve Bidirectional rollers. Oil temp. indicator with alarm & trip contacts Bottom drain & Filter valve with plug or cover plate. Double diaphragm Explosion vent Silica-gel breather		
— — — — — — — — — — — --	Air release plug / device. Separate neutral bushing Top oil filter valve Jacking pads Lifting lugs Two Earthing terminals. Thermometer pocket for O.T.I. Winding temp. indicator with alarm & trip contacts Pressure relief valve Rating and diagram plate HV & LV gland Any other required as per IS:1180 / IS:2026		
6.0	PERFORMANCE DATA :	Pl. furnish	
6.1. a)	Guaranteed Maximum Total losses without Positive tolerance (no-load + load losses at 75° C) at 100% of rated load.	IS:1180(Part-1):2014 / as per specifications	



SR. NO.	PARTICULAR	DETAILS	Confirm/DATA TO BE FILLED BY BIDDER
b)	Guaranteed Maximum Total losses without Positive tolerance (no-load + load losses at 75° C) at 50% of rated load.	IS:1180(Part-1):2014 / as per specifications	
c)	Impedance (Percent) on principal tap	IS:1180(Part-1):2014 / as per specifications	
6.2	Rated current	As per IS-1180(Part 1):2014	
a)	No load current at 100% voltage	2% of Full load Current	
b)	No load current at 112.5% voltage	5% of Full load Current	
6.3	Rated efficiency at 0.8 P.F.	As per IS-1180 (Part 1):2014	
a)	At full load	Pl. furnish.	
b)	At 100% load		
c)	At 50% load		
6.4	Rated regulation	Pl. furnish	
a)	At 0.9 P.F. lag		
b)	At 0.8 P.F. lag		
c)	At unity P.F.		
6.5	Load at which max. efficiency occurs	Pl. furnish	
6.6	Maximum efficiency	Pl. furnish	
6.7	Permissible flux density & Over fluxing	As per IS-1180 (Part 1):2014 Pl. furnish	
6.8	Current density	Pl. furnish	
7.0	MECHANICAL DATA :	Pl. furnish	
7.1	Total Quantity of oil.	Pl. furnish	
7.2 a)	Total Trans. Weight (with oil)	Pl. furnish	
b)	Trans. Weight without oil	Pl. furnish	
c)	Copper weight	Pl. furnish	
d)	core weight	Pl. furnish	
7.3	Dimensions (mm.) including all accessories:	Pl. furnish	



3.0 SWITCHYARD & TRANSFORMER YARD WITH FENCING & GATE

- Fencing around the outdoor transformer substation / 11 kV switchyard.
- The fencing shall be at a distance of not less than 1.525m on all sides of the substation (pole structure and transformer plinths, as applicable) to ensure free movement all round.
- Fencing shall be with Chain links with proper supports (concrete poles / MS Angle) for better look. The posts shall be installed at 2.5m. centre to centre and of 2.75m. height. The RCC posts shall be 100 mm square at top and 150mm square at bottom, 2.15m. having above ground level and 0.6m. below FGL, fixed in cement concrete foundation in 1:4:8 with 40 mm size stone jelly. In case of MS angles ISA 6565 angles having 6mm thickness shall be used as a minimum with rest as per RCC poles. The foundation shall be of suitable size to be finalized during detailed engineering.
- To include sand filling of 15 cm height. The fence shall be of chain link 75 mm size, 10 gauge. The height of fence is 2m after leaving 75mm gap from ground level including fixing the fence with the posts using GI binding wire etc. complete. A gate of minimum 2.5 metres or higher suitable width as required shall be provided on one side of the fencing with necessary access (road/pathway) for easy mobility of each transformers / vehicular movement and for ease of O&M of switchyard / transformer yard.
- Fencing & Gates shall be installed as per site condition / requirement.
- Fencing shall be earthed properly covering all rows on all sides. Caution notice should be fixed one on the 2/4 pole structure and at suitable location near transformers and another on the gate. The sub-station shall be uniformly levelled and spread with 35mm blue granite jelly to a depth of 15cm over a layer of sand.

4.0 LT PANEL – PMCC SWITCH BOARDS

Construction

- The MV switchboard panels shall be floor mounting, free standing, compartmentalized, Modular type suitable for indoor installation. The panel shall be totally enclosed and dust, damp & vermin proof. Enclosure shall have IP-52 or better degree of protection for indoor unit & IP-55 or better degree of protection for outdoor unit as a minimum. Outdoor unit shall be additionally provided with canopy or weather shed for protection.
- Overall height of Panel shall not exceed 2300mm (For Soft Starter panel height up to Max.2500mm can be accepted) including min. 100mm ISMC base frame. Minimum 175 mm height cable alley shall be provided at bottom of each vertical compartment as a part of panel in total height of 2300 mm. However, in case of panel mounted on floor without cable trench shall be mounted at least 500mm above the floor level to provide adequate bending radius for in & out cables.
- Soft Starter cubical compartment shall be provided with Min. **750mm width and Mini. 800mm depth & 1800/mm Height.**
- Bus bars chamber compartment shall be provided with Min. 300mm or higher as required.
- MFM and Ammeter both shall be provided for all starters rated 30kW & above.
- MV switch boards sheet steel shall be CRCA mini. 2.0 mm for load bearing members & 1.6 mm for non-load bearing members. Gland plate shall be CRCA sheet min. 3.0 mm thick.



- Make of the Panel CRCA / MS / GI Plates & sheet shall be “Essar / Tata / Jindal / Sail / Zenith / Asian” only.
- All the doors and others openings shall be provided with neoprene rubber gaskets or of durable material gaskets.
- All hardware shall be corrosion resistant. Star washers shall be used for effective continuity.
- Suitable lifting hooks and jacking pads shall be provided on each panel or on each shipping section for ease of lifting of switchboard.
- LT Panel shall be of fixed type, single/double front execution. LT Panel shall be single tier for all incomers & bus couplers and multi-tier for all outgoing feeders. Vacant space on incomer and bus coupler panel shall not be used for mounting the starter and switch gear modules.
- All auxiliary devices for control, metering, protection, indication & measurement such as push-buttons, control and selector switches, indicating lamps, ammeters, voltmeters, kWh meters and protective relays shall be mounted on the front side of respective compartment, for easy operation without opening the door.
- Cable alley should be provided as per requirement for all outgoing feeders.
- Circuit Breakers for capacitors shall have a current rating of at least 160% of the capacitor rated current. Circuit breakers capability to interrupt applicable capacitive current shall be specifically verified / supported by manufacturer recommendation.
- The switch board components, Bus bars etc. shall be designed to withstand the maximum Designed short circuit level for minimum 1 sec.
- MCCB for power feeders shall have built-in short circuit and thermal overload releases. The rated service short-circuit breaking capacity (Ics) of MCCBs shall be more than or equal to the specified fault level.
- The outgoing Motor Feeders should comply with Type-2 Coordination as per IS: 13947.
- Panel shall have main horizontal and riser bus bars air insulated, housed in a separate compartment, segregated from all other compartments, with sheet steel barriers.
- The MCC shall be provided with a continuous earth bus having sufficient cross section to carry the specified fault current for specified duration without exceeding the safe temperature throughout its entire length.
- All control wiring except C.T. secondary wiring shall be carried out with minimum 1.5 sq.mm copper conductors. C.T. secondary wiring shall be carried out with 2.5 sq.mm copper conductor.
- Adequately rated anti-condensation heater with porcelain connectors shall be provided in each breaker panel and in cable alley to maintain inside temperature 5 deg C above outside ambient temperature. It shall be supplied from 240V AC auxiliary bus for space heater. The space heater shall be provided with a thermostat having variable setting of 30-70 deg C and manually operated switch fuse and link for phase and neutral respectively.
- All starters shall be provided with Auto-Off-Manual and Local-Remote selector switches, to monitor & operate MCC or LCS, ICP / PLC.
- All multifunction meters, VFD and soft starters, where provided shall have RS485 port to communicate with PLC/SCADA.

Bus Bar



- Busbars shall be of high quality, high conductivity high strength electrolytic copper only with heat shrinkable sleeve of high dielectric strength in standard color suitable for carrying the rated and short time current without overheating supported on insulators made of non-hygroscopic, non-flammable material to ensure free thermal expansion. With tracking index equal to or more than that defined in IS. **Copper bars shall be sized for maximum 1.4 A/mm² current density only.**
- Bus bars for risers shall be rated to carry 125% of the rated current of all feeders connected to the risers.
- The current rating of neutral shall be min. half that of phase busbars.
- Both horizontal and vertical TP & N, bus bars, bus joints and supports shall be capable of withstanding dynamic and thermal stresses of the specified short circuit currents for 1 second.
- Only zinc passivated or cadmium plated high tensile steel bolts, nuts and washers shall be used for all bus bars joints and supports.
- The hot spot temperature of bus bars including joints at design temperature shall not exceed 95 deg C for normal operating conditions.
- All bus bars shall be insulated with heat shrunk PVC sleeves of 1100V grade.

Auxiliary Bus bars

- Auxiliary power bus bars of suitable rated size shall be provided for all Soft Starters, VFD & all Starters above 30kW rating. Cables / Wires shall not be acceptable.
- Auxiliary bus bars of suitable size in copper shall be provided for following application. Exact number of bus bars shall depend on various controls, metering and auxiliary power distribution requirement.
 - Panel space heater supply and motor space heater supply.
 - Control supply for breaker tripping, closing and indication circuits.
 - Control supply for breaker spring charging motors, motor starter control and indication circuits.
 - AC potential supply for energy meters, voltage operated relays, etc.

Wiring and Terminal Blocks

- All wiring shall be done with IS approved FRLS insulated copper conductors. The insulation grade for these wires shall be 660V grade. The control wiring shall preferably be enclosed in plastic channels or neatly bunched together.
- Control / CT circuit wiring shall be FRLS insulated, copper conductor of 2.5 sq.mm size.
- Each wire shall be identified at both ends by PVC ferrules.
- Interpanel wiring shall be done through PVC sleeves or rubber grommets.
- A minimum of 2 nos. or 20%, whichever is higher, spare terminals shall be provided on each terminal block.
- Marking on the terminal strips shall correspond to wire numbers on the wiring diagrams. All spare contacts and terminal of panel mounted equipment and devices shall be wired to terminal blocks.

Earthing



- All vertical panels shall be connected to a copper earth bus bar running throughout the length of the switchboard. The minimum earth bus size shall be suitable for fault level of LT Panel.
- All doors and movable parts shall be earthed using flexible copper connections to the fixed frame of the switch board. Provision shall be made to connect the earthing bus bar to the plant earthing grid at two ends. All non-current carrying metallic parts of the mounted equipment shall be earthed. Minimum 4 nos., 10mm dia hole shall be provided on the earth bus for termination of earth strip / wire.

Name Plate

- Nameplates shall be provided as per standard.

Painting

- The LT Panel shall be treated with seven tank process with cleaning of scale, grease rust and foreign adhering matter & chemical de-rusting, sand blasting, degreasing, pickling in acid bath and phosphating as per IS : 6005 and primed.
- After cleaning, the surfaces shall be given 2 coats of epoxy primer.
- After seven tank process and primer coating the external paint shall be powder coated with RAL-7035 or paint shade shall be 631 of IS-5 for indoor and outside of LT Panel.

Switchgear Modules

- Minimum 1kVA control transformer shall be provided for each bus section for motor control circuit voltage and each transformer shall be sized for the entire switchboard, with manual changeover switch.

Air Circuit Breakers

- Circuit breakers shall be air break, draw out type for feeders rated 630A and above.
- The ACB shall have 50kA (1 Sec.) S/C withstands rating and having I_{cw} for 1 Sec. = I_{cs} = I_{cu} . The breaker shall be manually draw-out type and electrically operated motor spring charging type in open execution
- All ACBs shall comply and tested as per IS – 13947 / IEC 60947-1 and IEC 60947-2 standards.
- ACB for all Incoming, Bus coupler and PCC Feeder outgoing should be Four Pole Type.
- ACB shall be with RS 485 Communication port on MODBUS.

ACB Trip Release should have Minimum following

- Overload with time delay
- S/C with time delay and Inst. Trip Setting
- Earth Fault with Time Delay.
- Under/over Voltage for incomer
- Trip Indications
- Ammeter Display

ACB shall be fitted with following

- Heavy duty switches having not less than 4 NO + NC contacts
- Built in resin cast current transformer



- Auxiliary contacts
- Shunt and under voltage tripping device
- The ACB shall be suitable for locking the breaker in various positions. Provision for door locking ACB shall be provided with the requisite end termination lugs/sockets. Terminal bars for connecting more than one terminal.

Switches/ Fuses

- The switches or fuse switches shall be load break, heavy duty / motor duty, air break type provided with quick make/break manual operating mechanism. The operating handle shall be mounted on the door of the compartment having the switch. Fuses shall be non-deteriorating HRC cartridge link type.
- Rating of heavy duty switches or motor duty starter modules shall meet the requirement of AC23 duty as per IS: 13947.

Contactors

- The contactors shall be air break type, equipped with three main contacts and minimum (2NO + 2NC) auxiliary contacts. The main contacts of a particular contactor for motor starter module shall have AC-3 rating.
- Unless otherwise specified, the coil of the contactor shall be suitable for operation on 240V, 1 Ph., AC supply and shall work satisfactorily between 65 to 110% of the rated value.

Bimetal Relay

- All bimetal overload relays shall be of manually reset type with at least 1NO and 1NC contact with reset type push buttons, mounted on door such that it shall be possible to reset the O/L relay without opening the compartment door.

Moulded Case Circuit Breakers (MCCB)

- All MCCBs shall be comply and tested as per IS - 2516 / IEC 60947-1 & IEC 60947-2 standards. MCCB shall be provided with short circuit delay & instantaneous protection, over load protection and Earth fault protection as inbuilt protection along with time delays. Position of the knob shall be clearly indicated ON, OFF and TRIP conditions as a minimum in front and 1 NO + 1 NC Aux. Contacts.
- All MCCB shall be of min. 50 kA (1 sec.) rated ultimate short circuit breaking circuit current rating as a min. or of higher short circuit current rating capacity as per fault level.
- MCCB as part of motor starter module shall be current limiting type and type tested for Type-2 co-ordination as per IS: 13947 / IS/IEC: 60947.

Protective Relays

- Relays shall be rectangular in shape, flush mounting type, having dust tight covers, removable from front, and shall be equipped with externally reset, positive action operations indicators. The relay shall have auxiliary units of either series connected or shunt connected type. All auxiliary relays shall be non-draw out type and protection relays shall be draw-out type with test facilities.



- Test plug shall be supplied loose. All relays shall conform to the requirements of IS-3231 or relevant IEC in general and IS - 3231 in specific.
- Relays shall be provided with adequate number of potential free self-reset / hand reset output contacts as required. Provision shall be made for easy isolation of trip circuits of each relays for the purpose of testing and maintenance.

Motor Protection Relay (MPR)

- Motor Protection Relay (MPR) shall be electronic type with having Overload, Earth fault; Phase currents out of balance, Over Voltage & under Voltage, Phase loss/reversal, No load running, Negative sequence & Single Phasing Preventer protection.
- Ten channels Temperature scanner shall be provided to detect high winding, and bearing temperature in order to generate tripping signals. The input signals to temperature scanner shall be derived from motor Industrial Type Pt-100 resistance temperature detectors provided in the motor windings and bearing.

1	Service and type	Motor winding and bearing temperature measurements – microprocessor based
2	Range	0 to 200° C
3	Alarm Contacts	Adjustable 4 Nos. (High temperature and very high temperature) for motor winding and bearing temperature high, very high and bearing temperature high and very high.
4	Type of Relay contacts	One Single Pole Double Throw per set point (Relay)
5	Input Signal	From RTDs for each Motor
6	No. of channels	10 Nos. (6 Nos. for Winding, 2 nos. Bearing , 2 Nos. Spare).
7	Accuracy	± 1° C
8	Communication	RS-485 for Instrumentation panel interface

Instrument Transformers (CTs/PTs)

- Current transformer & potential transformer shall generally conform to IS: 2705, IS/IEC: 60044-122 and any special requirement w.r.t. numerical relay shall be taken care of by contractor.
- Current transformers for instruments& protection shall have an accuracy class as per SLD.
- The current transformers in breaker feeders shall be capable of withstanding the applicable peak momentary short circuit and the symmetrical short circuit current for 1.0 sec.

Indicating / Measuring Instruments

- The meters shall be generally of square pattern type of 96 x 96 mm suitable for flush mounting. Instrument shall generally conform to IS: 1248 & shall have accuracy class of 1.0 or better.
- Digital meters shall have 3 ½ Digit, LED / LCD display as a minimum



- All auxiliary equipment such as shunt transducers, CT's, PT's etc., as required shall be included in the supply of switchboard. The current coil of ammeters and potential coils of voltmeters shall continuously withstand 120% of rated current and voltage, respectively, without the loss of accuracy.
- Digital type Multi-function Meter shall be of Accuracy Class: 0.5S (for Active)-IEC-687 / CBIP-88 and Suitable for measuring and digitally displaying the following parameters: kVA, kW, kWh, kVAR, A, V, P.F., frequency & with RS 485 communication port.

Danger Notice Plates:

- The danger notice plate shall be affixed in a permanent manner on operating side of the Panels. The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones as per IS 2551.

Push Buttons

- Pushbuttons shall be oil tight type with 2 NO + 2 NC contacts; each contact shall have rated operational current of not less than 4A (AC-11)
- Pushbuttons for START, OPEN, CLOSE, LEFT, RIGHT, FORWARD, REVERSE etc. shall be flush type with spring aided self-reset contacts.
- Pushbuttons for STOP/EMERGENCY STOP shall be mushroom headed type with stay put contacts & shall be colored red. The operation of the button shall be press to lock and twist to release. The stop PB for each outgoing feeder/starter at MCC and for field LCS shall be EMERGENCY STOP push button. Push buttons shall be in compliance with IEC 60947-5-5

Push button colours shall be as follows:

Stop / Open / Emergency	-	Red
Start / close	-	Green
Reset / Test	-	Yellow / White

Indicating Lamps

- Colour shade for the indicating lamps shall be as below LED type:

ON indicating lamp	:	Red
OFF indicating lamp	:	Green
TRIP indicating lamp	:	Amber
PHASE indicating lamp	:	Red, Yellow and Blue
TRIP circuit healthy lamp	:	Milky

SHOP DRAWINGS

- Prior to fabrication of the Panels the supplier / contractor 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 design calculations indicating type, size, short circuiting rating of all the electrical components used, bus bar size and calculation, internal wiring size, Panels dimension, 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.



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.
- The MV / LT Panels shall be offered for three stage inspection to be witnessed by client / TPI as under (If waiver not given by client) :
 - a) **Stage-I:** Raw Material Stage. The material shall be offered for inspection during fabrication stage. The material Test Certificates and makes shall be reviewed and witnessed.
 - b) **Stage-II:** Seven Tank Process Stage. After fabrication the enclosures/parts shall be offered for witness during seven tank process stage (in-house or external agency works)
 - c) **Stage-III:** Final Inspection

TEST CERTIFICATES

- Testing of Panels shall be carried out at factory as specified in Indian standards in the presence of by client / consultant / client's representative. The test results shall be recorded on a prescribed form. All type test certificates and routine test certificate for the test carried out at factory and bought out material and at site shall be submitted in duplicate to the consultant for approval.



DOCUMENT: TECHNICAL DATA SHEET FOR MEDIUM VOLTAGE PANEL BOARD

SR. NO.	PARTICULAR	DETAILS	CONFIRM/ DATA TO BE FILLED BY
1.0	SITE CONDITION		
1.1	Type/Make	Indoor/Aspertender	
1.2	Mounting	Floor	
1.3	Ambient Temperature	50° C	
1.4	Atmosphere	Corrosive, Humid and Dusty	
2.0	CONSTRUCTION		
2.1	Housing	2.0 mm thick CRCA sheet for body and all partitions	
2.2	Protection Class	IP-5X	
2.3	Doors	1.6 mm thick CRCA sheet with Hinges	
2.4	Base channel	75x40mm C Channel	
3.0	OPERATIVE CONDITION		
3.1	Voltage	415V \pm 10%	
SR. NO.	PARTICULAR	DETAILS	CONFIRM / DATA TO BE FILLED BY THE BIDDER
3.2	No. of phase	3	
3.3	System	3 phase, 4 wire	
3.4	Frequency	50Hz, +5%/-5%	
3.5	Fault Current	25 kA/50kA as per SLD	
3.6	Neutral Grounding	Solid	
4.0	CONTROL SYSTEM		
4.1	Voltage		
	For Indication	230V A.C.	
	For Metering	230V A.C.	
	For Protection	230V A.C.	
4.2	Control Supply Through	230V A.C. for MCC & APFC only	
4.3	Control Wiring	1.5/2.5mm ² FRLSCu. Wire	
5.0	BUSBAR		



5.1	PhaseBus barMaterial	Copper	
5.2	NeutralBus barMaterial	SameasPhaseBus bar.	
5.3	EarthBus barMaterial	SameasPhaseBus bar.	
6.0	PLCBasedSystem	As per SLD / BOQ.	
7.0	ElectronicMotor ProtectionRelay (with RS-485port)	Microprocessor based	
7.1	Type	Aspertender	
7.2	Make	Aspertender	
7.3	Protection	Pl.furnish	
	1)overcurrent 2)singlephasing 3)phasereverse 4)Currentunbalance 5)undercurrent(dryrun) 6)stall(bearingbroken) lockedrotor 7)RestartInhibition 8)Ground/Earth fault(CBCT)		
SR. NO.	PARTICULAR	DETAILS	CONFIRM / DATATOBE FILLED BY THE BIDDER
8.0	PAINTING		
8.1	Sheetshouldbe7tank processed,OvenBakedat 310°C withpowder coating.	Required	
8.2	Colour	RAL 7035	
8.4	Shade: Exterior & Interior	RAL 7035	
9.0	PANEL TEMPERATURE RISE		
9.1	Max.temperaturerise insidethepanel(°C)	35°Caboveambient	



10.0	ControlWiring		
10.1	WireSize	1CX2.5Mm ² /1CX1.5Mm ² Cu.	
11.0	Hardware(ZincPlated)	YES	
12.0	SpaceHeater	230VA.C.withthermostat	
13.0	PocketForDrawingsat door	YES	
14.0	AnnunciatorWindow(Free standingtobemountedat convenientlocationwith requiredcabling,required contactsshouldhave separateterminalblockin cablealley)	IndicationforeachPump: a.Pump Trip (Red)-Through starter b.Highlevelinsump c.Lowandverylowlevelinsump d. Highand lowdischargepressure e. ValveMotorTrip	
15.0	Instrumentationcompartment	Separate compartment for energymeter, Hr meter, level controller, etc. withnecessaryinternalwiring	
16.0	Panel Internal Lighting	Auto NO contact/switch with Panel door and CFL 18 W for Panel Internal Lighting	

Note:Otherspecificationsnotmentionedindatasheetshallbeconsideredaspertenderspecifications



5.0 AUTOMATIC PFIC PANEL & CAPACITOR BANK

- Panel height shall be 1800mm and depth shall be 600mm and length shall be minimum 900mm or higher length as required.
- The control equipment including capacitors shall be mounted in a panel made of 2 mm cold rolled sheet steel for all load-bearing members and 1.6 mm for doors and covers. The panel shall be of indoor type for internal part of LT panel as a cubical compartment as per SLD / BOQ.
- The housing of the capacitor banks shall be of open construction with free ventilation for capacitor units (IP5X). The connections from the capacitor units to the control panel shall be carried in totally enclosed, dust-proof, vermin-proof bus-ways or wire-ways.
- Except for the specific requirements of PFIC / APFC panel specified here in, **rest all specifications shall be as per LT Panel / MV Switchboard specifications specified above.**

The automatic control panel shall comprise of the following:-

- MCCB / MCB for Protection of Each Capacitor Bank (MCB should be suitable for Capacitor Switching)
- Microprocessor based APFC Relay for sensing and correction the power factor of the system with required no. of steps to achieve the specified improvement in power factor.
- 'ON' and 'OFF' push Buttons for manual control of each capacitor unit with indication lamp.
- 'ON' indication lamps with LED type lamps for each capacitor unit.
- Capacitor Duty Contactor with series Reactor.
- Any other components required for satisfactory and safe operation.
- Capacitor Banks shall comprise identical delta connected three phase units. Capacitor Banks shall be non-flammable, non – toxic, all polypropylene type with extended foil design. Capacitors should be of APP Double Layer Type only.
- Capacitor shall be compact in size and hermetically sealed. In built fuses & surge suppressors shall be provided for protection of each capacitor element.

Test and Test Reports

- All tests shall be conducted in accordance with the latest edition of IS – 2834 and as applicable for controls.
- Type test certificates for similar capacitor units shall be furnished.

Drawings to be submitted for the approval of the Engineers Representative:

- Fully dimensioned general arrangement drawings of capacitor and capacitor control panel with elevation side view, sectional view and foundation details.
- Complete schematic and wiring diagrams for capacitor control panel.

6.0 SOFT STARTER (FORMING PART OF LT PANEL)

SCOPE



This specification covers the requirement for design, manufacture, installation, testing and commissioning of step-less reduced voltage / solid state torque controlled soft starter for motors in MCC panel to provide linear ramp starting and stopping of A.C induction motors.

Constructional and Performance Features (Microprocessor Soft Starter)

- The PCB power structure shall consist of six SCR's mounted on a heat sink for ratings up to suitable rating of motor. PCB shall be self-tuning to accept control power input as per design.
- All phases should be controlled during start/stop.
- Soft starter shall consist of built-in MODBUS RTU for monitoring & control.
- Soft starter should be built for continuous operation without need of by pass for any reason.
- The logic circuitry shall incorporate a latch circuit for two wire / three-wire control.
- Control terminals shall be easily accessible and located on the front bottom of the device.

Following shall be considered while sizing the soft starter and its enclosure:

- Soft Starter (S/S) shall be de-rated as per manufacturer's recommendation for 50°C operating conditions based on site/operating condition and such de-rated current of Soft Starter shall be min. 110% of rated current of motor.
- Soft Starter shall be rated for DOL starting and shall have **In-built or External Bypass Contactor of AC3** rating.
- Soft starter shall be provided with breaker (MCCB/ACB) along with F.A. Semi-conductor fuse protection and with series contactor of rating as recommended by vendor and meeting Type-2 co-ordination requirement (soft starter signal to be interlocked with PLC and in manual mode timer based interlock to be provided to ensure that signal to turn on S/S is fed only if contactor close signal is received) to switch off supply to contactor through PLC when soft starter is not ON.
- Contractor/Vendor shall furnish the heat dissipation load data and shall provide the cooling arrangement accordingly to ensure that the temperature rise within enclosure does not exceed 5°C over the max. ambient temperature of 50°C.
- Min. Two cooling fans shall be provided or higher nos. as required. The enclosure cooling fans & temperature sensing device (RTD / Thermistors) with tripping arrangement shall be provided and shall also be interlocked with soft starter operation i.e. in case of cooling fan failure or excess temperature (55 deg C or as set), the soft starter shall be tripped / shall not turn ON. Vents shall be provided with washable filter.
- Soft Starter shall be provided with conformal coating to protection level 3C3 according to IEC-60721-3-3 to withstand harsh environment.
- Aux. contact of incoming breaker & contactor shall be used in series to provide "Soft Starter Ready" interlock signal for PLC/remote operation
- a) Detachable display/key pad with Digital parameter adjustment, preferred with cable suitable for door mounting. The Control keypad and display shall have the option for remote mounting. For safety reasons the controller should have green lights for running and red for start/stop.

CONTROL MODULE DESIGN FEATURES



User Adjustments

- The two acceleration start ramp & stop ramp timers shall have individual adjustments from 1 to 60 seconds & 2 to 60 seconds respectively.
- The initial torque setting shall be adjustable from 0 to 200 % of motor torque.
- The end torque setting shall be adjustable from 50 to 200% of motor torque.
- Current limit starting shall be adjustable from 150% to 500% of the motor's full load current.

Pump Control (Standard Feature)

- The standard feature pump control shall be implemented to provide closed loop control of a motor to match the specific torque requirements of centrifugal pumps for both starting and stopping.
- Pump stop shall be initiated without the need for a dedicated Pump Stop input. A coast-to-rest stop shall still be possible with stop input.

Controller's Features and Modes

- a) **Starting modes** required for controller includes Linear Torque control for Start, Pump Control Current Limit Start (Voltage ramp Start, Voltage ramp with current limit Start, Full Voltage DPL Start, Remote analogue control, Slow Speed time controlled, Slow Speed external controlled, Dual Ramp Start, Soft Start with Selectable Torque Boost), Bypass control & Bypass contactor mode with all the protection parameter working.
- b) **Stopping modes** required for controller includes Linear Torque control for Stop, Quadratic Torque control for Stop, Pump Control (DOL/Cost to stop, Remote analogue control Stop, Slow Speed time controlled, Slow Speed external controlled, Dual Ramp Stop, Bypass control).

Protection and Diagnostics

- Protections of Controller shall meet applicable standards.
- **Protective Features:** Motor Thermal Overload – selectable for starting class 10A, 15A, 25A under load protection (to avoid dry run), Soft Start thermal overload, PTC input, Phase imbalance, Phase reversal, Over voltage, Under voltage, Locked Rotor, Excessive Starts per hour for application, Phase loss input / output etc.
- Shaft Power measurement without the need of external electro-mechanical sensors.
- Electronic thermal memory shall be provided for enhanced motor protection.
- All Protections should be available in bypass mode also.
- When fault conditions are detected, the controller shall inhibit starting or shut down SCR pulse firing.
- **Fault Indications:** Controller shall indicate latest fault indications/occurrence for Line failure, Phase imbalance, Over temperature – motor, Over temperature – Soft Starter, Shorted Thyristor, Open Thyristor, Locked Rotor, Motor output loss, Overload & Under load – Shaft Torque, Over voltage, Under voltage, Excessive Starts & Phase reversal etc.
- **Viewing Functions:** Motor Current, Three Phase Voltage, Shaft Power in kW / HP (selectable), Motor thermal capacity, Motor Energy consumption (kWh), Power factor & Run time in hours etc.



7.0 INDUCTION MOTOR (IE3 TYPE)

SCOPE:

This specification covers the design, manufacture, inspection, testing at works, supply, delivery to site, installation, testing at a site & commissioning of three phase, squirrel cage, solid shaft induction motors with all accessories for driving various pumps / equipment required for the complete operation of the plant as per the scope of this work. All motors shall be as per these specifications unless for any other more stringent requirements mentioned elsewhere.

CODES AND STANDARDS:

The design, material, construction, manufacture, inspection, testing and performance of induction motors shall comply with all currently applicable status, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also confirm to the IS 325 and IS 12615-2011 or latest applicable standards.

GENERAL DESIGN AND CONSTRUCTION REQUIREMENTS:

Motors shall be continuous maximum rated as per IS:12615-2011, IS: 325, and IS: 4722 (latest edition) and preferably be designed for low starting current and smooth acceleration except for cases where the driven equipment characteristic demand otherwise. Motors shall be of 4/6/8 pole design as required and provided with terminal box large enough to accommodate armored PVC /XLPE insulated Alluminium conductor of appropriate size / ratings. Motors shall be of energy efficient design of IE3 as per IS:12615-2011.

OPERATING CONDITIONS

1) Frequency and Voltage Variation

All LT motors shall be squirrel cage motor and the motor shall be suitable for the following.

Supply voltage	:	415 Volts, 3 Phase, 50 Hz AC supply
Voltage variation	:	$\pm 10\%$
Frequency variation	:	$\pm 5\%$
Combined variation of		
Voltage & Frequency	:	10%
Design Temperature	:	50° C

2) STARTING

- a) Unless otherwise specified, motors shall be designed for direct-on-line starting.
- b) Motors shall be designed for re-acceleration under full load after momentary loss of voltage with the residual voltage being 100% and is in phase opposition to the applied voltage.
- c) Minimum locked rotor thermal withstand time at rated voltage shall be 10 seconds under cold conditions and 8 seconds under hot conditions. The starting time of motor shall be less than the hot thermal withstand time to permit application of conventional bimetal relays or thermal release against locked rotor and overload conditions.



- d) The motors shall be suitable for starting under specified load conditions with 75% of rated voltage at the motor terminals.
- e) Motors shall be designed to allow the minimum number of consecutive starts indicated in Table - I below:

Starts	Min. no. of Consecutive Starts
No. of consecutive start-ups with initial temp. of the Motor at ambient level (cold)	3
No. of consecutive start-ups with initial temp. of the Motor at full load operating level (hot)	2

3) **Direction of Rotation**

Motors shall be suitable for either direction of rotation. In case unidirectional fan is provided for motors, direction of rotation for which the motor is designed shall be permanently indicated by means of an arrow. When a motor is provided with bi-directional fans, a double headed arrow should be provided.

Normally clockwise rotation is desired as observed from driving (coupling) end. Ample space shall be provided in terminal box for interchanging any two external leads for obtaining reverse phase sequence.

PERFORMANCE

- 1) Motors shall be rated for continuous duty (S_1) unless otherwise specified.
- 2) Unless otherwise specified, the starting current (as % of rated current) shall not exceed 600% subject to tolerance.
- 3) In particular cases, when the starting current is to be limited or when starting with reduced voltage, care shall be taken such that the design value of torque meets the load requirement while at the same time complying of above mentioned clause for “starting” requirement of motor.
- 4) Starting torque and minimum torque of the motor shall be compatible with the speed torque curve of the driven equipment under specified starting and operating condition.
- 5) For heavy duty drives such as blowers, etc. high starting torque motors shall be provided.
- 6) In case where characteristics of driven equipment are not available while selecting the motor, minimum starting torque shall be 110% of rated value for motors up to 75 KW and shall be 90% of rated value for motors above 75 KW.
- 7) The pull out torque at the rated voltage shall be not less than 175% of the rated load torque with no negative tolerance. Unless otherwise agreed, the pull out torque shall not exceed 300% of rated load torque.
- 8) In case of motors driving equipment with pulsating loads (e.g. reciprocating compressors) the minimum value of pull out torque at 75% of rated voltage shall be more than the peak value of pulsating torque and the current pulsation shall be limited to 40%.



CONSTRUCTIONAL DETAILS

Motor Casing and Type of Enclosure

Motors for use in safe area shall be of industrial type meeting the specified ambient conditions, starting and operating requirements. Motors for use in hazardous areas shall have type of protection Ex-d or other as per area classification and to meet requirement of applicable Indian Standards.

The motor enclosure including terminal boxes and bearing housing shall have IP:55 degree of protection.

Motor casing shall be provided with a suitable drain for removal of condensed moisture for motors operating in safe area.

All vertical motors shall be provided with suitable canopies covering the motors fully. Motors designed to handle external thrust from the driven equipment shall be supplied with a thrust bearing at the NDE.

Motors shall have standard frame sizes for various output ratings as per IS.

Motors installed in outdoor areas shall be provided with suitable canopies/ covers.

All external surfaces of the motor and it's canopy shall be given a coat of epoxy based paint shade 632 as per IS.

Windings

Insulation and bracing

Unless otherwise specified, motors shall be provided with class 'F' insulation with the permissible temperature rise above the specified ambient temperature shall be limited to class 'B'. **VFD operated motor shall be with Class 'H' insulation.**

The winding shall be tropicalized. The windings shall preferably be vacuum impregnated. Alternately the windings shall be suitably varnished, baked and treated with epoxy gel for operating satisfactorily in humid and corrosive atmosphere.

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

Overhung of winding shall be DOUBLE coated with epoxy gel.

However, motors operating with Variable Frequency Drive shall have winding and other features as follows:

- Winding shall be double insulated, vacuum impregnated
- Winding shall have Class H insulation.
- Motors rated 11KW and above shall have forced cooling arrangement and for motors rated less than 11 KW, frame size shall be suitably selected for effective heat dissipation.
- Motors shall be suitable to continuously operate within 30% to 100% speed range variation.

Phase Connections& Terminal Box

The windings shall be connected in Delta. The ends of the windings shall be brought out into a terminal box. All motors shall be with six terminals and suitable links to connect them in star or in delta. Motors rated up to and including 2.2 KW which may be accepted with three terminals. The terminal box shall be located on the RHS as viewed from driving (coupling) end (for motors above 3.7 KW). The terminal box shall be rotatable in steps of 90 Deg. to allow



cable entry from any direction. An adequately sized earth terminal shall be provided in the motor terminal box.

Bearing and Lubrication

Motors shall have grease lubricated ball or roller bearings with minimum L-10 rating life of 5 years (40,000 hours) at rated operating condition. Bearings shall be capable of grease injection from outside without removal of covers with motors in running condition. Necessary seal to prevent entry of dust/moisture and loss of grease shall be provided. Grease nipples shall be provided with appropriately located relief devices which ensure passage of grease through the bearings.

Cooling System

All motors shall be self-ventilated, fan cooled. VFD operated motors rated 11 KW and above shall be force cooled.

Rotor

The motor shall be squirrel cage type, dynamically balanced to provide a low vibration level and long service life of the bearings.

Shaft Extension

Motors shall be provided with a single shaft extension with key-way and full key. Motor shaft shall be sized to withstand 10 times the rated design torque.

Lifting Hook

All motors weighing more than 30 kg. shall be provided with lifting hook of adequate capacity.

Earth Terminals

Two earth terminals of adequate size, located preferably on diametrically opposite sides shall be provided for each motor. Necessary nuts and spring washers shall be provided for earth connection.

ACCESSORIES

- Anti- condensation heaters of 240 V, Single Phase, shall be provided for motors as per SLD / rated 37 KW and above. Heaters shall remain ON when the motor is not in service and as such shall not cause damage to the windings. Heaters shall be metal encased with a low surface temperature.
- Thermistors / RTD, one for each phase, shall be provided for motors rated 90KW and above, suitably terminated in auxiliary terminal box.
- Name plates shall be provided on each motor as per IS.
- Noise level and Motor Vibrations shall be within the limits as laid down in IS.

MOTOR TESTING

Testing of motors shall comply with the requirements of IS:4029. Motor shall be subjected to all routine tests as per IS 12615-2011/ applicable standard, shall be carried on the motors in OEM factory, in witness of client / TPI agency. All type tests certificates shall be furnished during factory test. Generated values of efficiency and power factors at full load and $\frac{3}{4}$ load shall be furnished by the tenderer.



DRAWINGS: The contractor/manufacturer shall submit the following drawings for review / approval:

- GAD & Preliminary outline dimensional drawings showing other details of motor, terminal boxes etc.
- Typical cross sectional drawing showing constructional details with the complete bill of material and relevant standards.
- Performance curves.
- Data Sheets



DOCUMENT: TECHNICAL DATA SHEET FOR INDUCTION MOTOR

SR. NO.	PARTICULAR	DESCRIPTION	CONFIRM/ DATA TO BE FILED BY BIDDER
1.0	Make	Pl. Furnish	
2.0	Application	Pl. furnish as per applicable	
3.0	Type of motor	Squirrel cage induction	
4.0	Motor Ratings in KW	Please Furnish Detail	
5.0	No. of units/Qty.-nos	As per BOQ / Tender	
6.0	Supply neutral	Solidly earthed	
7.0	Rated voltage	415 V	
8.0	No. of Phase & frequency	3 Phase & 50 Hz.	
9.0	Full load Amp.-A	Pl. Furnish	
10.0	Supply condition	± 10% voltage variation ± 5% frequency variation ± 10% combined variation	
11.0	Synchronous Speed	As per BOQ / Tender	
12.0	Duty condition as per IS 325 / 12615 or equivalent	S1 suitable for continuous operations	
13.0	Method of starting	DOL / Star delta / Soft Starter / VFD etc. as applicable	
14.0	Guaranteed Motor Efficiency @ full load @ 3/4 load @ ½ load	Motor shall be IE3 as per IS:12615-2011. Pl. furnish	
15.0	Power Factor @ full load @ 3/4 load @ ½ load	As per IE3 as per IS:12615-2011. Pl. furnish.	
16.0	Starting torque % of full load torque	Sufficient starting torque to start the maximum full load of driven equipment. Pl. furnish.	
17.0	Pull out torque % of full load torque	Sufficient to bring the motor to normal speed in minimum time. Pl. furnish.	
18.0	Starting time at specified minimum starting voltage Sec.	Pl. furnish (As per Tender)	



SR. NO.	PARTICULAR	DESCRIPTION	CONFIRM/ DATA TO BE FILED BY BIDDER
19.0	Permissible running time at full load at minimum allowable voltage Min.	Pl. furnish (As per Tender)	
20.0	Locked rotor current withstand time (safe stall time) at 110% rated voltage	Pl. furnish (As per Tender)	
20.1	At rated temp. (Hot)	Pl. furnish (As per Tender)	
20.2	When cold	Pl. furnish (As per Tender)	
21.0	Class of insulation & temp. rise by thermometer	Pl. furnish (As per Tender)	
22.0	Design temperature	50° C	
23.0	Location	As per Tender	
24.0	Hazardous area division	As per Tender	
25.0	Atmosphere	As per Tender	
26.0	a) Type of Cooling b) Type of enclosure c) Degree of protection	Pl. furnish. Pl. furnish. For Motor & TB: min. IP 55:	
27.0	Terminal box	As per Mfg. Standard	
28.0	Earthing Terminals	Required as per IS. Min. 2 no.	
29.0	External cable details.	As per the SLD / Tender	
30.0	Shaft - Hollow / Solid	Pl. furnish (As per Tender)	
31.0	Type of Couplings	Pl. furnish (as per Tender)	
32.0	Type of bearings	Pl. furnish (As per Tender)	
33.0	Colour shade of paint	Epoxy Grey shade 632 as per IS:5	
34.0	Space heater for motors	Confirm as per SLD / SOQ / Tender	
35.0	RTD / Thermistors	Confirm as per SLD / SOQ / Tender	
36.0	Winding connections	6 Terminals	
37.0	Standard to be followed	IS 12615, 325, 8225, 4889, 4772, 4029, 4691 and other relevant Indian Standard or equivalent Standards.	

**Note: 1) Manufacturer / supplier shall submit separate data sheet for each duty/ rating.
2) Other specifications not mentioned in datasheet, shall be considered as per tender specification / IS.**



8.0 H.T. XLPE CABLES

Scope

- The scope shall cover supplying, laying, testing and commissioning of 3 core cables of circular stranded aluminium conductors, XLPE extruded dielectric, copper tape screened and PVC overall sheathed. The cables shall be armoured with galvanized steel strip/wire armour.
- Cables shall be capable of operating at a sustained conductor temperature of 90°C and suitable for a maximum conductor short-circuits temperature of 250°C.

Operating Conditions:

Electric system

- System Voltage : 11 kV
- Frequency : 50 Hz.

Environment

- Ground temperature : 35°C.
- Ambient air temperature : 50°C.
- Atmospheric conditions : Humid and dusty

Construction

11 kV grade cross-linked polyethylene (XLPE) insulated, PVC outer sheathed GI strip armoured, Aluminium conductor UE HT cable as per IS 7098 (part II) with latest amendment.

Cable Marking:

- Embossing on outer sheath:
- The PVC outer sheath shall be legibly embossed / Printed with the legend: “ELECTRIC CABLE 22000 / 11000 VOLT”, cable size, IS specification No., identification of manufacturer and year of manufacture etc. at each m length. Cable shall be supplied in non-returnable drums as per IS 10418 standard. Cable identification details as above shall be written on Drums also as per IS.

Testing:

Routine tests and acceptance tests shall be carried out in accordance with the relevant IEC standards / IS. The copies of Type test results shall be submitted along with each drum length or part thereof.

9.0 LT POWER & CONTROL CABLES

- The scope shall cover supply, laying, testing and commissioning of medium voltage PVC / XLPE cables.
- 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.



PVC / XLPE Insulated Cables (Medium Voltage)

1.1 kV grade PVC / XLPE insulated, Alluminium conductor GI strip / wire armoured LT cable as per IS 1554 (part I) / IS 7098 (part I) (for XLPE) with latest amendment.

RTD / BTD / Signal Cables:

Vendor is fully responsible for the sizing of all cables in their scope of supply considering factors like maximum distance between Panel/Control Room and the Units/Motors. Specifications for cables for RTD / BTD / Analog signals shall be as follows:

Cables shall be of 660V/1100V grade, single / multi-pair / Triad / Core cables as per BOQ/Price bid. Triad / Multi Core Signal cables shall be annealed, tinned, high conductivity 0.5/1.0/1.5 sq.mm stranded copper conductor, Polyester tapped PVC insulated nos. of cores twisted into pair, laid up collectively, individual pair / triad shielded and overall shielded with aluminum mylar tape, armoured with galvanized steel wire/strip, overall sheathed with PVC, conforming to IS:1554 & IEC:189 Part II.

Splicing and Termination

- 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. No joints shall be allowed within the conduit pipes, cable entry pipes or ducts for cable laying and wire pulling.

Testing:

Cables shall be tested in accordance with IS: 1554 / 7098.

Finished Cable Tests at Manufacturer's Works:

The finished cables shall be tested at manufacturer's works. Following routine tests for each and every length of cable and copy of test results shall be furnished for each length of cable along with supply. If specified, the cables shall be tested in presence of client's representative.

1. Voltage Test:

Each core of cable shall be tested at room temperature at 3 kV A.C. R.M.S. for duration of 5 minutes.

2. Conductor Resistance Test:

The D.C. Resistance of each conductor shall be measured at room temperature and the results shall be corrected to 20° c. to check the compliance with the values specified in IS 8130 - 1976.

Cable Test before and after laying of cables at site:-

1. Insulation Resistance test between phases, phase to Neutral and phase to earth.
2. Continuity test of all the phases, neutral and earth continuity conductor.
3. Sheathing continuity test.
4. Earth resistance test of all the phases and neutral.

**Sealing and Drumming:**

- Cable shall be supplied in non-returnable drums as per IS 10418 standard. Cable identification details like Voltage, size, name, etc. shall be written on Drums also as per IS.

11.0 LOCAL PUSH BUTTON STATION

Each motor shall be provided with a local control station in the field near the motor.

Construction Features:

- Push Button & related control switches shall be as per IS-6875 & as per BOQ.
- The local push button station / local control station (LCS) shall have die-cast aluminium enclosure with minimum IP-5X protection & canopy made of at least 14 SWG (2mm) galvanized sheet steel or FRP suitable for outdoor application. The enclosures painted with two coats of epoxy paint with final colour shade (both internal and external) of Light grey shade 631 of IS: 5
- All control stations shall be suitable for 10 A continuous current rating 240V AC as well as 110V/220V DC control supply.
- All push buttons shall be fitted with 2NO + 2NC rated to carry and break 6 Amps at 415 Volts (10 A at 240 V AC)
- The open/close/start push buttons shall be of the momentary contact push to actuate type and shall be green in colour.
- The stop push buttons shall be stay put type with mushroom knob and lockable in pressed position and shall be red in colour.
- All ammeters shall be of moving iron type having an accuracy class of 1.5 and suitable for 1 ampere CT secondary. The size of ammeter shall be 72mm x 72mm or minimum 65mm dia. The ammeter front glass shall be toughened.

Type of Push Button Stations

- Push button station Type-A - Each P.B. station suitable for outdoor installation and shall comprise two push buttons viz. 'START' and 'STOP' for control of **Non Reversible Motors**, with or without ammeter.
- Push button station Type-B - Each P.B. station for indoor installation and shall be comprise of three push buttons viz. 'OPEN', 'CLOSE' and 'STOP' with on/off indicating lamps for control of **Reversible Motor**, , with or without ammeter.

12.0 EARTHING SYSTEM**Standards**

The following standards and rules shall be applicable:

1. IS: 3043 - 1987 Code of practice for Earthing.
2. IS: 2309 -1989 Code of practice for the protection of buildings and allied structures against lightning.
3. Indian Electricity Act and Rules / Electrical inspector / statutory norms



All codes and standards mean the latest. The installation shall generally follow the Indian Standard Code of Practice or the British Standard Code of Practice in absence of Indian standard.

General

- The resistance of any point in the earth continuity system of the installation to the main earth electrode shall preferably not exceed 1.0 ohm.
- The earth resistance shall be maintained with suitable soil treatment, (If required).
- The main earth loop shall be laid at a depth of 500mm below ground level.
- All medium (LT) and high voltage (HT) equipment (above 230V) shall be earthed by two separate and distinct connections with earth.
- Lightning protection shall be provided as per IS: 2309. Self-conducting structures may not be provided with aerial rod and down conductors but shall be connected to the earthing grid at minimum two points of the base. An independent earthing network shall be provided for lightning protection and this shall be bonded with the main earthing network minimum at two points at the buried electrodes.
- Plant instrument system clean earthing, UPS system clean/safety earth shall be separate from the electrical earthing system.
- The main earth electrodes after being driven into the ground shall be protected at the top by constructing brick masonry chamber of size 400 mm x 400 mm x height 300 mm shall be provided with 6mm thick chequered plate cover / CI cover hinged with CI frame for housing of funnel & pipe.
- The earth electrodes shall be situated at a distance not less than 3.0 m from the building fencing structure and equipment foundations.
- The distance between two electrodes shall not be less than 3 meter.
- The surrounding the electrodes, soil shall be treated up with salt, coke and charcoal.
- The earth system connection shall generally cover the following:
 1. Equipment earthing for personnel safety
 2. Transformer, DG and System neutral earthing
 3. Static and lightning protection
 4. Current and potential transformer secondary neutral
 5. Metallic non-current carrying parts of all electrical apparatus such as transformers, switchboards, bus ducts, motors, neutral earthing resistors, capacitors, UPS, battery charger panels, welding receptacles, power sockets, lighting/power panels, control stations, lighting fixtures ceiling fan & exhaust fan, Street light, flood light pole circuit / cable.
 6. Fence and Gate for electrical apparatus (e.g. transformer yard, etc.)
 7. Cable shields armour & Shield wire.

Scope of work

The scope of work shall cover supply, laying, installation, connecting, testing and commissioning of:

- Plate (600 x 600 x 3 mm Copper plate)/ Pipe (40 mm dia B class G.I pipe) type Earthing station with G.I Pipe / Copper plate of size as per BOQ / IS.



- Earthing Copper strips from Plate earthing station & G.I strip for Pipe earth, to equipotential bar / earth grid.
- Earthing G.I / Copper strips / wires from earth grid / equipotential bar to power panels, DBs, motors, Indoor / Outdoor lighting systems, etc.
- Bonding of Non-current carrying parts, and metallic parts of the electrical installation.
- Qty. of pits mentioned are minimum or higher as per soil resistivity. Measurement of soil resistivity to be carried out by contractor at no extra cost.
- All the earthing material and installation & construction of Earth Pit, chamber etc. shall be as per IS 3043 and BOQ.

13.0 INTERNAL AND EXTERNAL LIGHTING SYSTEM:

- Section covers supply, installation, connection, testing and commissioning of internal & external lighting system, definition of point wiring, system of wiring, point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan etc.
- Lighting system shall conform to the latest Indian Standards.

Point Wiring

- The point wiring shall be complete with the branch wiring from the distribution board to the outlet point, through switch board, conduit with accessories, junction, pull, inspection boxes, control switch, socket, outlet boxes, ceiling roses, batten / swan holder, earth wire DB to SB & point etc.

System of Wiring

- The system of wiring shall consist of ISI marked, single core, stranded copper conductor PVC insulated, 650/1100 volt grade, FRLS wires laid through exposed (surface mounted) PVC conduits as directed.
- In places where ceiling fans are provided, lighting fixtures shall be installed suspended / wall mounted below fan level with the help of conduits / chains to avoid shadows on the floor.

Conduit Wiring - PVC Conduit

- All non-metallic PVC conduits shall conform to IS: 9537 and shall be used with the corresponding accessories.
- PVC conduits pipes of approved minimum 1.6mm wall thickness shall be used. The minimum PVC conduit diameter shall not be less than 20 mm.
- In long distance straight run of conduit, inspection type junction box at reasonable intervals shall be provided
- To facilitate drawings of wire in the conduit. GI mesh wire of 16 SWG shall be provided while laying of recessed conduit.
- Conduit pipes shall be fixed by heavy gauge clamps, secured to suitable wood plugs or other approved plugs with screws in an approved manner at an interval of not more than 60 cm but on either side of the couplers bends, or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings.



- The saddle should not be less than 24 gauge for conduits up to 25 mm dia and not less than 20 gauge for larger diameter.
- Where conduit pipes are to be laid along the trusses, steel joints etc. the same shall be secured by means of ordinary clips or girder clips as required by the Engineer-in-Charge. Where it is not possible to drill holes in the truss members, suitable clamps with bolts and nuts shall be used.

Boxes:

- Switch box shall be made of metal on all sides, except on the front.
- In the case of cast boxes, wall thickness shall be at least 3 mm and in case of welded mild steel sheet boxes the wall thickness shall not be less than 18 gauge for boxes, up to a size of 20 cm x 30 cm and above this M.S. boxes having minimum sheet thickness of 1.6mm shall be used.
- Inside each switch box, one bolt shall be welded to receive earthing wire.
- Switch boxes shall be galvanized after fabrication. Except where otherwise stated 3 mm thick phenolic laminated sheets like Bakelite hylam/sun mica shall be fixed on the front with brass screws. Clear depth of the box shall not be less than 60 mm and this shall be increased suitably to accommodate mounting of fan regulators in flush pattern.

Cables:

- The size of the cables used for internal wiring shall be as per BOQ / IS :

Switches & Sockets:

- Switches & Sockets shall conform to IS: 3854, IS: 1293 and IS: 4615.

Joints

- The wiring shall be by looping back system, and hence all joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only.
- **No joints shall be made inside conduits and junction boxes.**
- Joints where unavoidable, due to any specified reasons, prior permission in writing shall be obtained from the client before making such connections. Joints by twisting conductors are prohibited.

Testing of Installation

Before a completed installation is put into service, the following tests shall be complied with

Insulation Resistance

1. The insulation resistance shall be measured by 500 volt Megger with all fuses in places, circuit breaker and all switches closed
2. The insulation resistance of an installation, measured shall not be less than 50 mega-ohms divided by the number of points on the circuit.
3. The insulation resistance shall be measured between Earth to phase, Earth to neutral, Phase to neutral
And Phase to phase.



4. Polarity test on single pole switches.

Completion Certificates:

- All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms.
- Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result form shall be submitted to the client for approval.
- On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

Light Fixtures

Scope:

- The scope of work shall cover the supply, assembling, installation, testing and commissioning of various types of light fixtures as per specification and latest standards, including wiring from ceiling rose / point to the fixture with 3 core flexible copper conductor wire.
- All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the relevant British Standard Code of Practice in the absence of Indian Standard.
- The light fixtures shall be of standard make from list of vendors as per tender.

General Requirements:

- All fixtures shall be complete with lamp/luminaire with all required fittings & accessories and pre wired at manufacture work.
- Fixture shall be completely wired with FRLS wires and constructed to comply with the regulations and shall confirm to relevant IS standards for Electric Lighting Fixtures, unless otherwise specified.
- All the fixtures are as per the IP – 2X / 4X protection for indoor application where as IP - 6X protection for outdoor application.

Lamps:

- Lamps used for temporary lighting service shall not be used in the final lamping of fixture units.
- Lamps shall be of wattage and type as given in the drawings and schedules. Where not given, the details shall be ascertained from the client before procurement.
- Lamps for permanent installation shall not be placed in the fixtures until so directed by the Client's representative, and this shall be accomplished directly before the respective portions are ready for occupation.

LED Light Fixtures / Lightings:

LED fixtures shall be generally having



- LED luminous Efficacy lumens/watt: - 100% min.
- Efficiency of Electronics system :- 80% - 85% min.
- LED Lamp/Light efficiency :- 85% - 90% min.
- Total Harmonic Distortion :- For Outdoor Fittings - $\leq 20\%$
For Indoor Fittings - $\leq 10\%$
- Power Factor :- ≥ 0.85
- Colour Rendering Index (CRI) :- ≥ 70
- Colour temperature / apparent : $\geq 6500\text{K}$ (Cool day light)
- Radiation :- No Ultra-Violet (UV) or Infra-Red (IR) radiation
:- No RF to interfere with radio equipment
- LED Life :- Long Life, generally 30,000 – 50,000 Hrs.
- RoHS compliant, Eco-Friendly green technology, Mercury free
- Outdoor LED fixtures must be fully enclosed with minimum IP Rating of IP66/65 (Weatherproof). LED optical system must be gasketed (enclosed) to minimize light dirt depreciation.
- Electrical safety for outdoor LED Lights shall be of Class-I.
- Luminaries must be clearly marked with manufacturer name, model number, electrical rating and agency approval (If applicable - CSA, UL, etc.).

Lighting Poles

Lighting poles shall be steel tubular swaged type made from GI pipe conforming to IS:1239 medium class and made as per IS:2713.

Street light pole, steel tubular swaged type, 9 / 7.5 / 6 meter long (6 / 4.5 / 3.0m x 1.5m x 1.5m) 139.7mm, 114.3mm, 88.9mm dia respectively, 4.85mm, 3.65mm, 3.25mm thick respectively, with M.S. base plate, pipe cap, single/double arm of 1/0.5m height & and over hung 1/1.5m long GI pipe having dia. to suit the socket of lighting fixture as applicable. Street light pole shall be conforming to IS 2713: 1980.and with

1. PVC junction boxes on pole with 8 way connector & 1 no. 4 A SP MCB.
2. Street light pole shall be as per approved drg.
3. Internal pole wiring with 3 core 1.5/2.5 sqmm flexible stranded cooper conductor wire from junction box to up to Street light / Flood light / fixture as per BOQ and as required.

TEST:

The routine tests shall be conducted as per the relevant Indian Standards

14.0 SAFETY EQUIPMENTS

The contractor shall provide safety equipment as per IE rules / as specified in BOQ, on the HV panels, Generator panels, Control panels and main MV panel rooms. Generally following shall be provided:

- Rubber mat conforming to IS 5424 in front of all the HT and MV panel for their entire length – 1000 m. wide.
- Pairs of electrically tested rubber gloves. These are to be kept in a suitable wooden box.



- A shock treatment instruction chart in English and local language duly framed as detailed in IS: 1355. Detail of the nearest medical facility available with phone number shall also be kept.
- First aid box containing of medicines for treatment of electrical burns in the main switch room.
- Portable fire extinguishers of dry powder (Store type) as per IS : 935 to suit the individual substation, panel rooms requirement.
- Caution notices in English shall be fixed permanently on the equipment to comply the requirement of IE rules.
- Safety posters for vigilance against electrical accidents as detailed in IS : 1255.
- Fire buckets with MS angle stand and with 4 Nos. round bottom fire buckets marked fire shall be provided in the HT sub station.
- 3 Mtr& 6 Mtr. long folding aluminium ladders for safe maintenance of lighting system, etc.

15.0 OTHER EQUIPMENT AND ACCESSORIES SPECIFICATIONS:

This defines specifications and requirements mainly for the equipment and accessories, which are generally supplied by the erection agency.

- All materials, accessories, consumable to be supplied by the contractor shall be selected from the list of specified make and shall conform to the specification given here under.
- The equipment shall be manufactured in accordance with current Indian Standard specifications wherever they exist or with the BS or NEC specifications, if no such IS standards are available. In the absence of any specification, the materials shall be as approved by the owner / consultant or his authorized representative.
- All similar materials and removable parts shall be uniform and interchangeable with one another. Makes of bought out items selected by the contractor must be approved vender list of tender.

Cable Trays:

- These shall be channel type, fabricated from structural steel, hot dip galvanised, complete with all accessories such as bends, tees and reducers.
- MS / Aluminium flat clamps with G.I. / Chrome plated bolts, nuts/screws to be used for clamping cables.
- Sizes of these trays shall be as specified in bill of quantities/ drg. or approved by client.

Cable Glands:

- Cable glands shall be heavy duty double compression type of Ni-Plated brass. These shall be suitable for armoured/Unarmoured cables, which are being used.

Cable Connectors:

- Cable connectors, lugs/sockets, shall be of copper/aluminium alloy, suitably tinned, solder less, crimping type.
- These shall be suitable for the cable being connected and type of function (such as power, control or connection to instruments etc.).



Cable Indicators

- All cables shall be identified by cable tag of 2 mm. thick, 15 mm wide of enough length of Aluminium straps securely fastened to the cable. PVC identification number, ferrules shall be used for each wire.

G.I. Pipe for Cables:

- For laying of cables under floor, Med. Duty G.I. pipes shall be used.
- Pipe shall be laid at an angle of max. 45 deg. to trench wall. Both ends of pipe shall be sealed with approved W.P. Sealing plastic compound after cabling work.
- Size of pipe shall depend upon the overall outer diameter of cable to be drawn through pipe.
- To determine the size of pipe, assume that 40% area of pipe shall be free after drawing of cable.

C INSPECTION & TESTING

- All the equipment shall be tested and inspected at vendor manufacturer's works before dispatch to ensure compliance with the specifications/requirements mentioned in the tender / BOQ and applicable codes and standards and agreed quality assurance/testing plan.
- The owner / Client or his authorized representative may visit the works during manufacture of various electrical equipment/materials to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given full assistance to carry out inspection. Owner/ client's representative shall be given minimum two weeks advance notice for witnessing of final testing.
- Field tests as per approved procedures / procedures available with engineer-in-charge or his authorized representative shall be performed on the electrical system / equipment before it is being put into service. All test equipment shall be arranged by the vendor. Test reports shall be approved by the engineer-in-charge before acceptance of the complete plant and equipment.
- All the cost pertaining to inspection including to & from travel, local conveyance, lodging and boarding expenses shall be borne by contractor for minimum 2 representatives of client / client's consultants / Third Party Inspection Agency.



D ERECTION, TESTING & COMMISSIONING OF ELECTRICAL INSTALLATIONS

Scope

- The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical system like HT Equipment, HT Panel, transformer, M.V panels, Cables, earthing system, Internal and External lighting, Light fixtures etc. Requirement of this project shall be as specified in bill of quantities / approved drawings / general specifications or as per the battery limits fixed by the owner / consultant.
- Inspection at manufacturers premises: All tests of all major items like HT panel, LT panel, Transformers, Power cable (in case of more than a drum) shall be conducted at manufacturer's work in presence of third party inspection agency and client's representative appointed by purchaser's representative. However, all the expenses like transportation, loading & boarding shall be borne by contractor.

Standards

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specification / codes of practice of the Indian Standards Institution, approved drawings and the instructions issued by the authorized representative, from time to time.

Some of the relevant Indian Standards are listed elsewhere in this tender document.

In addition to the standards mentioned in the tender, all works shall also conform to the requirement of the following:

1. Indian Electricity Act and Rules framed there under
2. Fire Insurance Regulations.
3. Regulations laid down by the Chief Electrical Inspector of the State / State Electricity Board / Union Territory.
4. Regulations laid down by the Factory Inspector of the State / Union Territory.
5. Any other regulations laid down by the local authorities.
6. Installation & operation manuals of original manufacturers of equipment.

ERECTION & TESTING:

The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. Equipment shall not be removed from packing cases unless the floor has been made ready for installing them. The cases shall be opened in presence of the client / consultant or his authorized representative. Any document if found with the equipment shall be handed over to the client's representative.

ONAN Type Transformer

Erection

- Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out.



- After the completion of erection, necessary stoppers shall be provided at the wheels.
- All loosely supplied fittings / accessories shall be cleaned and mounted on the transformer and connections made.
- After completely assembling & installation, the transformer shall be cleaned and touched up with a paint supplied by the manufacturer applied wherever necessary.
- All cover bolts shall be checked for proper tightness. All the civil foundation work required shall be in the scope of contractor.

Testing

- Winding insulation resistance shall be measured from primary and secondary to ground and between primary and secondary.
- Check the polarity of terminals and the phase sequence.
- Insulation resistance test with 1000 V megger.
 - Between primary to earth
 - Between secondary to earth
 - Between primary and secondary
- Polarity marking and phase sequence.
- Earth resistance : Body as well as Neutral link.

MOTOR CONTROL CENTER, DISTRIBUTION BOARDS:

Erection

- Electrical panels his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation.
- The contractor shall be responsible for final assembly and interconnection of bus bars / wiring. Foundation channel shall be delivered in convenient shipping section by the manufacturer.
- Switchgear shall be aligned and levelled on their base channels and bolted to them as per the instructions of the client / consultant.
- The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. The contacts of the draw out circuit breaker shall be checked for proper alignment and inter changeability.
- After erection, the switchboard shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost. If the instrument transformers are supplied separately, they shall be erected as per the direction of the client / consultant.
- The contractor shall fix the cable glands after drilling the bottom / top plates of all switchboards with suitable holes at no extra cost.
- Range of overload relays / timers etc. shall be checked with requirement of motor actually to be connected at site and if the same is undersized / oversized, it shall be brought to the notice of the client / consultant, who shall arrange procurement of corrected components.
- However, the contractor shall not charge anything extra for labour for such replacements.

Testing



- Before electrical panel is energised, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.
 - Before switchgear is energised, the insulation resistance of all control circuits shall be measured from line to ground.
 - Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulation resistance measured from phase to phase and phase to ground.
 - All adjustable direct acting trip devices shall be set using values given by the manufacturer.
 - The dielectric strength of insulating oil wherever applicable shall be checked. Before switchgear is energised,
 - The following tests shall be performed on each circuit breaker in its test position.
 1. Close and trip the circuit breaker from its local control switch push button or operating handle. Switchgear control bus may be energised to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.
 2. Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
 3. Test proper operation of circuit breakers latch, check carriage limit switch if provided. Test proper operation of lockout device in the closing circuit. Wherever provided by simulating conditions which would cause a lockout to occur.
 4. Trip breaker either manually or by applying current or voltage to each of its associated protective release.
- Before switchgear is energized, the tests covered above shall be repeated with each breaker in its normal operating position.
- Capacitor banks shall be tested as per manufacturer's instructions.
 - All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.
 - Insulation resistance test (contacts open, breaker racked in position)

Between each phase of bus	:	Mega ohm
Between each phase and earth	:	Mega ohm
DC and AC control and auxiliary circuits	:	Mega ohm
Between each phase of CT / PT	:	
Between CT & PT circuit if any	:	Mega ohm

Installation of Cable Network:

- Cable network shall include power, control and lighting cables which shall be laid in underground trenches, cable trays, G.I. pipes, or on building structures as per drawings / site condition as per cable schedules or as per the client / consultant's instructions.
- Supply & installation of cable trays, G.I. pipes / conduits, cable glands and sockets of end isolators, junction boxes, remote push button stations, etc. shall be in the scope of the contractor.

General Requirements for Handling Cables:

- a) Before laying cables, this shall be tested for physical damage, continuity, absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500 / 1000 V megger.



- b) The cables shall be supplied at site, wound on wooden drums as far as possible. For smaller length and sizes, cables in properly coiled form can be accepted. The cables shall be laid by mounting the drum of the cable on drum carriage. Cables shall be handled and laid as per IS 1255.
- c) While drawing cables through G.I. pipes, conduits, RCC pipes, ensure that size of pipe is such that, after drawing cables, 40% area is free. After drawing cables, the end of pipe shall be sealed with approved WP sealing plastic compound.
- d) Armoured cables shall never be concealed in walls / floors / roads without G.I. pipes, conduits or RCC pipes.
- e) A minimum loop of 3 m shall be provided on both ends of the cable, and on both ends of straight through cable joint if any.
- f) Cable shall be neatly arranged in the trenches / trays in such manner so that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cable within the trenches / trays shall be the responsibility of the contractor.
- g) All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided. The cable routes indicated is indicative only and the same may be rechecked with the client / consultant before cutting of cables.
- h) All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tapes. Use of friction type or other fabric type tape is not permitted.
- i) Wherever cable rises from underground / concrete / masonry trenches to motors / switchgears / push buttons, these shall be taken in G.I. pipes of suitable size, for mechanical protection up to 300 mm. distance of concerned cable gland or as instructed by the client / consultant.
- j) The cable pass through foundation / walls of other underground structures, the necessary ducts for opening will be provided in advance for the same. However, should it become necessary to cut holes in existing foundation of structures the electrical contractor shall determine the location and obtain approval of the client / consultant before cutting is done.
- k) Cable trays, racks and trenches shall be installed to allow for 20% future cables. Cable installation shall provide minimum cable bending radius recommended by cable manufacturer.

Laying of Cables (Underground System)

- Cables shall be so laid in trench that this will not interfere with other underground structure. All water pipes, sewage lines or other structures which become exposed by excavation shall be properly supported and protected from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded / diverted as directed by the owner / consultant.
- The cables shall be laid and protected by filling trench bottom with a layer of sand. This sand shall be levelled 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. This laying work shall comply with **IS 1255** with latest amendments and enclosed tender drawings
- Cable shall be laid at minimum depth of 750 mm. in case of L.T. and 1000 mm. in case of H.T. from ground level. Excavation will be generally in ordinary soil. The width of trench shall be sufficient for laying of required no. of cables.



- The surface of the ground after back filling the earth shall be made good so as to conform in all respects to the surrounded ground and to the entire satisfaction of the client / consultant.
- For all underground cables, route markers should be installed at 30 Mt. Interval along the cable route. Separate route markers should be used for LT, HT and Instrumentation cables.
- Route markers should be grounded in ground with 1:2:4 cement concrete.
- RCC Hume pipe for crossing road in cable laying shall be provided by employer. No deduction shall be made for cable laying in Hume pipe for not providing bricks, sand and excavation.
- RCC hump pipe & pipe sleeves shall be sealed at both ends by bituminous compound / WP sealing after laying and testing of cables by electrical contractor without any extra charge.

Laying of Cable in Masonry Trenches

- Masonry / concrete trenches for laying of cables shall be provided by employer. However, steel members such as M.S. angles / flats etc. shall be provided and grouted by electrical contractor to support the cables without any extra charge.
- Cables shall be clamped to these supports with minimum saddles / clamps. More than one tier of cables can be provided in the same trench if the no. of cables are more.
- Entry of cables in trenches shall be sealed with approved WP sealing plastic compound to stop entry of water in trenches.

Laying of Cables in Cable Trays

- Cable trays and steel members such as M.S. angle / channel / flats etc. shall be provided and fixed by the contractor.
- Cable shall be fixed in cable trays. Cables shall be clamped with flat clamps and galvanised bolts / nuts in cable trays.
- Earthing flat / wire can also be laid in cable tray along with cables.
- After laying of cables, minimum 20% area shall be spare.

Termination and Jointing of Cables:

- For HT cables suitable size of heat shrinkable type termination kit shall be used as per BOQ/SLD. For HT cable manufacturer's recommendation should be followed.
- For LT cables:
 1. All PVC cables up to 1.1 KV grade, armoured or Unarmoured shall be terminated at the equipment / junction box / isolators / push buttons / control accessories, etc. by means of suitable size double compression type cable glands, crimped type solder less lugs / connectors for termination of cable.
 2. Armour of cable shall be connected to earth point.
 3. In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, a close fit hole should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

Dressing of Cable inside the Equipment:



- After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.
- For motors of 20 HP and above, terminal box if found not suitable for proper dressing of aluminium cables, the erector shall modify the same without any additional cost.

Cable Test before and after laying of cables at site:-

1. Insulation Resistance test between phases, phase to Neutral and phase to earth.
 2. Continuity test of all the phases, neutral and earth continuity conductor.
 3. Sheathing continuity test.
 4. Earth resistance test of all the phases and neutral.
- All tests shall be carried out in accordance with relevant Indian Standard Code of practice and Indian Electricity Rules. The Vendor shall provide necessary instruments, equipment and labour for conducting the above test and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the client and results shall be recorded in the prescribed forms.

EARTHING SYSTEM:

- The plate/pipe electrode shall be installed as per IS: 3043 / tender specification / BOQ.
- Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS: 3043, Code of Practice for Earthing Installation.
- The earth conductors (Strips / Wires copper / hot dip G.I.) inside the building shall properly be clamped / supported on the wall with galvanised Iron clamps and Mild Steel Zinc Passivated screws / bolts. The conductors outside the building shall be laid at least 600 mm below the finished ground level.
- Measure earth resistance of each electrode separately. If a number of earth electrodes are interconnected with one another, combined earth resistance shall also be measured. The earth resistance of each electrode and/or a group of electrodes shall not exceed the values specified.
- Carry out line earth loop impedance test. The loop comprises the line conductor from the point of fault, back to the supply transformer, the path through transformer winding, the earthed neutral point of the transformer and path for that point to the point of fault through the earthing system.
- Continuity test for earth continuity conductors with ELV tester.
- The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

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. Each earthing station
 2. earthing system as a whole
 3. Earth continuity conductors
 4. 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 client's or PMC.

Erection:

Ceiling / Wall Outlet Boxes for Lights / Fans:

- Outlet boxes shall be of steel with cover and so installed as to maintain continuity throughout.
- In beams conduit socket shall be provided in place of outlet boxes. The same shall be used for installation of luminaries.
- For fixing light fixtures / brackets, outlet boxes complete with knock out for holding conduits shall be used. For lighting fixture suitable for 40/20 watts fluorescent tubes / incandescent lamps / mercury vapour lamps, only one outlet box is required.
- For fixing ceiling fans, circular outlet boxes, 100 mm. diameter, complete with 12 mm. dia. Mild Steel rod 300 mm. long, for holding 12 mm. dia. Mild Steel cover 125 mm. dia. at bottom shall be used.

Switch and Socket:

- Switches shall be installed at 1200 mm above finished floor level unless otherwise indicated on the drawings.

Installation of Lighting Fixtures:

- Scope of work under this item shall start from light point, with 3 nos. 1.5 mm.² PVC insulated wires from connector to the connector inside the lighting fixture, connections, fixing of lighting fixture complete with all accessories, lamps on wall / roof / steel truss etc. testing the lighting fixture and commissioning.

Installation of Exhaust Fans:

- Scope of work under this system shall start from exhaust fan point, with a ceiling rose, 2 core 2.5 mm.² PVC insulated wire from ceiling rose to connector of exhaust fan, connections, making fan opening in walls including repair / finishing fixing of exhaust fan complete with accessories and louvers on walls with hold-fasts, testing the exhaust fans and commissioning.

COMPLETION TESTS of INSTALLATION:

After supply and installation of complete project or a particular building / area, following tests shall be carried out by the contractor before switching on the power to installation and the results shall be recorded and submitted to the Site-Engineer.



If results are not satisfactory / as per standards set herewith, the contractor shall identify the defects / short coming and shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.

Insulation Resistance

- The insulation resistance shall be measured by 500 volt Megger with all fuses in places, circuit breaker and all switches closed
- The insulation resistance of an installation, measured shall not be less than 50 mega-ohms divided by the number of points on the circuit.
- The insulation resistance shall be measured between
 - Earth to phase
 - Earth to neutral
 - Phase to neutral
 - Phase to phase
- Earth continuity test for all points, fixtures, fans etc.
- Polarity test all single phase switches.

Completion Certificates:

- All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms.
- Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result form shall be submitted to the client for approval.

On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

STATUTORY APPROVAL

The Contractor shall be totally responsible for obtaining statutory approval from the electrical inspector or any other statutory authority for the entire installation carried out by him unless otherwise specified and agreed. Necessary test reports, drawings & documents shall be submitted by him to electrical inspector. This will be an integral part of the contract and shall not be paid for separately. **The contractor shall liaison with local electric supply company for getting power supply and only necessary fees, if any, payable to supply company shall be borne by the Owner.**

HANDING OVER / TAKING OVER:

After completion of works and tests specified above, the various installations of equipment can be taken over by the employer as and when these are ready in all respects. The defect liability period shall start from the date, when all the installations of the equipment have been executed, tested as described above, successfully commissioned and handed over after trial run of three months.



(E) APPROVED VENDOR LIST FOR ELECTRICAL EQUIPMENT / COMPONENTS

SR NO.	Product	Vendor
(1)	H.T VCB PANEL	CGL, ABB, JYOTI, SIEMENS, AREVA, SCHEINDER, BICCO LAWRIE, L & T
(2)	TRANSFORMER	AREVA, CROMPTON GREAVES, SIEMENS, VOLTAMP, ABB, KIRLOSKAR
(3)	HT PROTECTIVE RELAYS	L & T, SIEMENS, AREVA, ABB, ESSUN RAY RULL, SCHNEIDER
(4)	L.T POWER CABLE	CCI, UNIVERSAL, FINOLEX, INCAB, TORRENT, GLOSTER, HAVELLS, BHARATCAB
(5)	H.T POWER CABLE	CCI, UNIVERSAL, FINOLEX, INCAB, TORRENT, HAVELLS, GLOSTER
(6)	H.T, LT JOINTING KITS	RAYCHEM, XICON, M-SEAL
(7)	LT SWITCHGEARS	L& T, SIEMENS, SCHNIDER, ABB,GE
(8)	MCB	SIEMENS, MDS, L& T, MG,INDOKOPP, SCHNEIDER, HAGER,HAVELLS,ABB LAGRAND,C&S.
(9)	ELECTRONIC TIMERS, TIME SWITCH	GEC, HAGER, SIEMENS, SCHNEIDER, ABB, LEGRAND
(10)	MANUAL CHANGE OVER SWITCH	L & T, SIEMENS, SCHNEIDER, ABB, HPL.
(11)	FUSES	L & T, SIEMENS, SCHNEIDER, ABB, BUSSMAN
(12)	LED INDICTORS	ESBEE (L & T), SIEMENS, SCHNEDIER, ABB, RAAS CONTROL, TEKNIK, VAISHNO, BINAY
(13)	PUSH BUTTON	L & T, SIEMENS, SCHNEIDER, ABB, RAAS CONTROL, BINAY
(14)	SELECTOR SWITCH	KEYCEE, SALZER, SIEMENS
(15)	EPOXY CAST RESIN C.T	L & T, PACTIL, ASHMOR, KAPPA, SILKANA, GILBERT, PRECISE
(16)	Microprocessor based MOTOR PROTECTION DEVICE	SCHNEDIER, L & T, SIEMENS, C & S, ABB,SOFT HARD
(17)	CABLE TERMINATION KIT (LUGS & GLANDS)	DOVELLS, JENSON, HEX, 3D, HMI
(18)	DIGITAL METERS	SECURE, L & T, ABB, CONSERV, SOCOMEC, SIEMENS, TRINITY
(19)	ANALOG METERS	MECO, RISHLINE, IMP, AE, RISHABH (L & T)
(20)	APFC RELAYS	EPCOS, KBR, L & T, DUCATII, BELLUK, TRINITY, SCHNEIDER, ABB
(21)	CAPACITOR	EPCOS, SCHNEIDER, DUCATII,CROMPTON, L & T, YESHA, KHATAU, SUBODHAN,ASIAN, ABB.



(22)	TERMINAL CONNECTOR	CONNECTWELL, WAGO, PHOENIX, ELEMEX
(23)	ON LINE UPS	TATA LIBERT, MERLIN GERIN, SOCOMAC, APC
(24)	SMF BATTERY	PANASONIC, EXIDE, BASE, PRESTOLITE, ROCKET, AMRON, TATA-GREEN
(25)	ENGINE OF D.G. SET	GREAVES, CUMMINS, LEYLAND, KIRLOKAR, CATERPILLAR
(26)	ALTERNATOR OF D.G.SET	CROMPTON, KEC, STAMFORD
(27)	PANEL BOARD MANUFACTURER	CPRI & FIA APPROVED (to be got approved prior to supply)
(28)	H.T CONNECTORS	NUTAN, POWER SYSTEM GUJARAT
(29)	CABLE TRAYS	INDIANA, SHARDA, B.M.ENGINEERING, TUSHARTECH, SUPERFAB, BVK ENTERPRISE
(30)	AUXILIARY CONTROL RELAY	OEN, PLA, OMRON, PHOENIX, ABB
(31)	DC POWER SOURCE	PHONIX, INTEX, MICROTUX, SCHNEIDER, SIEMENS, ALLEN BRADLEY, OMRON, APLAB, IFM
(32)	COMPUTER SYSTEM	DELL, HP, LENOVO, COMPAQ
(33)	INVERTER	SUKAM, MICROTUX
(34)	LIGHTING FIXTURE	PHILIPS,CROMPTON,BAJAJ,SURYA,HAVELLS

NOTE ON APPROVED VENDOR LIST: -

1. Equipment/ items for which no make is specified, approval shall be obtained from the SMC prior to supply.
2. Various options are given in the above vendor's list. However, choice as to the selection of particular make will rest to the Competent Authority of the SMC.
3. Exact make intended to be supplied must be got approved prior to supply.
4. Right to select/reject a particular make rest with the SMC.



6.20.9 DETAILED TECHNICAL SPECIFICATIONS (DTS) FOR INSTRUMENTATION & AUTOMATION

APPLICABLE NATIONAL/INTERNATIONAL STANDARDS

AGA	American Gas Association, Gas Measurement Committee
ANSI/ASME	American National Standards Institute/American Society of Mech. Engineers
B 1.20.1	Pipe Threads
B 16.5	Steel Pipe Flanges and Flanged Fittings
B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges
ANSI/FCI	American National Standards Institute/Fluid Controls Institute
70.2	Control Valve Seat Leakage Classification
API	American Petroleum Institute
RP 520	Sizing, selection and installation of pressure relieving systems in refineries.
	Part-I - Sizing and selection
	Part-II - Installation
RP 521	Guide for pressure relieving and depressurising systems
RP 526	Flanged steel safety relief valves
RP 527	Seat tightness of pressure relief valves
MPMS	Manual of Petroleum measurement standards
RP 551	Process measurement instrumentation
	Part - I Process Control and Instrumentation
RP 552	Transmission Systems
S 2000	Venting atmospheric and low pressure storage tanks
S 670	Vibration, Axial-Position and Bearing Temperature Monitoring Systems
ASTM	American Society for Tests and Materials
BS	British Standards
BS-1042	Measurement of Fluid Flow in Closed Conduits
BS-5308 Part-II	Specification for PVC insulated cables
BS-7244	Breather Valves
DIN-43760	Temperature Vs. Resistance curves for RTDs
DIN-19234	Electrical Distance Sensors; DC interface for distance sensors and signal converter
DIN-50049	Document on Material Testing
IEC	International Electrotechnical Commission
IEC 79	Electrical apparatus for Explosive Gas atmosphere
IEC 85	Thermal evaluation and classification for electrical insulation
IEC 332	Test on bunched wires or cables
	Part III Cat. A
IEC 529	Classification of degree of protection provided by enclosures



IEC 534-2	Industrial Process Control Valves - Flow capacity
IEC 584-2	Thermocouples - Tolerances
IEC 751	Industrial Platinum Resistance Thermometer Sensors
IEC 801	Electromagnetic compatibility for industrial process measurement and control equipment

IS	Indian Standard
IS-5	Colours for ready mixed paints
IS-319	Specification for free cutting brass bars, rods and sections
IS-1239	Mild Steel tubes, tubulars and other wrought steel fittings
IS-1271	Specification of Thermal Evaluation and Classification of Electrical Insulation
IS-1554 Part-IPVC	insulated (heavy duty) electrical cables – working Voltage upto and including 1100V
IS-2074	Ready mixed paints, air drying, red oxide - zinc chrome
IS-2147	Degree of protection provided by enclosures for low voltage switch gear and control gear
IS-2148	Flame proof enclosures for electrical apparatus
IS-3624	Specification for Pressure and Vacuum gauges
IS-5831	PVC insulation and sheath of electric cables
IS-7358	Specification for Thermocouples
IS-8784	Thermocouple compensating cables
ISA	Instrument Society of America
S-5.2	Binary logic diagrams for process operations
S-7.3	Quality standard for instrument air
S-75.01	Flow equations for sizing control valves
ISO 5167	Measurement of fluid flow by means of orifice plates, nozzles and venture tubes inserted in circular cross-section conduits
NACE	National Association of Corrosion Engineers - MR-01-75
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
ICS-6	Enclosures for industrial control and systems
NFPA	National Fire Protection Association
NFPA-496	Purged and pressurised enclosures for electrical equipment
OSHA	Occupational Safety and Health Authority

Any other national and international codes as applicable subject to approval of SMC.



1. **GENERAL:**

The Contractor shall obtain all instruments from manufacturers of international standing.

The design and quality of all instruments shall be fully suited to the conditions which will be met in service. The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC-801.

The instrumentation and control system shall be designed, manufactured and installed to ensure highest standard of operational reliability. Major instrumentation shall be electronic type. Panel mounted receiving instruments shall be electrically operated miniature flush mounting type unless otherwise specified. All instruments shall be installed in accordance with the recommendations or instructions of the instrument manufacturer for particular application.

All instruments shall be capable of carrying their full load currents without undue heating. They shall not be damaged by the passage of fault currents within the rating of the associated MCB or through the primaries of their corresponding instrument transformers. All instruments shall be back connected and the cases shall be earthed. Approved means shall be provided for zero adjustment of instruments without dismantling.

All voltage circuits to instruments shall be protected by MCB's in each unearthed phase of the circuit placed as close as practicable to the main connection.

Analogue signals shall be 4-20 mA according to BS 5862:Part I 1986 or its latest edition. They shall operate over two wires and be isolated from earth. 1-5V DC signals shall only be permitted within the main instrument enclosure.

Analogue signals shall be so connected that the failure of a remotely transmitted signal to another panel can not affect other readings on instruments operated by the same signal.

The contractor shall furnish technical details / catalogues / drawings for the instruments and panels offered for monitoring and control of the plant, as per the operation philosophy specified, to client/consultant for their approval prior to procurement of the same. Contractor shall offer inspection for the instruments/panel offered by him and in case of waiver of inspection by the client / consultant, necessary test certificates shall be submitted for approval of client / consultant before clearing the material for despatch. Contractor shall submit their inspection plan to client/consultant for their approval for this purpose.

All instruments procured by the contractor as per the Engineer's approval, and those which perform similar duties shall be of uniform type and manufacture throughout the scheme in order to facilitate maintenance and the stocking of spare parts. Moving parts and contacts shall be adequately protected from the ingress of dust, and all instruments shall be protected by moisture and dust-proof cases including those mounted in panels. All equipment shall be suitable for its environment.

Panel mounted receiving instruments shall be of the electrically operated miniature flush mounting type unless other wise stated.



Scales shall be clearly marked with black lettering and graduations on a white background. Instruments of the same type and range shall have identical scales. Unless otherwise specified, the normal working range of all indicating instruments shall be between 30% to 70% of the full scale range.

After a power failure, when power supply resumes, the instruments and associated equipment shall start working automatically.

The instruments shall be designed to permit maximum interchangeability of parts and ease of access during inspection and maintenance.

The field instruments i.e. the instruments mounted outside the control panel shall be mounted at a convenient height of approximately 1.2 m above platform.

Lockable enclosure shall be provided for the field mounted instruments wherever required.

All field instruments, and cabinets / panel-mounted instruments shall have tag plates/name plates permanently attached to them.

In general, Instrumentation System shall be designed as per good engineering practice.

DISMANTLING WORK

The job involves dismantling of any assembly in best engineering manner, wherein almost care should be taken not to damage the equipment being dismantled.

Shut down shall not be given on any ground. Therefore, the Contractor is required to submit his line of action well in advance.

If any damage is caused by the contractor during the course of work to new or existing plant or buildings or any machinery or any part thereof, the contractor shall make good, repair or replace the damage or replace the whole equipment promptly and effectively as directed by the Engineer-in-charge up to his satisfaction at no extra cost to the Corporation and in case, damage/ replacement is not carried out as directed by the Engineer-in-charge, SMC reserves the rights to withhold/ deduct/ recover the cost is estimated to be equivalent to the rectification/ replacement of deficiencies from his running bill or otherwise.

2. POWER SUPPLY TO PACKAGE:

- A) Power Supply shall be made available by the bidder at the following voltage levels, unless otherwise specified.
- For Instruments, Control Systems, Analysers: 230V AC \pm 10%, 50 Hz \pm 3 Hz
 - Solenoid Valves, Relays, Lamps : 24V DC
 - Input Interrogation Voltage : 24V DC
 - Panel/Cabinets Lighting : 230V AC \pm 10%

Contractor shall make provision for a separate feeder in the Plant MCC of suitable current rating to provide 230V AC \pm 10%, 50 Hz \pm 3Hz supply to Instrument Panel(s).

24V DC required for Input Interrogation, SOVs, relays and lamps etc., same shall be generated by the bidder using dual redundant power supply. Power shall be suitably



conditioned by providing UPS / Isolation Transformer-Voltage Stabilizer-CVT to prevent damage to instruments against power fluctuation / disturbances.

- B) Instrument power circuits shall be individually protected from fault with the help of fuses. Power supply to the individual instrument shall be disconnected with the help of fuses. Miniature circuit breakers (MCB's) may be selected in place of switch fuse unit in case protection is provided for overload protection.

3. EARTHING :

Vendor shall provide separate earth bus bar connections for shield and panel electrical earthing. Any special earthing requirements, if required, shall be provided by vendor during detailed engineering.

Necessary earth pits for instrument earth and signal earth (minimum 2 nos. of each type) shall be provided by the vendor.

4. ENCLOSURE :

All instruments enclosure mounted in the field shall be weatherproof to IP-65 / NEMA4 as a minimum.

5. INTERLOCKS / LOOPS :

All plant interlocks shall be carried out using PLC / electromagnetic relays to be supplied by vendor for fail safe and reliable operation. Vendor to indicate all process interlock requirements on the P&IDs.

Loop integrity must be maintained for each loop. No component of any loop shall be shared by other loop.

The system shall be designed fail safe and shall meet the following requirements, as a minimum :-

- a) All initiating contacts shall be close under normal conditions and shall open under abnormal conditions.
- b) All relays and solenoid valves shall be energised under normal conditions and shall de-energise under abnormal conditions.

The system shall be designed using PLC / electromagnetic relays unless specified otherwise and shall be located locally or remotely as per the operational requirements. The system shall meet the following requirements as a minimum :

- a) The electromagnetic relays shall be low power continuously rated type and shall have LED for status indication.
- b) The relays shall be plug-in type and their plug-in bases shall have screwed terminals for interconnection. Lug type soldered connection shall not be acceptable.
- c) Each relay shall have three numbers of 'NO' and three numbers of 'NC' contacts as a minimum each suitable to drive the connected. Out of these, one 'NO' and one 'NC' contacts shall not be used.



- d) Each shutdown/interlock logic shall be individually protected using separate switch-fuse unit and shall have a lamp for indicating power healthy status.

Each shutdown circuit and solenoid valve shall be provided with a switch-fuse unit separately.

6. INSTRUMENT CONTROL PANEL / CONTROL DESK (ICP) :

The Control Panel shall be free standing & enclosed cubicle type with backdoors. Instruments to be mounted on control panel shall be as per this bid document as a minimum.

Control panels shall be prefabricated type, Sourced from Approved Vendors.

Control Panel shall be CNC machine prefabricated out of CRCA sheet steel of thickness not less than 1.5 mm, modular in construction, properly reinforced, powder coated and having rigid frame structure. Internal mounting plate including the gland plate shall be 3 mm thick. The instrument panel shall have dimensions as per system requirement. However, the Control panel height shall not exceed 2100 mm.

The exterior corners and edges shall be rounded to give a smooth overall appearance with projections kept to a minimum.

Lifting lugs shall be provided for installation purposes and shall be replaced with corrosion resistant bolts after installation.

Control Panel shall be completely metal enclosed and shall be dust, moisture and vermin proof. Panel enclosures shall provide a degree of protection not less than IP 52 in accordance with IS: 13947 Part-I.

Control Panel shall be freestanding type. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation.

Metal sills in the form of metal channels properly drilled shall be furnished along with anchor bolts and necessary hardware for mounting the Instrument panels. These shall be dispatched in advance so that they may be installed and leveled when concrete foundations are poured.

Cable entries to the panels shall be from the bottom with fire retardant spray compound sealing. Instrument panels shall be provided with louvers along with washable micron filters AIRIN – AIROUT fans will be provided.

No process fluid of any kind, except instrument air, shall enter the instrument cubicle. All cable entry shall be from the bottom of the panel. Also power supplies greater than 230 V shall not enter the LCP.

The internal layout of the panel/cabinets shall be designed considering proper approach for each item for maintenance. Following point must be taken into consideration while deciding the internal layout :



- a.) All wiring inside the panels shall be housed in covered non-flammable plastic raceways arranged to permit easy accessibility to various instruments for maintenance adjustment, repair and removal. No raceway shall be more than 70% full.
- b.) Separate wiring raceways shall be used for power supply wiring, DC and low level signal wiring.
- c.) Distance between terminal strips and side of the panel parallel to the strips up to 50 terminals : Min. 50 mm.
- d.) Distance between terminal strip and top and bottom of cabinet : Min. 75 mm.
- e.) Distance between two adjacent terminal strips : Min. 100 mm.
- f.) Distance between cable gland plate and the bottom of strips : Min. 300 mm.
- g.) 20% spare terminals shall be provided as a minimum.

Overall height of Control Panel shall not exceed 2100 mm. Panel mounted instruments and controls shall be such mounted that they are accommodated between 800 mm and 1300 mm from floor level.

Control Panel shall be provided with fluorescent type lighting fixtures controlled from totally enclosed door operated switches for internal illumination of the panel cabinets.

Contractor shall provide with necessary cooling fans and cut-outs covered with appropriate filters for necessary air changes to limit temperature rise within panel to 5 deg C over ambient temperature.

Contractor shall consider necessary power conditioning unit (UPS / Voltage Stabilizer-CVT etc.) to prevent power fluctuation and surge to damage the instruments as well as other electronic components.

For cases where PLC is to be mounted, panel shall be designed suitably as per PLC manufacturer's recommendation. Necessary marshalling boxes may be considered if required as per design.

Mounting

All equipments on front of panel shall be mounted flush or semi-flush. In case of semi-flush mounting, only flange or bezel shall be visible from the front.

Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment.

Equipment mounted inside the panel shall be so located that terminals and adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly visible.

Earthing for Instruments

The panel shall be equipped with an earth bus securely fixed along the inside base of panel.

Minimum two numbers of Dedicated Earth Stations to be provided each for Instruments / Panel Earthing and for Signal (Electronic) earthing. The earth station shall be of maintenance free pipe in pipe technology having earth electrode of 50 mm dia. and length of 3000 mm.



All metallic cases of instruments and other panel mounted equipment shall be connected to the instrument earth bus.

Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken shall not be permitted. However, looping of earth connections between equipment to create alternative paths to earth bus shall be provided.

A separate instrument earth bus will be created which will be floating and all the cable shields will be terminated onto this bus. This bus will be connected to an electronic earth pit as specified above.

Frame Earthing

All metal parts other than those forming part of an electrical circuit shall be connected to a copper earth bar run along the inside bottom of the panel. The minimum section of the earth bar shall be 25 mm x 3 mm. A 15 mm diameter hole is to be provided at each end of the bar. Connection of the earth bar to the station earth shall be carried out by Contractor.

Space Heater

Strip type space heaters of adequate capacity shall be provided inside control panels to prevent moisture condensation on the wiring and panel mounted equipment when the panel is not in operation. The heaters shall operate on 230 V AC. Heaters inside the panels shall not be mounted close to the wiring or any panel mounted equipment. The operation of heaters shall be controlled by thermostats.

Interior Lighting and Receptacles

Each panel shall be provided with either a CFL lighting fixture rated for 11 watt, 230V, 1 phase, 50 Hz supply for the interior illumination of the panel during maintenance. The illumination lamp shall be operated by door switch or manual switch. Each panel section shall be provided with separate lighting.

Each panel shall be provided with 230V, 1 phase, 50 Hz, combined 5 amps and 15 amps, 3 pin receptacle with a switch and neon indication. The receptacle with switch shall be mounted inside the panel at a convenient location. If the panel has front and rear doors then maintenance socket shall be provided at both locations.

Labels

All the equipment mounted on the front facia of Instrument panel as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation engraved. The labels shall be mounted directly below the respective equipment. Also the panel shall be provided at the top with a label engraved with panel designation.

Switches and Miniature Circuit Breakers (MCBs)

Each instrument panel shall be provided with necessary arrangement for receiving, distributing, isolating and protecting of DC and AC supplies for various controls, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with DP Miniature Circuit Breakers (MCBs). Potential circuits for relaying and metering also shall be protected by MCBs. All such major MCBs will be provided with an auxiliary contact to be used for providing MCB tripped alarm.



Intra-panel (i.e. Panel Internal) Wiring

Connections within a panel, between panel mounted devices and terminal blocks or between two panel mounted devices will be made by 600 volt grade, multi stranded copper flexible conductor insulated with FRLS Grade PVC and designed for a minimum conductor temperature of 70 degrees centigrade. The wires shall be shielded, where necessary.

Panels shall be supplied completely wired internally, with a colour coding scheme decided mutually between the Purchaser and the Contractor, to equipment and terminal blocks and ready for external cable connections at the terminal blocks.

Wires within the panel shall be continuous i.e. without splicing and shall comprise stranded copper conductors. Internal wiring or wiring between the two assemblies shall be commensurate with mechanical safety.

Wire termination shall be made with solder less crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules, marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire is disconnected from terminal blocks. The ferrule system shall adopt single tube printed arrangement so that all the characters remain on one line always & hence easily readable

Terminal Blocks

Terminal blocks for power connection shall be 600V grade, 20 amps rated, one-piece moulded, complete with stud type terminals, washers, nuts and lock nuts and identification markings. Terminal block design shall include a white fiber marking strip with clear plastic, hinged terminal covers. Markings on the terminal strips shall correspond to wire numbers on the wiring diagrams. All control output terminals will be fused type and all other input signal terminals will be clip on shrouded type.

All spare contacts and terminals of the panel mounted equipment and devices shall be wired to terminal blocks.

Panel internal wiring shall not be looped directly from instrument to instrument. The same shall be looped through the panel terminal block only.

If accidental short circuiting of certain wires is likely to result in malfunction of equipment, such as closing or tripping of a breaker, these wires shall not be terminated on adjacent terminal blocks.

Cable Supports

All external cables shall present a neat appearance and shall be suitably braced, placed in toughing clipped or laced to prevent effects of vibration.

Terminal / Identification

Every terminal plug shall be uniquely identified within the terminal cabinet by means of a terminal number. Appropriate labels shall be used to permit quick and unambiguous identification of each terminal and test plug.



Painting of System Cabinet/ Control Desk

All sheet steelwork shall be painted using seven tank process in accordance with the following procedure:

- i. The pre treatment shall be hot process with running water for rinsing.
- ii. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.
- iii. Rust and scale shall be removed by trickling with clean water followed by final rinsing with dilute dichromate solution.
- iv. The control panel shall be powder coated. Thickness of coating shall be around 60 microns. QA test certificate shall be furnished for thickness adhesion and hardening of powder coating.

7. ALARM ANNUNCIATOR :

Visual alarm at HMI and audio alarm through panel mounted hooter along with hooter reset push button shall be provided for all the required alarms as per specifications / approved P&ID / process requirement.

8. RECEIVING INDICATORS/CONTROLLERS :

All indicators/controllers, where specified in tender specifications / detailed specifications for instruments, shall be electronic (microprocessor based) programmable indicator and shall be mounted on the control panel located in the control room.

Notes :

Indicating instruments shall indicate various process parameters as per following measuring units, in general :

Flow	M ³ /Hr or MLD or LPS	as per process requirement
Level	m	Meters
Pressure	Mt. head of water or Kg/Cm ²	as per process req.
Temperature	C	Degree Celsius
Concentration	ppm or mg/l	Parts per million or Milligram per ltr.
Current	A	Amperes
Voltage	V	Volts
Power	W	Watts
Electrical Energy	Whr	Watt-hours
Frequency	Hz	Hertz
Speed	r.p.m.	Revolutions per minute.

Multiplying factors for flow scales shall be specified on manufacturer's name plate.

Subminiature recorder shall have 100 mm. Strip chart with chart speed of 25 mm/hr. Microprocessor based recorder shall have strip chart of 250 mm. Approx. and chart speed of 50 mm./hr. with a provision to change speed at site.

9. PUSHBUTTONS AND SWITCHES



Pushbuttons, where applicable, for operational circuits shall be provided with a shroud, guard or other suitable means to prevent inadvertent operation. They shall be in accordance with the high standard generally required by the specification as a whole and by the equipment with which they are associated.

Illuminated pushbuttons where applicable / used shall be of a design that allows easy replacement of the lamps from the front of the panel.

If legends are engraved on the pushbuttons they shall be clear and concise and shall be approved by the Engineer – In charge before manufacture.

Control switches shall be in accordance with the high standard generally required by the specification as a whole and by the equipment with which they are associated.

10. INSTRUMENT CONNECTIONS:

Electrical cable entry shall be ½” NPT(F). Suitable cable gland shall be used.

End connections shall meet the following unless, otherwise specified:

Threaded end connection shall be NPT as per ANSI / ASME B.1.20.1

Flanged end connection shall be as per ANSI / ASME B16.5

11. ANALOGUE SIGNAL MULTIPLIERS:

The flow, level and Pressure signals shall be provided with back of panel mounted signal multipliers. They'll provide loop power with option to select measurement with power and without. The multiplier will provide 2 outputs of 4-20mA one for the panel mounted indicator and other for PLC i/p. There will be total galvanic isolation between field I/O's and also between the 2 outputs.

DETAILED SPECIFICATIONS FOR INSTRUMENTS

Instruments as per following details and specifications shall be provided by vendor as a minimum. Quantities mentioned, if any, are indicative and minimum only and contractor shall provide all necessary instruments described in this section or as required for proper operation of the plant as described else where in this tender or found necessary during detailed engineering in addition to below mentioned instruments and their locations.

All instruments, gauges and control equipment shall be strictly procured as per the list of approved vendors enclosed herewith as part of the tender documents.

a) ULTRASONIC LEVEL TRANSMITTER

Ultrasonic level measurement shall be accomplished by the use of non-contact, echo-time measuring equipment operating at ultra-sonic frequency.



The sensor shall be suitable for mounting in the open, or within an enclosed tank, and shall be with environmental protection to IP-68 as minimum. The sensor / transducer range shall be as required to cover Liquid Depth + Free Board + Blanking Distance as a minimum.

The control units shall incorporate:

Facilities for calibration and shall have an output of 4-20mA proportional to selected measurement parameter of level as per user selection / program.

4 digit or other suitable as per mfr std. LCD read out of selected measurement parameter in suitable engineering units.

The contractor shall provide a canopy for the sensor and the control unit exposed to sunlight to provide protection from direct sunlight.

Ultrasonic Transmitter for Level Measurement:

Ultrasonic transmitter shall be provided to measure liquid level for WDS Sump and ESR . It shall also be provided for other tanks/sumps as specified elsewhere. The purpose is to monitor Sump and ESR levels and for start/stop of pumps/valves in auto mode through suitable logic to be decided during detailed engineering, low/high level alarm annunciation on PLC/SCADA at control room, etc. The brief specifications in addition to above specifications shall be as under:

Type	:	Ultrasonic, Programmable, Remote Tx. for ESR and Inegral Tx. for WDS Sump
Mode of Operation	:	Level
Accuracy	:	$\pm 0.25\%$ of range OR 6 mm, whichever is greater
Resolution	:	0.1 % of range OR 3 mm, whichever is greater
Outputs	:	4-20 mA analog output proportional to level
Programming Device	:	In-Built in controller or Hand-held
Local Digital Display	:	Level in Engg. Units
Power	:	2/4-Wire (24 V DC or 230V AC, 50Hz)
Temp. Compensation	:	Required, Built-in temp. sensor in transducer
Control Unit Protection	:	IP-65 as a minimum
Operating Temp.	:	-20° to 50° C
Meas. Range	:	As per SOQ
Transducer Protection	:	IP-67/68
Blanking Dist.	:	0-3-0.4m max.
Transducer Cable Length	:	As Per SOQ
Sensor MOC	:	PVDF or equi. suitable
Sensor Protection Class	:	IP 68 Enclosure

Level readings shall be continuously displayed locally as well as in remote at Panel mounted Process Indicator and at PLC/SCADA at control room (as provided for / specified in BOQ & philosophy). Low-Low & High-High level alarms shall be annunciated at HMI/SCADA. Pump operation shall be interlocked with the status of motorized valve at inlet of ESR /ESR water level in on/off mode subject adequate level of water in WDS. The pump shall operate in level/timer based auto mode i.e. start at set high level and stop/close



at set low level or at set times as finalized during detailed engineering. The working and standby pump shall be selected by operator at HMI or shall be determined by operating hours of pump such that pump with minimum operating hours shall start first & so on and in case of pump trip, pump with maximum operating hours shall stop first and so on. Operating hours of pump shall be logged in PLC.

Ultrasonic Level Transmitter provided at ESR for monitoring ESR level and control the Electric Actuator operated valve provided at inlet pipe of ESR in case of ESR level reaching programmed high level (to prevent overflow and to open valve in case of ESR level reaching programmed low level. ESR low level alarm shall be provided at WDS.

WDS Pump operation shall be interlocked with the status of motorized valves at inlet of ESR / ESR water levels in on & off mode subject adequate level of water in WDS. It shall also be interlocked with pressure transmitter based on operational experience.

b1) ELECTRO MAGNETIC FLOW MEASURING SYSTEM (MAINS SUPPLY)

Generally, the flowmeter shall be as follows:

Flow metering System

Each flow metering system shall consist of the primary transducer (Sealed to IP-67 for above ground / non-submerged application and IP-68 for below ground within chamber for submerged application), earthing rings, the necessary signal converter and power supply unit and all cabling between the primary transducer and signal converter and power supply unit.

The general specifications for electromagnetic flow meter shall be as under:

Service		Treated Water Application
Function		To measure & indicate Instantaneous Flow and Totalised Flow / Transmit (Flow)
Fluid Conductivity		> 5 μ S/cm
Installation		Indoor or Outdoor, Below or Above Ground as per piping / site conditions
Flow Sensor / Tube / Element		
Type of Sensor		Full Bore type
Flange Materials		CS or better as per mfr. Std.
Tube Material		SS304 or SS 316
Liner Material		Hard Rubber
Body Material / Coil Housing		CS or better as per mfr. Std.
Electrode Material		SS316L or Ha-C
Power Supply		From Transmitter
Grounding	Type / Material	Earthing Electrode / Set of earth rings SS316
Protection Class	Above GL or Indoor within	IP-67 for flowmeters installed above Ground Level or if installed indoor within



	Pump House / Bldg.	pump house / building below ground level.
	Below GL outdoor	IP-68 for flowmeters installed outdoor below Ground Level (shall be mounted within RCC / Brick Masonry Chamber)
Cable Entry (for separated / remote version) & Glands		Shall be as per mfr. Std. and suitable to maintain the specified protection class at site
Cable Length	Sensor to Transmitter	Min. 25m, dual shielded cable
Painting, where applicable	CS / other	Chemical Resistant, Epoxy Painted
TRANSMITTER		
Function		Transmit and Indicate
Type		Remote (Non-Integral) type, Microprocessor based, User Programmable
Flow / Velocity Measurement Range	Max. Flow Velocity	Flowmeter shall be capable to measure flow with velocity up to max. 10 m/sec.
Accuracy	Flow Vel. ≥ 0.5 m/s	$\pm 0.5\%$ of Flow Rate / Measured Value or better
	Flow Vel. < 0.5 m/s	as per mfr. Std. for flow velocity up to 0.3 m/s
Analogue Output Signal	For Flow	Isolated, 4 -20 mA DC
Pulsed O/P		For Totalized flow
Instrument Power Supply		230 VAC $\pm 10\%$, 50 Hz $\pm 5\%$
Cable / Conduit Entry		1/2" NPT.
Local Indicator / Display	Inst. & Total Flow	Backlit LCD Display (Inst. & Totalized Flow)
Enclosure	Type & Protection Class	Weather Proof to IP-65 as a minimum or better
	MOC	Cast Alu. or equi. as per mfr. Std. suitable outdoor installation & for withstanding harsh environment
	Type	Wall mounting / Pipe mounting
Vibration Conditions		Conformity with IEC 60068-2-6 or equi., shall be able to endure vibration, when in service, without any degradation in performance
Pipe not Full Detection / Empty Pipe Detection		Required
Canopy for Analyzer / Transmitter	To prevent from direct sun and rain	Required. MOC: FRP - min. 4mm thick / G.I. - min. 2mm thick
Expansion Bellows	SS 304	Required at suitable location to enable ease



		of removal / insertion of flow meter for maintenance
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These flowmeters shall be provided at locations as specified in SOQ.

Flow (Instantaneous and Totalised) readings shall be continuously displayed at PLC HMI. Real time and historical trend shall be available for last 180 days.

Flow meter shall be mounted above ground level / HFL as far as possible. In case of flowmeter mounted below ground level / HFL shall be provided with suitable water proof covered chamber constructed in RCC (with access through manhole of sufficient size & CI rungs) & elevated 300mm above FGL of sufficient size for ease of operation and maintenance as decided during detailed engineering to avoid submergence in water.

Flowmeter shall be mounted as per manufacturer's recommendation and good engineering practices with required upstream and downstream straight length and other precautions as recommended by vendor to ensure proper flow measurement and each flow meter shall be provided with a bellows at suitable location to enable ease of removal / insertion of flowmeter for maintenance. For flowmeter mounted below ground level, chamber shall be sized suitably to accommodate flowmeter and bellows in the same chamber.

The Flow meters shall be calibrated according to the ISO-8316. Standard. Performance Type Testing Certification (ISO 9104) strictly not acceptable. The suppliers shall also have a testing facility in India or abroad so that methodology and procedures can be verified. The testing facility shall be duly accredited in accordance with ISO 17025 standards in India.

Test bed shall be accredited by national /international certifying authority (FCRI & NABL) as per ISO 8316 (Calibration by Volumetric Method) or ISO 4185 (Measurement of fluid flow in closed conduits - weighing method).

Minimum 10% or one no. (Whichever is higher) of flow meters of each size shall be wet calibrated at accredited facility / test bed as mentioned above either at manufacturer works or any other such facility in India. Flow meters shall be tested for accuracy, calibration & sealed in presence of the Client Engineers / TPI / PMC at manufacturer's works / Calibration Facility. All electro-magnetic flow meters shall be provided with manufacturer's calibration certificates.

b2) ELECTRO MAGNETIC FLOW MEASURING SYSTEM- (BATTERY OPERATED)

The general specifications for battery operated electromagnetic flow meter shall be as under:

SR. NO.	ITEM	DESCRIPTION/MOC
A	PROCESS DATA	
1	Fluid	Treated water



2	Temp.	Water 0 to 40°C
		Ambient 0 to 50°C
3	Inlet Press. Operating Kg/Cm ²	As per design
B	GENERAL	
1	Meter Type	Full bore micro processor based, programmable, Remote / Integral type
2	Meter Range Max. m ³ /Hr.	Vendor to specify
3	Min. Fluid Conductivity	≥20 micro S/cm
C	SENSOR	
1	Meter Size	As per SOQ
2	Sensor housing	Sheet steel, Polyurethane coated
3	Measuring tube	SS 316 / Non magnetic Alloy
4	Liner Material	Hard Rubber, EPDM, Rilson
5	Connection Type	Flanged end connection to ASME B 16.5 Class 150 RF
6	Flange Material	CS with epoxy coating
7	Electrode Material	SS-316L /Ha-C
8	Enclosure Class	IP68 cable & cable glands factory sealed
9	Grounded Electrode	Require SS-316L / Ha-C
10	Grounding Straps / ring	SS 316 or suitable shall be provide as per site condition / vendor recommendation
11	Pipeline Material	DI K-9
12	Up Stream / Down Stream Clearance	3D / 2D or lower is desired. Vendor to confirm recommended requirement in their offer
D	TRANSMITTER	
1	Type:	Microprocessor based
2	Accuracy Class	+/-0.5% of rate or better
3	Mounting	wall mounting
4	Enclosure Protection Class	IP68
5	Enclosure Material	Die cast Aluminium with Polyurethane coated, SS
6	Length of sensor cable	Min. 20 meters
7	Power Supply	Powered by battery Shall be able to also operate on mains power if available (preferred)
8	Battery Type	Lithium / Alkaline battery, Internal battery pack / External battery pack with IP 68 Protection, 2D Cell 3.6V / 33Ah or Better
9	Battery Life	Min. 3 years with Two time data transmission in a day and ambient temp. of 35° C
10	Battery Replacement	Must be without data loss



11	Data logger	Required, with adequate data logging and selectable as Daily, Weekly, Monthly
12	Forward, Reverse and bidirectional net flow totalize flow data	required
13	Low flow cut off	Required
14	Display	Flow rate , Totalized Flow, Velocity, Remaining battery life with alarm, empty Pipe detection, etc.
15	Output	RS 485 with Modbus / As per mfr. Std. (with suitable / matching connectivity for modem / PLC / RTU as required)
16	GSM Modem	Required with required cable / Built in with flow meter
17	Antenna	Required with 3 meter cable if applicable
18	Alarm Output	For abnormality in flow measurement or battery indication
19	Calibration Certificate	Required
20	Necessary software at receiving end	Required shall integrate with TP SCADA to provide and display flow and other relevant flowmeter data on SCADA.
21	Flow meter shall be suitable for Pressure measurement in future for leakage alarm if required	Provision shall be available in Flow meter
22	Password Protection	Multiple level password protection required
23	Diagnostic Capability	Required
24	Size & Qty.	As per SOQ

These flowmeters shall be provided at locations as specified in SOQ.

Flow readings & other relevant data shall be transmitted to control room through GSM sytem once or twice in a day as decided by client and shall be displayed at SCADA at control room.

The battery life shall be atleast 5 years considering remote data transmission (GSM/GPRS) once in a day.

Vendor to quote for battery replacement & any other recommended spares cost as part of offer.

Vendor to specify clearly the life of battery for one and two time data transmission per day (GSM/GPRS) and considering average ambient temperature of 35 degC and peak ambient of 45 degC.

Flow meter shall be mounted as per manufacturer's recommendation and good engineering practices.



The Flow meters shall be calibrated according to the ISO-8316. Standard. Performance Type Testing Certification (ISO 9104) strictly not acceptable. The suppliers shall also have a testing facility in India or abroad so that methodology and procedures can be verified. The testing facility shall be duly accredited in accordance with ISO 17025 standards in India.

Test bed shall be accredited by national /international certifying authority (FCRI & NABL) as per ISO 8316 (Calibration by Volumetric Method) or ISO 4185 (Measurement of fluid flow in closed conduits - weighing method).

Minimum 10% or one no. (Whichever is higher) of flow meters of each size shall be wet calibrated at accredited facility / test bed as mentioned above either at manufacturer works or any other such facility in India. Flow meters shall be tested for accuracy, calibration & sealed in presence of the Client Engineers / TPI / PMC at manufacturer's works / Calibration Facility. All electro-magnetic flow meters shall be provided with manufacturer's calibration certificates.

b3) ULTRASONIC SINGLE / MULTI CHANNEL FLOW MEASURING SYSTEM FOR PIPE LINE APPLICATION

The general specifications shall be as under:

Service		Treated Water Application
Function		To indicate & transmit Flow
Installation		Suitable for Indoor or Outdoor application
Flow Sensor / Tube / Element		
Type of Sensor		Ultrasonic, Insertion Type, single track / channel, two sensor type
Measurement Principle		Transist (time of flight) time principle
Sensor Housing		SS 304 or better as per mfr std.
Sensor contact surface		Chemically resistant plastic or as per mfr std.
Power Supply		From Transmitter
Protection Class		IP-68
Cable Entry (for separated / remote version) & Glands		Shall be as per mfr. Std. and suitable to maintain the specified protection class at site
Cable Length	Sensor to Transmitter	Shielded, Min. 10m or higher as per requirement
TRANSMITTER		
Function		Transmit and Indicate
Type		Remote (Non-Integral) type, Microprocessor based, User Programmable
Flow / Velocity Measurement Range	Max. Flow Velocity	Flowmeter shall be capable to measure flow with velocity up to max. 10 m/sec.



Accuracy	Flow Vel. \geq 0.5 m/s	\pm 2% of Full Scale or better
Analogue Output Signal	For Flow	Isolated, 4 -20 mA DC
Instrument Power Supply		230 VAC \pm 10%, 50 Hz \pm 5%
Cable / Conduit Entry		1/2" NPT.
Local Indicator / Display	Inst. & Total Flow	Backlit LCD Display (Inst. & Totalized Flow)
Enclosure	Type & Protection Class	Weather Proof to IP-65 as a minimum or better
	MOC	Cast Alu. or equi. as per mfr. Std. suitable outdoor installation & for withstanding harsh environment
	Type	Wall mounting / Pipe mounting
Canopy for Transmitter	To prevent from direct sun and rain	Required. MOC: FRP - min. 4mm thick / G.I. - min. 2mm thick

These flowmeters shall be provided at locations as specified in SOQ.

Flow (Instantaneous and Totalised) readings shall be continuously displayed at PLC HMI / SCADA and at ICP mounted FIQ in main control room.. Real time and histroical trend shall be available for last 180 days.

Flow meter shall be mounted above ground level / HFL as far as possible. In case of flowmeter mounted below ground level / HFL shall be provided with suitable water proof covered chamber constructed in RCC (with access through manhole of sufficient size & CI rungs) & elevated 300mm above FGL of sufficient size for ease of operation and maintenance as decided during detailed engineering to avoid submergence in water.

Flowmeter shall be mounted as per manufacturer's recommendation with required upstream and downstream straight length and other precautions as recommended by vendor to ensure proper flow measurement. For flowmter mounted below ground level, chamber shall be sized suitably to accommodate flwometer and bellows in the same chamber.

All Ultrasonic flow meters shall be provided with manufacturer's calibration certificates.

c) RECEIVING INDICATORS MOUNTED AT ICP/LCP:

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. 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 Output:	:	Required, 4-20 mA in 600 ohm load
Accuracy	:	± 0.25% of FSD
Terminals	:	suitable for up to 2.5 sq.mm. wires
Mounting	:	panel flush mounting
Power	:	230 V AC, 50 Hz
Comm. Port	:	RS-485 Serial Port (Modbus)

Flow Indicator cum totaliser shall also have following in addition to above:

Totalising Counts/Hr	:	User Programmable at site
Totaliser Display	:	8 Digit Digital Display with Battery Backup to retain totalized data in the event of power failure for a minimum period of 24 hours.

d) PRESSURE GAUGES:

All pumps, compressors and air blowers shall have PG at their discharge lines. 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 confirm 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 150mm 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 ±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

e) TRANSMITTERS (Pressure / Diff. Pressure)



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. Indication shall be provided at PLC HMI / SCADA.

The transmitter housing shall be IP-68, 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 mA output signals proportional to the measured conditions. They shall operate on a 2 wire system receiving their power from the residual 4 mA 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 of 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 cocks and any similar ancillary item of equipment.

Process data, calibrated shall, 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 following specified data as a minimum :-

Transmitter tag no.

Purchase order no.

Name and address of Manufacturer

Type/Model No.

Serial No.

Calibrated range

Range and maximum working pressure, temperature, speed, vibrating level etc.

Materials of construction.

Electrical protection classification.

Pressure readings shall be continuously displayed locally as well as in remote at Panel mounted Process Indicator and at PLC / SCADA at main control room (as provided for /



specified in BOQ and philosophy). Low & High alarms shall be annunciated at HMI/SCADA.

Pressure transmitters are proposed to be provided at common header line of pumps of WDS to monitor the discharge pressure with local and remote indication at panel mounted process indicator & at HMI with low & high alarms.

Pressure transmitters are also proposed to be provided at critical nodes / locations on pipe lines in proposed and existing distribution network to monitor pressure at the location and transmit the data to Master and Zonal SCADA room for alarms and corrective action and for data storage and monitoring at SCADA system as required.

f) FLOAT/BUOYANCY SWITCHES:

WDS sump shall be provided with low level switches for dry run protection of pump (in addition to ultrasonic type level transmitter) for auto trip to prevent dry running of all pumps in auto as well as manual mode. The necessary contacts shall be multiplied by relay in ICP and shall be interlocked with each starter as applicable. Low level alarm shall be provided at PLC HMI / SCADA .

The level switch shall be with PP float. Switching element shall be a micro switch with switching ball of PP or equi. non corrosive material. Contact shall be 1NO + 1NC and contact rating shall be minimum 2A rated at 230V AC resistive load.

g) FLOAT & BOARD TYPE LEVEL GAUGES:

WDS sump shall be provided with local level indication gauge as specified. Gauges shall be mounted in a manner that it is easily visible .

Meas. Range	:	As per Tank Height
Float Size / MOC	:	300mm dia. / SS316
Float Wire Size / MOC:	:	1.5-1.6 mm / SS316
Guide Wire Size / MOC:	:	3 mm / SS316
Bottom Anchor Bar	:	SS316
Guide Pipe	:	G.I., Class B
90° Sheave Elbow	:	Cast aluminium
Roller Pulley	:	2 nos.
Top Anchor	:	Cast aluminium
Tension Spring	:	Cd Plated Steel
Pipe Support & U Bolts:	:	MS (Epoxy coated)
Scale	:	MS (epoxy painted), 125 mm wide, White background, Minor marking at every 50 mm in Black, Major marking at every 1000 mm in Red.
Pointer	:	MS (Cd Plated), painted in red

I) PROGRAMMABLE LOGIC CONTROLLERS SYSTEM FOR WDS, ESR (PROPOSED & EXISTING) ,DISTRIBUTION NETWORK (PROPOSED & EXISTING), ZONAL SCADA AND MASTER CONTROL SCADA



Bidder to note the location specific requirements specified as under to be provided/included in scope of work irrespective of whether mentioned in following general specifications or not:

- a) **3 nos. WDS Location (WDS-1 at FP-157 TP-7 Anjana, WDS-2 at FP-107 TP-7 Anjana, WDS-3 at FP-R-13 TP-13 Maghob) :**
PLC Based Instrument control Panel with Local SCADA system comprising of min. 21" PC with A4 size laser jet printer for report / alarm printing, Min. 1 kVA online UPS along with CVT, Open protocol connectivity along with required Ethernet switch, GSM/GPRS modem (4G), SIM card for remote data transmission to Zonal SCADA as well as Master control SCADA is proposed for monitoring of water distribution station operation and also to monitor the level of sump as well as flow and pressure in the common delivery header of pumps. The data communication shall be based on GSM/GPRS with required communication port and modem suitable for GPRS data communication on 4G network of selected service provider.
- b) **Proposed 7 nos. ESR Location:** Micro PLC based control system is proposed at each ESR location for acquiring the ESR location data (level, flow and inlet valve status), Min. 1 kVA online UPS along with CVT, Open protocol connectivity along with required Ethernet switch, GSM/GPRS modem (4G), SIM card for remote data transmitting to Zonal SCADA as well as master control SCADA and concerned WDS for necessary monitoring and for control action at WDS. The data communication shall be based on GSM/GPRS with required communication port and modem suitable for GPRS data communication on 4G network of selected service provider along with SIM card.
- c) **At Proposed Distribution Network Locations:** Micro PLC based control system is proposed at each pressure, Flow and actuator location for acquiring the field instrument data (pressure / inst. & tot. flow), Min. 1 kVA online UPS along with CVT, Open protocol connectivity along with required Ethernet switch, GSM/GPRS modem (4G), SIM card for remote data transmitting Zonal SCADA as well as Master Control SCADA and concerned WDS. The data communication shall be based on GSM/GPRS with required communication port and modem suitable for GPRS data communication on 4G network of selected service provider along with SIM card.

The Panel proposed at Field locations shall be with IP-66 enclosure, with padlocking facility and necessary arrangement for applying seal shall be provided to prevent panel tempering. An MS section Pillar shall be provided with lockable door to enclose the PLC Panel suitable for installation in outdoor area. Additionally a door lock limit switch shall be provided interlocked with PLC to provide local & remote alarm with SMS to programmed users in case of an attempt to open the panel door by any person. The panel / enclosure shall be wall/floor mounting type.

The data of WDS as well as field instruments at ESR and distribution network shall be transmitted to SCADA system to be provided at WDS/SMC office location as directed by SMC for acquiring data, storage and monitoring.



- d) Following is proposed for **Zonal SCADA at Control room for 3 Nos. WDS, 7 Nos. ESR and Distribution location:**

The provision of SCADA System shall be keeping in mind the data acquisition/transfer to & from various WDS, ESR & field locations of concerned ward or additional wards and with provision to display various process data of WDS, ESR & Field Locations within Distribution Network as per design for required monitoring, alarm and initiating control/corrective steps at concerned WDS & Field by O&M agency. Lease line / Dark Fiber connection shall be provided at SCADA location. The proposed SCADA system shall also meet the following requirements:

- Selected SCADA shall be with Unlimited Tags/Screens for future up-gradation
- SCADA Software shall have Web Access facility for monitoring
- Daily and weekly Reporting shall be available in Downloadable Format
- A minimum of 12 months and up to 36 months historical data should be Downloadable
- Administrator should have access to control over users right to access the system. System shall be pass word protected.

The SCADA system shall comprise of:

- 2 Nos. Desktop PC (One for EWS and Other for OWS) with 32" LED Display,
 - Required Licensed OS (Operating System), Anti-Virus & othe software
 - Required communication ports / Multi-channel receiving modems
 - Providing Lease line at SCADA location (Min. 2 Mbps speed) / Dark Fiber Connection
 - 4TB Data NAS System -high performance RAID network storage and backup device for data storage
 - A4 Laser jet Printer – 1 No.
 - PLC + SCADA (Runtime + Full development) Software License
 - Reporting Software license
 - SMS transmission facility, additional Micro PLC shall be provided as required
 - VPN Router with suitable number of ports
 - SIM CARD as required (at all locations viz. SCADA, WDS, ESR & Network locations)
 - Industrial grade Ethernet switch min. 8 port
 - 2KVA (Min.) UPS along with CVT with CVT with 1 Hour Back up – 1 No.
 - Copper plate earth pit - min. 4 nos. or higher as required / recommended by SCADA vendor
 - Copper wire / copper strips for earthing as required
 - 2 nos. 1.5 Ton capacity Air conditioners
- e) Existing 3 nos. ESR Location: Micro PLC based control system is proposed at each ESR location for acquiring the ESR location data (level, flow and inlet valve status), Min. 1 kVA online UPS along with CVT, Open protocol connectivity along with required Ethernet switch, GSM/GPRS modem (4G) , SIM card for remote data



transmitting to Zonal SCADA as well as master control SCADA and concerned WDS for necessary monitoring and for control action at WDS. The data communication shall be based on GSM/GPRS with required communication port and modem suitable for GPRS data communication on 4G network of selected service provider along with SIM card.

- f) At Existing Distribution Network Locations: Micro PLC based control system is proposed at each pressure, Flow and actuator location for acquiring the field instrument data (pressure / inst. & tot. flow), Min. 1 kVA online UPS along with CVT, Open protocol connectivity along with required Ethernet switch, GSM/GPRS modem (4G) , SIM card for remote data transmitting Zonal SCADA as well as Master Control SCADA and concerned WDS. The data communication shall be based on GSM/GPRS with required communication port and modem suitable for GPRS data communication on 4G network of selected service provider along with SIM card.

The Panel proposed at Field locations shall be with IP-66 enclosure, with padlocking facility and necessary arrangement for applying seal shall be provided to prevent panel tampering. An MS section Pillar shall be provided with lockable door to enclose the PLC Panel suitable for installation in outdoor area. Additionally a door lock limit switch shall be provided interlocked with PLC to provide local & remote alarm with SMS to programmed users in case of an attempt to open the panel door by any person. The panel / enclosure shall be wall/floor mounting type.

The data of WDS as well as field instruments at ESR and distribution network shall be transmitted to SCADA system to be provided at WDS/SMC office location as directed by SMC for acquiring data, storage and monitoring.

- g) Following is proposed for **Zonal SCADA at Control room for Existing 3 Nos. ESR and Distribution location:**

The provision of SCADA System shall be keeping in mind the data acquisition/transfer to & from various WDS, ESR & field locations of concerned ward or additional wards and with provision to display various process data of WDS, ESR & Field Locations within Distribution Network as per design for required monitoring, alarm and initiating control/corrective steps at concerned WDS & Field by O&M agency. Lease line / Dark Fiber connection shall be provided at SCADA location. The proposed SCADA system shall also meet the following requirements:

- Selected SCADA shall be with unlimited Tags/Screens for future up-gradation
- SCADA Software shall have Web Access facility for monitoring
- Daily and weekly Reporting shall be available in Downloadable Format
- A minimum of 12 months and up to 36 months historical data should be Downloadable
- Administrator should have access to control over users right to access the system. System shall be pass word protected.

The SCADA system shall comprise of:

- 2 Nos. Desktop PC (One for EWS and Other for OWS) with 32" LED



Display,

- Required Licensed OS (Operating System), Anti-Virus & othe software
- Required communication ports / Multi-channel receiving modems
- Providing Lease line at SCADA location (Min. 2 Mbps speed) / Dark Fiber connection
- 4TB Data NAS System -high performance RAID network storage and backup device for data storage
- A4 Laser jet Printer – 1 No.
- PLC + SCADA (Runtime + Full development) Software License
- Reporting Software license
- SMS transmission facility, additional Micro PLC shall be provided as required
- VPN Router with suitable number of ports
- SIM CARD as required (at all locations viz. SCADA, WDS, ESR & Network locations)
- Industrial grade Ethernet switch min. 8 port
- 2KVA (Min.) UPS along with CVT with 1 Hour Back up – 1 No.
- Copper plate earth pit - min. 4 nos. or higher as required / recommended by SCADA vendor
- Copper wire / copper strips for earthing as required
- 2 nos. 1.5 Ton capacity Air conditioners

h) Following is proposed for **Master Control SCADA** at Sarthana WDS/SMC office location as directed by SMC for Overall Monitoring of Flow & other process data at SMC Office or other suitable Location as decided by competent authority comprising of

The provision of SCADA System shall be keeping in mind the data acquisition/transfer to & from Zonal SCADA of Transmission (Refurbishment), Zonal SCADA of Main (Proposed) and Transmission main (Sarthana WDS to WDS-1,2,3 & khatodara) as per design for required monitoring, alarm and initiating control/corrective steps at concerned WDS & Field by O&M agency. Lease line / Dark Fiber connection shall be provided at SCADA location. The proposed SCADA system shall also meet the following requirements:

- Selected SCADA shall be with min. Unlimited Tags / Screen for future up-gradation
- SCADA Software shall have Web Access facility for monitoring
- Adequate number of users should be able to log in and view window of their choice (Min. 10 user license shall be provided).
- Daily and weekly Reporting shall be available in Downloadable Format
- A minimum of 12 months and up to 36 months historical data should be Downloadable
- Administrator should have access to control over users right to access the system. System shall be pass word protected.

The Master SCADA system shall comprise of:



- 2 Nos. Desktop PC (One for EWS and Other for OWS) with 32" LED Display
- 2 Nos. min. 55" TFT / LED Display for large screen viewing with required Licensed OS.
- Required Licensed OS (Operating System), Anti-Virus & other software
- Required communication ports / Multi-channel receiving modems
- Providing Lease line at SCADA location (Min. 2 Mbps speed) / Dark Fiber connection
- 4TB Data NAS System -high performance RAID network storage and backup device for data storage
- A3 Laser Printer for Report printing – 1 no.
- A4 Laser Printer for alarm printing– 1 no.
- SMS transmission facility, additional Micro PLC shall be provided as required
- VPN Router with suitable number of ports
- SIM CARD as required required internet charge (4G)
- Industrial grade Ethernet switch min. 16 port
- 5KVA (Min.) UPS along with CVT with 1 Hour Back up – 1 No.
- SCADA unlimited tag / unlimited screen software license (Runtime + Development)
- Reporting software license
- PLC programming software license (1no.)
- Bulk message software 200 SMS per day limit thru gateway
- Centralized command centre
- MS office license , Quick heal antivirus license, Team viewer Software license
- 1 no. laptop
- Copper plate earth pit - min. 4 nos. or higher as required / recommended by SCADA vendor
- Copper wire / copper strips for earthing as required
- 2 nos. 1.5 Ton capacity Air conditioners
- **Android application for monitoring all DATA shall be provided. Necessary software shall be developed for the same.**

The bidder shall select service provider after checking the feasibility and signal strength in the area of coverage of this contract and obtain prior approval from SMC.

Necessary provision shall be made at Master SCADA to transmit data to SMART CITY control room (SMAC) of SMC and all necessary hardware and software shall be included in scope.

Bidder shall include all cost of obtaining / procuring all items for the remote telemetry and SCADA system, whether specifically mentioned in BOQ / Specifications or not, to complete the work including SIM cards, modems, leased line connection, VPN router, Ethernet switches, etc. and including connection charges & operational & renewal charges of various services required for proper performance of the systems during SITC and O&M period. The control / operation philosophy



shall be provided during execution / detailed engineering and all software for PLC, SCADA & Telemetry system shall be developed accordingly by the successful bidder.

Note: Bidder to note that the control logic shall be finalized during detailed engineering and shall be required to be changed / fine tuned during operation phase as per operational experience and requirement to provide adequate supply with minimum manual intervention. This is applicable for all entire instrumentation work including PLC/SCADA logic and screen development.

PROGRAMMABLE LOGIC CONTROLLERS (PLC) SYSTEM SPECIFICATIONS

Codes and Standards

PLC shall comply with International standards such as NEMA, IEC, ANSI, ISA, IEEE, DIN and VDE

DESIGN AND CONSTRUCTION REQUIREMENTS

PLC H/W & S/W shall be from the same family and should be sourced from approved Vendors only.

Programmable logic controller (PLC) shall be microprocessor based with 32 bit or other suitable processor and be fully programmable and capable of performing control relay logic, including timing, counting, sequencing, and interlocking to provide the required functionality.

The PLC shall be high performance processors suitable for real time process application. High inherent reliability, self checking, error-recovery and trouble-shooting features shall be some of the features of PLC.

The PLC shall have a modular / modular chassis design which allows for ease of future expansion. The processor module shall be easily removed from the I/O chassis for service or repair. The I/O chassis shall have slots for installing I/O cards, communications, or other special function modules. All I/O cards and modules shall be capable of being installed in any open slot in the chassis or shall be DIN rail mounted. Module and channel level diagnostics should be standard feature.

The PLC shall have a suitable power supply and can be easily serviced or replaceable. The system shall be capable of being powered on 120VAC / 230VAC / 24V DC as per mfr. Std..

The PLC shall be rated to operate from 0 to 60 Degrees C, with a humidity rating of 5 to 95% (non-condensing). All module circuit boards shall be encased and protected such that, when properly installed, they are not exposed to accidental contact by personnel or other objects.

The PLC shall be of high quality and reliability with replacement processors, power supplies, chassis, I/O and specialty modules that are readily available on an urgent or emergency basis. All PLC products shall be fully supported and spares shall be available for purchase for up to ten (10) years from the date of the original system purchase.



After completion of the automation and actual plant operation starts working on PLC/SCADA System the concerned staff likely to run plant is required to be fully trained by the executer for the operating features and preventive maintenance aspects and preliminary trouble shooting methods of the offered system. This training at site shall be of one day duration which shall be attended by 4-6 persons of client to be deputed from various levels. Additionally bidder shall also consider to provide class room training of required duration (up to 7 days) for up to 6 persons of SMSS (2 Engineers + 4 Technicians) at PLC manufacturer's training centre within the country covering the selection & programming aspects of PLC / SCADA system.

Basic Processor Functions

Real-time control of output points for turning on and off digital devices such as motor starters, actuators, and solenoids.

Read the status of real world digital inputs from limit switches, float switches, actuators, motor starters, dry run protection devices, various instruments, and other field devices.

Real-time control of analog process control variables.

Read the status of real world analog set points and feedback values.

Perform timing, counting, sequencing, and interlocking functions for pump/equipment control.

Process alarm handling & annunciations functions including alarms at all SCADA screens

Math and Advanced Functions

Four function math in floating point or signed integer format

Convert to/from BCD

Data comparison and manipulation

Scaling from integer data into engineering units such as flow, level and pressure

Full PID Instructions for control of process control variables such as flow, level and pressure.

ASCII instruction set for interfacing to ASCII devices

Compute Instruction which executes a mathematical expression and can be used for totalizing functions

Trigonometric and Exponential math functions

Real-Time Calendar Clock for time stamping alarms and events.

Automatic restart of the system on resumption of power shall be provided.

The processor shall have solid state RAM memory to store the application program, process data, and alarm status. This memory shall have both capacitor and battery backup in the event that input power to the processor is lost. It shall also have the capability of EEPROM backup which automatically reloads the memory on a power cycle. The processor shall have the ability to automatically control the process on a power cycle, provided there are no major or unrecoverable processor faults.

Sufficient program memory and data memory space shall be provided. 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.



Further, the instrument diagnostic data shall be analyzed by PLC and necessary alarm / reports shall be generated for calibration / fault / maintenance need of the instrument, if such data transfer facility is provided for in the instrument.

Specific Requirements for PLC

- (a) Expandability in future : 20% of installed capacity
- (b) Weather Protection : IP-20 for PLC hardware and shall be IP-54 of IS 13947 when mounted in ICP/LCP
- (c) Power Supply : 230V AC / 24V DC
- (d) Interrogation Voltage : 24V DC
- (e) CPU, communication module and power supply module : Required , high performance 32 bit or suitable CPU Module having modular configuration suitable for real time process application. CPU shall be of same family for all locations. Communication: Modbus, Ethernet, Profibus ports / modules shall be provided as required.
- (f) Scan time : 0.7 Milliseconds or better for 1K instructions
- (g) Key Switch for Processor : Shall be as per mfr. Std.
- (h) Three way to configure channel : (1) Via BOOT P or DHCP
(2) Manually by software
(3) Via LCD Display
- (i) Duplicate IP add. detection : Check every 2 Min. on network
- (j) Mounting : Inside the main instrument / local instrument control panel with viewing glass on the door
- (k) I/O Capacity of CPU : 20% expandability in future over present I/O requirement (for each panel)
- (l) Inputs and Outputs : Discrete Input Card: Solid-state input circuits rated for 10-30VDC operation, available in 8 or 16 or 32 point configurations and shall source current to the field device. Each input point shall have a status LED which indicates the ON or CLOSED condition for that field sensor or switch.
Discrete Output Cards: Solid-state output circuits rated for 24VDC operation, available in 8 or 16 or 32 point configurations and shall be able to operate a control relay. Each output point shall have a status LED which indicates the ON condition of the output. The control Relay-contact shall be rated for 5A @240VAC or 5A @125VDC. The control relay shall have a LED indication to show the status of the control relay.



- Analog Input / Output Cards: Shall capable of reading in 0 to 20mA or 4 to 20mA signal. The A/D converter shall provide a minimum 12 bit resolution over the full range from module minimum to module maximum
- (m) System Loading : Max. 60% under worst loading conditions
 - (n) Power supply to sensor / transmitters : Required
 - (o) Type of input : NO/NC – Contacts field selectable from programmer.
 - (p) Outputs : Relay outputs for driving MCC starter coils, SOVs, driving motorized valves etc.
 - (q) Spare I/O (Wired) : Min. total 20% of each type of I/O, whichever is higher, wired to terminal block with minimum 2 point I/Os of each type of digital signal and 1 point I/O of each type of applicable analog signal available as spare at each panel / location.
 - (r) Accessories : Licensed Software, each for Application Programming (Ladder Programming S/W supporting LD/IL/ST AND SFC language as per IEC 61131) and SCADA licensed software (Full development + Runtime) shall be supplied for each Zonal and Master control SCADA and Run time SCADA licensed software shall be supplied for 3 nos. WDS. (For all PC based HMI)
Reporting software also shall be provided for Master SCADA, zonal SCADA and 3 nos. WDS. (for all PC based HMI)
 - (s) Interposing Relays : Shall be provided for all the Digital Output (DO) including spare DO & for Digital Input where ever required
 - (t) Interface (Hardware and Software) to SCADA : Required (plug and play) ready to use type Remote data transmission facility (GSM/GPRS - 4G)
 - (u) HMI : NA
 - (v) Printers for alarm, status, report generation : Required as per SOQ
 - (w) Operator and Engg. Work Station at Control Room : 2 Nos. Desktop PC (One for Engineering work station and other for operating work station for each zonal SCADA and Master control SCADA having following specifications as a min.:



Intel core i7 (quad core, 8MB, 3.6 GHz) CPU or better / 32" LED Monitor / 4 GB (1 x 4 GB) DDR3 RAM / 1 TB HDD / 8 x DVD+/-RW Drive / PS/2 Keyboard / Scroll Mouse / Audio and Network Interface / Required External I/O Port viz. Headphone, microphone, and 2 USB 2.0, 1 standard serial port, 1 parallel port, PS/2 keyboard and mouse, 1 RJ-45, 1 audio in, 1 audio out, etc. Licensed OS of latest version and supported by SCADA software / licensed version for entire contract period of Quick Heal Total Security anti-virus software package. One no laptop also provide at Master control SCADA [with all licence software (PLC+SCADA+Reporting+MS office)].

- (x) Type of Protocol on : The data communication shall be based on communication port GSM/GPRS with required communication port and modem suitable for GPRS data communication on 4G network of selected service provider.

NOTE: CPU & I/O modules shall be same family at Master and Zonal SCADA

The I/O cards shall have optical isolation between digital and field side circuitry and some of the common features of the I/O modules shall be as follows:

- 1) Filters for noise rejection.
- 2) Surges withstand facility as per standards.
- 3) All the modules shall be of addressable type.

Communications

- (a) Minimum one port (High performance Ethernet communication at 10/100 Mbps) or more as required with required accessories/ switches / repeaters, etc. for program upload / download, on-line editing, data acquisition, man machine interfaces (HMI at ICP & Filter House) and for SCADA station.
Shall be open protocol for connectivity and communication with third party hardware/PLC/SCADA of existing plants
- (b) One RS 232C/RS485 port for connecting devices over network for data acquisition from Energy analyzers/soft starters /temp. scanners etc. (Power Consumption should be monitored for each & every Pump on zonal & master SCADA)
- (c) Any other communication ports / modules (Profibus-DP, HART, Modbus, etc.) as necessary for connecting devices over network for communication / data acquisition from field instruments as per specifications / bidder's selection of



communication facility with field instruments, variable AC drives, energy analyzers, etc. required to be monitored as per this tender scope / specifications.

Specifications for GSM/GPRS Modem shall be as under:

1	Modem shall support SIM900 Quad Band GSM/GPRS engine suitable to transfer data over GPRS for any 4G network
2	Modem shall have Built In RS232 Serial Interface Port/ Ethernet /Suitable port
3	Modem shall have Built In Network Status LED
4	Modem shall have Built In Sim Card Holder
5	Modem shall have configurable Baud Rate
6	Modem shall operate with Input Voltage of 24VDC

General Specifications for Panel Enclosure (ESR & Field Network locations):

1	Panel shall be pre-fabricated from CRCA Sheet Steel, having all round solid construction enclosure, with Primer & Powder Coated Textured Surface Finish (RAL 7035 Color shade or Equi. Approved). Panel shall be wall mounting type with required wall mounting brackets at rear.
2	Panel shall be with IP 66 have locking facility with common master key and necessary arrangement for applying seal shall be provided to prevent panel tempering. Additionally a door lock limit switch shall be provided interlocked with PLC to provide local & remote alarm with SMS to programmed numbers in case of an attempt to open the panel door by any person. It shall be possible to swap the door to opposite side to suit site conditions. An MS section Pillar with lockable door shall be provided to enclose the PLC Panel suitable for installation in outdoor area.
3	Panel shall have Zinc Plated Mounting Plate
4	Enclosure shall have one Gland Plate in Base with Neoprene Gasket.
5	Enclosure shall have IP-66 Degree of Protection Confirming to EN 60529/09.2000 as a minimum

Centralization

All the Data/parameter including graphics/trend/alarm/history etc., of all location (WDS ESR and distribution location) shall be continuously displayed in master control SCADA. Successful contractor has to provide the necessary communication equipment for the data fetching. All data shall be acquired at Master SCADA and shall be disseminated to rest locations (zonal / WDS SCADA) from Master SCADA location or can be as per vendor design to meet the specified objective of monitoring and control at each SCADA location. All required hardware, software and communication devices including the charges for the same for registration/activation/operation as applicable shall be considered in the scope of bidder including any other as required to make the system fully operational but not specified herein.

Programming Software



The programming software should help in maximizing performance, save on project development time and improve productivity.

Programming Software: should be able to operate on latest Windows-7/ Windows8 /Windows-XP or Windows-NT operating system or such latest OS.

The programming software shall have Online editing features which is used to modify the application program while the process is still operating.

Features like drop and drag editing to copy instructions or part of a program from within a project or across projects to save project development time.

Make system backup copies while the system is online.

Upload and down load programs to the PLC

Uninterruptible power Supply

UPS of suitable capacity as per following specifications for 30 or 60 minutes back-up as specified in BOQ shall be supplied for entire load of instrument control panel including PLC (including field instruments load) and essential / critical instrument supply for necessary shut-down in case of power failure.

- (a) The UPS shall be floor mounted, self contained and metal clad and shall be suitable for supplying a non linear load.
- (b) It shall be possible to open the enclosure front door when the unit is in use without exposing any live contact touch.
- (c) The UPS shall be on-line type incorporating a six-pulse rectifier and pulse width modulation inverter technology with microprocessor control. It shall incorporate a static bypass switch that shall operate in event of UPS failure, overload or manual initiation in order to transfer the output supply to mains without disturbance to the output supply.
- (d) The UPS shall incorporate a DC under voltage trip circuit to Electro-mechanically trip the UPS output in order to protect the batteries.
- (e) The noise level of the unit shall not exceed 60 dB(A) at 1 m from the UPS cabinet.
- (f) The output of the inverter shall be a sine wave having less than 2% THD for linear loads and less than 4% for 50% non linear loads. It shall be suitable for load power factors 0.7 lag to 0.9 lead.
- (g) The unit shall have a dynamic response such that 100 % step load causes an output voltage transient of less than $\pm 4\%$ with a recovery of less than 4ms. The load crest factor shall not be less than 3:1.
- (h) Indicators shall be provided for the following



- i. UPS status
 - ii. PS alarm conditions
- (i) The UPS shall provide volt free contact outputs for the following purpose:
- i. Warning, (viz., low battery voltage)
- (j) The UPS shall have an overloaded capacity of 150% for 30 seconds and shall be protected in the event of a short circuit of the output.
- (k) The batteries shall be housed, within a separate matching battery cubicle suitable for location adjacent to the UPS. The batteries shall be of the rechargeable, sealed maintenance free lead acid type. The battery supply to the UPS shall be via a fused load break switch disconnecter circuit breaker. The battery recharge time to 90% of full charge shall be approximately ten times the discharge time at full load.
- (l) Terminals shall be shrouded to prevent accidental contact

The Uninterruptible Power Supply (UPS) System with SMF Lead Acid battery shall conform to the minimum following specifications:

- i. Input
 - Input Voltage : 230 V, $\pm 5\%$
 - Frequency : 50 Hz $\pm 5\%$
 - Nominal DC input (Battery) : Bidder to design and submit calculations
- ii. Output
 - Output : 230 V AC, applicable KVA with 25% margin as per Load Calculation (Shall be min. 2KVA capacity)
 - Regulation mode : $\pm 1\%$
 - Load power factor : 0.8 to unity
 - Duty : Continuous
 - Ripple on DC : $< 2\%$
- iii. General
 - Principal of operation : Shall be solid state, pulse with Modulation (PWM)
 - Cable entry : Bottom
 - Cooling method : Forced air



Type of Battery : Sealed Maintenance free

Additionally **CVT** (Single phase Constant Voltage Transformer) as per following specifications shall be supplied along with UPS (to be considered as part of Item of UPS) for entire load of instrument control panel including PLC/UPS/PC & instrument for protection in case of any higher jerk/spike in incoming power for each ICP.

Capacity: as per capacity of UPS

Input: 180-270 vAC,

Output: 230 V \pm 1%.

Efficiency: 85 % (with Full Load)

D) INSTALLATION MATERIALS:

Vendor shall supply all erection hardware required for the installation of complete instrumentation forming part of this tender.

This includes items like cables, cable glands, junction boxes, instrument valves and manifolds, mounting accessories, impulse piping / tubing, pipe/tube fittings, pneumatic signal tubes, air line pipes and fittings, filter regulator, insulation material, cable duct and trays, conduits, identification tags, structural material required for instrument supports and trays etc.

A) CABLES:

Vendor is fully responsible for the sizing of all cables in their scope of supply considering factors like maximum distance between Control Room and the Unit. Specifications for cables for analog signals, digital signals and instrument power cables shall be as follows:

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.

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.

Cables for instrument power supply:

Cables of 660V/1100V grade, multi-core cables, multi-stranded high conductivity annealed 2.5 sq.mm, 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.

Laying of Cables:

Cables shall be laid on trays, in trenches, conduits, ducts as necessary. Instrument cables shall not be buried in ground as far as possible. Cable joints in instruments signal and power supply cables shall not be permitted. In case if some of the instrument cables are to be buried in the ground, it shall be as per standard/good engineering practice and shall be subject to client's/consultant's approval.

The contractor shall also supply necessary materials such as junction boxes, glands, lugs etc. required for termination of cables. Each cable shall be terminated to individual panel/terminals box. Cable glands shall be of Nickel plated Brass and of Double Compression Weather proof type.

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.

B) CABLE GLANDS:

Cable glands shall be nickel-plated brass and shall be of double compression type suitable for armoured cables.

Flame proof gland wherever required shall be with Ex(d) certification.

C) INSTRUMENT VALVES (MINIATURE TYPE) AND MANIFOLDS:

Body rating shall be as per piping class or better. Valve body and Trim material shall be SS316 as a minimum. Packing material in general shall be PTFE. Valves and Manifolds shall be of forged type only.

D) PIPE AND TUBE FITTINGS:

Tube fitting shall be flareless compression type and of three piece construction of Swagelok / Parker Hannifin make.

Ferrule shall be os SS in general.

Socket Weld type forged pipe fitting of suitable material and rating shall be supplied for pipe fittings. The minimum rating shall be 3000 lbs. Weld neck fittings shall be used where socket weld is not allowed by piping class.



For air service instrument brass fittings suitable for use on copper tubes conforming to ASTM B 68 / B 68M shall be used. It shall be manufactured from Bar Stock or equivalent and shall be nickel plated.

E) CABLE TRAYS:

All branch cables/tubes, cables on various civil units/structures shall run on cable trays only.

Cable trays shall be made out of galvanized mild steel sheets of 2.5 mm thickness. The width shall be so selected that 40-50% space is available for future use.

Suitable cable clamps shall be supplied for binding cables / tubes at every 500mm.

F) JUNCTION BOX:

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.

13. INSPECTION :

Contractor shall submit test and calibration certificates for various instruments for review and approval prior to despatch. Factory inspection for instruments is not required.

Contractor shall offer FAT for PLC system at the manufacturer's / system integrator's works. The system shall be inspected for the workmanship, correctness of wiring and operation with necessary simulation.

The documents (i) Piping and Instrument diagram (ii) Instrument Index, (iii) Instrument specifications and (iv) complete catalogues with part list for all vendor supplied instrument, controls etc. and data sheets, which have to be given along with bid can be submitted after award of the job.

14. Online Water Quality Monitoring System at Each WDS:

1) Scope in Brief:

Parameters to be monitored through online water quality monitoring system

- Turbidity
- Free Residual Chlorine(FRC)

2) Scope also includes followings

- A. Supply of calibration standard(s), accessories, consumables for Turbidity, FRC.
- B. Calibration standard should be NIST traceable



- C. Installation of above sensor shall be done in transparent acrylic water sample collection chamber which needs to be placed in specified Area.
- D. Authorized agency / person remains to calibrate the sensors with NIST standards on semi-annual basis. Records of calibration remains to be submitted to Executive Engineer – Head Water Works.
- E. All above sensors and controller shall have two years of guarantee from date of installation.
- F. Necessary piping network alongwith necessary accessories for taking samples from lines/UGSR upto the sample collecting chamber.
- G. All monitored and recorded data of the analyser to be integrated with Zonal, Master SCADA & SMAC system.

ON-LINE FILTERED WATER TURBIDITY SENSOR (1 No at each WDS)

SR NO.:	PARAMETER	Description
1	Type	microprocessor-based, continuous reading, on-line nephelometric instrument
2	Measurement Type	Scattered light
3	Range	0.001-100 Nephelometric Turbidity Units (NTU)
4	All wetted part s MOC	Non Corrosive material
5	Accuracy	Accuracy (Defined according to ISO 15839.) $\pm 2\%$ of reading or ± 0.015 NTU (whichever is greater) from 0 to 40 NTU; $\pm 5\%$ of reading from 40 to 100 NTU
6	Response Time	Response Time Initial response in 1 minute, 15 seconds for a full-scale step change
7	Sample Temperature	0 to 50°C (32 to 122°F)
8	Operating Temperature	Single sensor system: 0 to 50°C (32 to 122°F)
9	Operating Humidity	5 to 95% non-condensing
10	Storage Temperature	-20 to 60°C (-4 to 140°F)
11	Power Requirements	100-230 Vac, 50/60 Hz, auto selecting; 40 VA
12	Recorder Outputs	Two selectable for 0-20 mA or 4-20 mA; output span programmable over any portion of the 0-100 NTU range; built into the Controller
13	Alarms	Three set-point alarms, each equipped with an SPDT relay with unpowered contacts rated 5A resistive load at 230 Vac; built into the Controller
14	Enclosure	NEMA-4X (indoor)/IP66 Controller
15	Digital Communication	Network card compatible; MODBUS®/RS485, MODBUS/RS232, LonWorks® protocol (optional)
16	Displayed Resolution	0.0001 NTU up to 9.9999 NTU; 0.001 NTU from 10.000 to 99.999 NTU
17	Compliance	As per USEPA method 180.1



ON-LINE RESIDUAL (FREE) CHLORINE MEASUREMENT SYSTEM: (1 No at each WDS)

Free Chlorine readings shall be continuously displayed locally and remotely at SCADA.

On-line type Free Residual Chlorine analyzer shall be provided to measure free residual chlorine values in Clarified Water. The specifications shall be as under:

Type	:	Microprocessor based, programmable
Measurement type	:	Amperometric type
Range	:	0-10 mg/l or suitable
All wetted parts MOC	:	Non-corrosive material
Analog Output	:	4-20 mA proportional to residual chlorine
Contact Output	:	Min. 2 potential free changeover contacts
Local Display	:	Free Chlorine value
Accuracy	:	± 5% of reading or better
Mtg / Sensor Holder Type	:	Flow Through assembly or suitable as required (Suitable sampling system shall also be provided, if required)
Sensor Cable required	:	included, min. 5m length or higher as suitably
Power	:	230 V AC, 50 Hz
Transmitter Housing	:	Weather proof to IP-65 / NEMA-4X as a minimum
Electrical Connection	:	½" NPT
Sensor Failure Alarm	:	Required
Instrument Canopy	:	Required
Accessories Required	:	As per mfr. Standard

RC reading shall be continuously displayed locally and remotely at PLC/SCADA. Low / High FRC level alarm shall be annunciated at PLC/SCADA. Real time and historical trend shall be available as per requirement.

Display unit alongwith Controller for Two Sensors (1 No. at each WDS)

Sr.No	Parameter	Description
1	Power Requirements	100 to 230 Vac, 50/60 Hz Optional: 24 Vdc
2	Display	Resolution: 160 x 240 pixels or Equivalent
3	Relays	As per Manufacturer
4	Sensor Inputs	2 Max Digital and/or Analog with Sensor Card
5	Outputs	2 Standard analog 4-20 mA Optional digital communications via MODBUS® (RS-485) or PROFIBUS DP.
6	Inputs	1 Analog Input Signal Analog 4-20mA Card
7	Communication (Optional)	MODBUS 232/485 Profibus DP V1.0



8	Data Management	SD Card Service Cable
9	Mounting Configurations	Surface, panel, and pipe (horizontal and vertical)
10	Controller plugged with sensors-	FRC, turbidity, etc. Use them in any combination



VENDOR DATA REQUIREMENT (INSTRUMENTATION)

Sr. No.	Description	With Bid	Info. / Review	As-Built
1	Piping & Instrument Diagram		*	*
2	Instrument index		*	*
3	Vendor List for Instruments & accessories		*	
4	Sizing Calculations		*	
5	Utility requirements		*	
6	Instrument Specifications and data sheets		*	*
7	Detailed loop drawings		*	*
8	Panel front arrangement		*	*
9	Wiring diagram for panels		*	*
10	Cable Schedule		*	*
11	Instrument Installation drawings		*	*
12	Bill of Material for installation items		*	*
13	Inspection and Test procedures		*	
14	Test Certificates and certific. from statutory bodies		*	*
15	Complete catalogues with part list for all vendor supplied instruments, controls etc.	*	*	
16	Installation, Operation and maintenance manuals			*

NOTE : This list indicates the minimum drawing and document list. However vendor shall also furnish any other drawing or document required to be furnished during the course of job execution.



LIST OF APPROVED VENDORS (INSTRUMENTATION)		
Sr. No.	Item Description	Approved Vendors
1.	Online Water Quality Analysers (Turbidity, Free Residual Chlorine)	HACH, DKK-TOA, WTW, GLI, Radiometer, E&H,
2.	Ultrasonic Type Level / Diff. Level / LOH & ROF / Open Channel Flow Transmitter	ABB, E+H, Krohne, Siemens, Vega
3.	Ultrasonic/Electro Magnetic Flow Meter	Siemens, ABB, Krohne Marshall, E+H, FLEXIM, Fuji, Keiki.
4.	Differential Pressure / Pressure / Temperature Transmitter	ABB, Emerson, Honeywell, Siemens, Yokogawa
5.	Pressure Switch	Dag Process Instruments, Danfos, E+H, Indfos, N.K. Instruments, Verma Trafag, Orion, Switzer
6.	Float Level Switch	ATMI, E+H, Nivelco, P+F
7.	Electric Actuators	Auma, Marsh, Rotork
8.	Programmable Logic Controller (PLC) System	ABB, Honeywell, Rockwell (Allen Bradeley), Schneider, Siemens
9.	GSM /GPRS Modem (3G/4G)	Mastero, Axitech, Moxa
10.	UPS	Liebert, APC, Merlin Gerin, Socomec
11.	CVT	Capri/Sarathi/ABC-Power
12.	SMF Batteries	Panasonic, Exide, Prestolite, Ameron
13.	LT / Instrument Power & Control Cables	CCI, UNIVERSAL, FINOLEX, INCAB, TORRENT, GLOSTER,BHARATCAB
14.	Signal (Analog) Cables	Associated Cables, Assocaited Flexibles & Wires, Brooks Cables, Delton, Havells, Uday Pyro, Finolex, RR Kabel
15.	Communication Cables	D-Link, Delton, Finolex, Lapp Cable, Molex
16.	Cast Aluminium Junction Boxes	Ex-protecta, CEAG, Sudhir, Baliga
17.	Air Conditioners	Hitachi , LG , Samsung, Bluestar
18.	Panel Enclosures	BCH, Enklotek, Rittal, Bartakke, equi. reputed
19.	Instrument Valves and Manifolds, Tube Fittings, Pneum. Brass Fittings	Excel Hydropneumatic, Industrial Enterprise, Festo, Multimetal Industries, Placka, SMC, Technomatic
20.	Lugs & Sockets	DOWELLS / ISMAL /3D / JAISON
21.	MCB/MCCB	SIEMENS / MDS / L& T / MG / SCHNEIDER/ AREVA/
22.	Selector Switch	KEYCEE / SALZER / SIEMENS / JYOTI
23.	FUSES	L&T, SIEMENS, ABB, SCHNEIDER, BUSSMAN
24.	LED INDICATORS	ESBEE (L&T), SIEMENS, ABB, SCHNEIDER, RAAS CONTROL,



		TEKNIK, VAISHNO, BINAY
25.	PUSH BUTTON	L&T, SIEMENS, ABB, SCHNEIDER, RAAS CONTROL, BINAY
26.	Indicating Lamp	RAAS CONTROL / TEKNIK / VAISHNO / BINAY/ESBEE(L&T)
27.	GI Pipe	Tata, Asian, Jindal
28.	Miniature Relay	ABB, O\E\N, Omron, Phoenix
29.	Indication Pilot Lamps (LED Type)	Teknic, Schneider, Siemens, equi. reputed
30.	Push Button/ Selector Switch (with NO/ NC Element)	Teknic, Schneider, Siemens, equi. reputed
31.	DC Power Supplies (DIN Rail mounted)	Phoenix, Omron, Aplab, IFM, equi. reputed
32.	Terminals	Elmex, Phoenix, Wago, Connectwell
33.	Panel Wires	Finolex, Havell's, R R Kabel, Lapp Cable
34.	Panel Illumination	Philips, Crompton, GE
35.	Cable Glands	Ex-protecta, Braco, Sudhir, Comet, Connectwell, HMI
36.	Cable Tray	Globe, Jacinth, M.M. Engineering, Tushar Tech, equi. reputed
37.	Receiver Indicators (Panel Mounted)	ABB, Masibus, Nivam, Nishko, Electronet

The contractor shall distinctly understand that it will not be their prerogative to insist on a particular brand from the list, final selection will be done with the approval of Engineer in charge.

Hydraulic Engineer,
Surat Municipal Corporation.

Signature & Seal of Contractor

Address

Date

6.20.10 DETAILED TECHNICAL SPECIFICATIONS FOR CONSUMER WATER METER CONNECTION

Providing and Maintaining of All Consumer Water Connection

Item No.1: Issuing the form for the water connection to the consumer, receiving the form from the consumer, scrutinize the form and giving approval for the house connection. Notice shall be issued to consumer for paying the charges of water connection. The item shall inclusive of office accommodation, telephone, stationery and administrative expenses required for above item. (application form shall be get approved from S.M.C.).

1.1 Bidders shall distribute the prescribed application forms of SMC to the consumers, who are desirous to have water supply connection from SMC. Each consumer has to furnish details, such as TPN No., FPN No., Plot area, Number of units, super-built-up area of each unit. The application form duly filled in shall be submitted along with the zero copy of the receipt of last/latest tax payment to SMC. Consumer (plot holder) shall submit this application form, duly filled for scrutiny to the Contractor. After scrutinizing the application forms, notices shall be issued to the consumers for paying charges of water connection.

1.2 Following points are to be considered for this item.

- (a) SMC prescribed forms shall be issued by the Authority to the Service Provider. Account of the forms to be maintained by the Service Provider.
- (b) Collection of forms.
- (c) Filling and submission of forms (approval of S.M.C.).
- (d) Duplicate copy of approved form to be forwarded to the assessment department.
- (e) Prepare and give estimate to consumers sketches of connections showing details from network pipeline to consumer connection (AutoCAD drawing).
- (f) Collection of connection charges/fees.
- (g) Digging of roads/pavements (with approval of S.M.C.).
- (h) Boring for water connection on S.M.C. Distribution Network.
- (i) Fixing Ferule and making connection.
- (j) Fixing/installation of water meter (supplied by S.M.C.).
- (k) Construction of water meter chamber.
- (l) Prepare and give final cost to consumer with final sketches of connections showing details from network pipeline to consumer connection (AutoCAD drawing).
- (m) Preparing master data form.
- (n) Data Entry of connection details.

1.3 The payments shall be made as per the number basis.

Item No.2: Fixing of AMR water meter / bulk water meter of approved make of following sizes. The rate is inclusive of all taxes, insurance, transportation etc. complete.(Rate for installation only). The water meter will be supplied by SMC free of cost from any of the Store within city limit.

1.1 INSTALLATION OF WATER METERS

1.1.1 The new water meters are to be fixed on the service connections of consumers situated in different ten DMA of project area. Contractor has to submit the program of fixing of water meters before actually starting the work. Contractor has to fix the meters in suitable batches i.e. DMA wise. Contractor will have to prepare a data entry form as approved by SMC which shall be filled at the time of replacement of new water meter & subsequent replacement for repairs. A PVC seal shall be provided to the new meter/repaired meter after testing. The PVC seal shall be specially manufactured for SMC and shall have SMC logo and serial number. Contractor will have to keep the record of seals with respect to the meters sr. nos. The cost of PVC seal shall be included in the cost of Annual Maintenance. The new meter is to be fixed on service pipeline just after its entrance preferably near boundary of consumer property except in places found difficult to do so as per site conditions. The new meters shall be installed as per IS/ISO approved installations or as per manufacturers recommended installation procedure including cost of all specials like couplings, union, bends, elbows, flanged/mechanical tail pipes, including cost of all labour and for cutting pipe, jointing etc completed. Contractor shall suggest the preventive arrangement required to be made by the consumer to avoid damages to the installed new meter. Issuing guidelines for suitable location and installations system, procedure etc. shall be the responsibility of Contractor. Any leakage observed in the joints of specials, pipelines during the contract period, contractor will be responsible to stop the leakage at his own cost.

1.1.2 General:

Approximate 27000 (3390 Nos. meter in Part-1 and 23630 Nos. in Part-2) consumers to be covered under this contract are spread throughout the project area of city. Contractor will have to form specific DMA wise groups of consumers and prepare the program of replacement/ fixing of consumer meters of each DMA such that the meters of all the consumers in particular DMA shall be fixed within a specified time of 24 x 7 water supply can be given to that DMA.

1.1.3 The Contractor's staff referred to in the Conditions of Contract shall include at least an approved skilled working installer to supervise the installation of the Works and sufficient skilled, semi-skilled and unskilled labour to ensure completion of the Works in time. The Contractor shall not remove any representatives, installers or skilled labour from the Site without the prior approval of the SMC Engineer's Representative.

The working installer who shall be deemed to be the Contractor's Representative shall be conversant with the installation, commissioning, operation and maintenance of the complete Works. Should there be more than one installer, one shall be in charge and the Contractor shall inform the Engineer's Representative in writing which installer is designated as his representative and is in charge.

The Contractor's installation staff shall arrive on the Site on date to be agreed by the Engineer's Representative who will give to the Contractor one month's notice in writing of the dates on which they will be required. Before they proceed to the Site, however, the Contractor shall first satisfy himself, as necessary, that sufficient material of his (or his sub-contractor's) supply has arrived on Site so that there will be no delay on this account.

The Contractor shall be responsible for setting up and installing the system to the line and level required and shall ensure that such Water meter is kept in position while being built in.

The Engineer's Representative, with his best judgment, may allow access to the part/part of Site with due consideration to Contractor's Programme and commitment to contract times. The appropriate contract time for the particular item or group of items shall be deemed to have commenced from the date the part access is given.

- 1.1.4 The Contractor shall furnish all supervision, labour, tools, equipments, rigging materials and incidental materials, such as bolts, wedges, anchors, concrete insert setc. required to completely install, test and adjust the equipment. The Contractor shall submit in Schedule the list of tools, tackles and testing and calibration equipment with quantities which he proposes to use on the job at the time of bidding. The Corporation/Engineer's Representative reserve the right of inspecting them during the execution of the construction and advise any additional equipment or increase in quantities that may be required to complete the job and the same shall be arranged by the Contractor. The Contractor shall submit test certificates for all these test instruments certified by National Standards Institutions. The date of certificate shall not be earlier than three months before the start of actual usage.

1.4.1.1 The Contractor shall move all material into the premises through the regular doors.

1.4.1.2 The Contractor shall take out most care in handling of the material.

1.4.1.3 This item also includes necessary excavation in any type of strata as per site condition including dewatering and refilling of trenches (including dewatering by pump if necessary), cutting of existing line, threading of GI pipes/flanged welding of CI pipes, etc complete.

1.4.1.4 This item also includes the necessary fittings required to install meters.

1.4.1.5 This item also includes providing & fixing of non-return valves, butterfly valves/check valves of required size along with nut, bolt, washers, gasket etc complete.

1.1.5 WELDING

1.1.5.1 Weldings shall comply with BS:5135 Code latest Revision.

1.1.5.2 General Welding Requirements

Inspection and quality of surveillance shall not be limited to the examination of finished welds. The equipment used shall be suitable for the quality of work specified. The techniques employed shall be based on methods which are known to produce good results and which have been verified at site by actual demonstration.

A hazardous striking of the electrodes for establishing an arc shall not be permitted. The arc shall be struck either on the joint or on a starting tag. The starting tag shall be of the same material or a material compatible with the base metal being welded. Any inadvertent strike on a place other than the welding, the area affected shall be ground flush and examined by liquid penetration methods.

All attachmentssuch as lugs, brackets and other non-pressure partsshallalsobe done by qualified welders in accordance with the design details and materials specifications. Temporary attachmentsshallberemoved in a manner that will not damage the parent metal. Areas of temporary attachments shall be dressed smooth and examined by liquid penetration methods. If weld repairs are necessary, they shall be made using qualified procedures and welders and examined by liquid penetration methods.

All tack weldsshallbemade using qualified procedure and welders, the number and size of tack weldsshallbekeptassmallasto consist of adequate strength and joint alignments. All tack weldsshallbeexamined visually for defects and if found defective shall be completely removed. As welding proceeds, tack weldsshallbeeither removed completely or shall be properly prepared by grinding or filling the starting ends so that they may be satisfactorily incorporated in the welds. Unaccepted defects shall be removed by grinding machine or chipping or gouging or flame gouging may be permitted provided gouged surfaces are ground at least by 1.5 mm below the deepest indentation.

1.1.6 Commissioning

During commissioning the Contractor shall supply all labour to supervise, operate, keep in operation, repair, and do all things necessary to keep the water meters running. This shall include for the provision of such labour/staff during the first run period and for such other period of continuous operation as the Engineer's Representative may consider necessary to establish the efficient operation of the water meters.

1.1.7 Mode of Payment:-

The payments shall be made on a number of basis of installed and successfully commissioned water meters.

Item No.3: Providing, supplying, lowering, laying, jointing of MDPE pipe conforming to ISO - 4427 including compression fitting conforming to ISO/DIS 14236 such as female adopter, elbow, bend, reducer, Tee required for house service connection inclusive of all taxes, insurance, transportation, freight charge, inspection charges, hydro testing etc. complete. The item also includes dismantling of asphalt / metal road, excavation, refilling, watering, ramming, consolidating and restoration of road etc. complete.

- (i) 20mm dia.**
- (ii) 32mm dia.**
- (iii) 50mm dia.**
- (iv) 63mm dia.**

MDPE pipe PE-80 shall conform to ISO-4427. Bidders shall supply the required diameter and length of pipe ISI marks at this cost. The pipe ends shall be cut at right angle to the pipe axis. Each pipe shall be clearly and indelibly marked. The rate shall be inclusive of transportation to site.

1. Raw Material

Raw material used to Manufacture MDPE Blue Pipes shall be Virgin Natural Resin PE 80 containing those anti – oxidants, UV Stabilisers & Pigments necessary for Manufacturing of pipes. The Density of Pipes shall be in the Range 0.926 to 0.940 g/cm³ confirming to ISO 4427 Standard. The PE 80 Resin shall have MRS of 8 Mpa.

2. Effects on Water Quality :

The MDPE PE 80 Blue Pipes shall confirm to clause 3.5 of ISO 4427 for conveyance of Water for Human Consumption. Also the pipes intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW/KIWA/SPGN/WRC-NSF and certificate of compliance to be produced for the following parameters

- a. Odour & Flavour of Water
- b. Appearance of Water
- c. Growth of Micro Organism
- d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
- e. Extraction of Metals

3. Pressure Rating:

The Pressure rating of MDPE Blue PE 80 Pipes shall be confirming to Clause 4.1 of ISO 4427 : 1996.

4. Colour of Pipes:

The Colour of MDPE PE 80 Pipes shall be BLUE confirming to Clause 3.2 of ISO 4427 : 1996.

5. Dimensions:

The pipe dimensions shall be as per latest revisions of Clause 4.1 of ISO 4427 : 1996 and pipes upto diameters 32 mm shall be supplied in Coils of 300 mtrs. The internal diameter, wall thickness, length and other dimensions of pipes shall be as per relevant tables of ISO 4427:1996. Each pipe shall be of uniform thickness throughout its length.

The wall thickness of the PE 80 Pipes shall be as per ISO 4427.

The dimension tolerances shall be as per ISO 4427 clause 4.1.3

6. Performance requirements

The Pipe supplied should have passed the acceptance test as per ISO 4427. The manufacturer should provide the test certificates for the following tests.

1. Melt Flow Rate
2. Density,
3. Oxidation and Induction test,
4. Hydrostatic Test ,
5. Pigment dispersion Test,
6. Longitudinal Reversion Test.

These tests should be performed in the in-house laboratory of the pipe manufacturer. The Employer will depute Third Party Inspection Agency to the pipe manufacturing facility of the manufacturer to inspect the pipes as per QAP approved by Engineer In charge.

TECHNICAL SPECIFICATIONS FOR COMPRESSION FITTINGS

90 DEG COMPRESSION ELBOW WITH METAL INSERT

One end of the Metal threaded compression Elbow will be with Taper male threads & other end will have compression fittings suitable to connect to PE pipe. The Taper male threads will be pressure tight. Pressure rating will be PN16.

Body, Nut and Thrust Ring will be injection molded from Polypropylene and UV stabilized body & thrust ring black in colour, Nut blue in colour. Lip gaskets in Food safe Rubber (NBR) black colour must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clamping material will be Polyacetal (POM) white colored and shall not be connected to thrust ring. Male threaded part will be made of SS304.

The product will be tested as per below

Typetest	Standard
Dimension of the threads	ISO 7/1
Tightness of the joints	ISO 3458
Tightness of the joints when subjected to bending	ISO 3503
Resistance to pull-out	ISO 3501
Internal under-pressure test	ISO 3459
Long term pressure test	ISO/DIS 14236

90 DEG COMPEL BOW with COMPRESSION JOINT BOTH ENDS

The Compression Elbows will have compression ends in both sides, so that PE pipe can be connected at both ends. Pressure rating will be PN16.

Body, Nut and Thrust Ring will be injection molded from Polypropylene and UV stabilized body & thrust ring black in colour, Nut blue in color. Lip gaskets in Food safe Rubber (NBR) black colour must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clamping material will be Polyacetal (POM) white colored and shall not be connected to thrust ring.

The product will be tested as per below

Typetest	Standard
Dimension of the threads	ISO 7/1
Tightness of the joints	ISO 3458
Tightness of the joints when subjected to bending	ISO 3503
Resistance to pull-out	ISO 3501
Internal under-pressure test	ISO 3459
Long term pressure test	ISO/DIS 14236

FEMALE THREADED ADAPTER WITH METAL OFFSET TAKE

One end of the Female adaptor with metal offset take will be with female threads & other end will have compression fittings suitable to connect to PE pipe. The Taper male threads will be pressure tight. Pressure rating will be PN16.

Body, Nut and Thrust Ring will be injection molded from Polypropylene and UV stabilized body & thrust ring black in color, Nut blue in color. Lip gaskets in Food safe Rubber (NBR) black color must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clamping material will be Polyacetal (POM) white colored and shall not be connected to thrust ring. Female threaded part will be made of SS304.

The product will be tested as per below

Typetest	Standard
Dimensionsofthethreads	ISO7/1
Tightnessofthejoints	ISO3458
Tightnessofthejointswhensubjectedtobending	ISO3503
Resistancetopull-out	ISO3501
Internalunder-pressuretest	ISO3459
Longtermpressuretest	ISO/DIS14236

The pipe and fittings shall be lowered, laid and joint using electro-fusion process and hydraulic testing shall be done as specified above in electro-fusion fitting.

Or

Compression fittings used for House service connection comply as per ISO 14236

Material of Construction

Compression fittings material shall confirm to ISO14236.Clause -5.

- A .Body-Polypropylene
- b. Nut / Cap –Polypropylene.
- c. Clip Ring-POM (Acetylic resin)
- d. Packing bush- Polypropylene
- e. “O” ring – NBR
- f. Threaded metal inserts –SS 304 with BSP Threads

Pressure testing

The pressure rating of compression fittings as per clause 8 of ISO 14236 which shall be PN16

Dimensions:

The Dimension of compression fittings shall be as per clause 7.1 of ISO 14236

Performance requirements

The compression fittings shall be tested as per ISO 14236. Following Test methods shall be performed.

Clause 8.2.1 -Leak tightness under internal pressure.

Clause 8.2.2	-Resistance to Pull out.
Clause 8.2.3	-Leak tightness under Internal Vacuum.
Clause 8.2.4	-Long term Pressure Test for Leak tightness for assembled joint
Clause 8.3.2.1	-MRS Value as per ISO 9080
Clause 8.3.3.1	-Resistance to Internal pressure.

Effects on Quality of Water

The Compression fittings for intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW / KIWA / SPGN / WRc –NSF and certificate of compliance to be produced for the following parameters :

- a. Odour & Flavour of Water.
- b. Appearance of Water.
- c. Growth of Micro Organism
- d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
- e. Extraction of Metals.

For clear identification of the water services, the nuts of the fittings should be coloured blue while the body to be black. All fittings with threaded ends should be with BSP threads.

Excavation

General

Any soil which generally yields to the application of pick axes and shovels, or as rakes or any such ordinary excavating implement or organic soil, gravel, silt and turf loam, clay, peat etc. fall under this category.

Clearing the site

The site on which the structure is to be built shall be cleared, and all obstructions, loose stone, materials and rubbish of all kind, bush, wood and trees shall be removed as directed. The materials so obtained shall be property of the Government and shall be conveyed and stacked as directed within 50m. lead. The roots of the trees coming in the side shall be cut and coated with a hot asphalt.

The rate of side clearance is deemed to be included in the rate of earthwork for which no extra will be paid.

Setting out

After clearing the site, the centre lines will be given by the Engineer in charge. The contractor shall assume full responsibility for alignment, elevation and dimension of

The

each and all parts for the work.
for setting out the reference
required and directed.

Contractor shall supply labours, materials, etc. required
marks and benchmarks and shall maintain them as long as

Excavation

The excavation in foundations shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed. The contractor shall do the necessary showing and shuttling or providing necessary slope to a safe angle, at his own cost. The payment for such precautionary measures shall be paid separately if not specified. The bottom of the excavated area shall be leveled both longitudinally and transferely as directed by removing and watering as required. No earth filling will be allowed for bringing it to level, if by mistake or any other reason excavations is made deeper or wider than that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation up to 1.5m. depth shall be measured under this item.

Disposal of the excavated stuff

The excavated stuff of these selected types shall be used in filling the trenches and plinth or levelling the ground in layers including ramming and watering etc.

The balance of the excavated quantity shall be removed by the contractor from the site of work to a place as directed with lead up to 50m. and all lift.

Dismantling of asphalt/metal road

Under this item contractor shall demolish existing gas asphalt or WBM/CC pavement met with during laying pipe.

Only area of pavement intercepted in pipe laying shall be demolished. If excess area is demolished same shall be reinstated by the contractor.

Demolished material like asphalt pavement lump and metal shall be stacked separately as directed by the Engineer in charge.

Work done to the extent of requirement for laying of drain and as per specifications shall be measured in sq.m. and paid at the tender rate.

Mode of measurements and payment

The description of each item shall, unless otherwise stated, be held to include where necessary, conveyance, and delivery, handling, unloading, storing, fabrication, hoisting, all labour for finishing to required shape and size, setting, fitting in position, straight, cutting and waste, return of packing etc.

The length shall be measured on running metre basis of finished work. The length shall be taken along the centre line of the pipe and fittings. The pipes fixed to walls, ceiling, floor etc. shall be measured and paid under this item.

All the work shall be measured in decimal system as fixed in its place, subject to tolerance given below unless otherwise stated.

- (i) Dimension shall be measured to the nearest 0.01 metre. (ii)
Area shall be worked out to the nearest 0.01 sq. metre.

All measurements of cutting shall unless otherwise stated be held to include the consequent waste.

In case of fitting of unequal bore, the largest bore shall be measured for the test.

Testing of pipelines, fittings and joints include for providing all plant and appliances necessary for obtaining access to the work to be tested and carrying out the tests.

The rate includes all the electro-fusion fittings such as female adapter, elbow, bend, reducer, coupling etc. required for the water meter connection.

The rate shall be for a unit of one running metre.

Item No.4: Providing, supplying and fixing Ductile Iron strap saddle inclusive of all taxes, insurance, transportation, freight charge, inspection charges etc. complete as per the detailed specification.

DI Strap Saddle required for providing house service connections on DI/CI mains.

4.1 General specification:

Strap saddle shall be suitable for CI/DI pipes of nominal size 60mm to 300mm with nominal outlet connection size from 1/2", 3/4" & 1" BSP female thread.

The body shall be **Resicoat@epoxy** coated with thickness >250 micron as per GSK standard & EN 14901. The saddle shall be single type up to pipe sizes of NB 300 and service outlet of 1/2", 3/4" and 1" BSP female thread.

Fasteners shall be of threaded nut-bolt-washer type. Nut-bolts of size 1/2" (M12) shall be used.

Saddle strap shall be with NBR protection rubber.

The sealing between the saddle and main shall be obtained by using a profiled elastomeric seal matching to the curvature of the pipe. Theseal shall be of NBR elastomeric type, suitable for all potable water applications.

The clamp saddle shall be suitable for on-line tapping with spatula & drilling tool, maximum working pressure up to 16 bars.

Material and Design Specifications

Saddle body: DIGGG40 with Resicoat® epoxy (for corrosion protection of fittings) coating with length 172 mm, width 75 mm, height 67 mm & thread depth 24.5 mm. The body shall have retaining cavity housing for internal and external retention of the elastomeric seal. Sealings shall be achieved by pressure exerted by the body while fastening the saddle straps & body on the pipe.

Saddle strap: Saddle strap shall be made of stainless steel 304 grade, gauge 16 & width 40 mm to prevent corrosion over the long service life & should be with no weld joint to avoid inconsistency of strength.

Strap Protection Rubber: NBR UV protected Elastomeric (rubber) shall be such that none of the Stainless Steel Strap is in direct contact with the pipe. It shall ensure a firm non-slip grip mounting on the pipe due to external loading.

Saddle seal: It shall be virgin rubber NBR Class 70 complying with EN 682-2002. It shall be of type pressure activated hydro-mechanical design. It shall be contoured gasket to provide a positive initial seal which increases with increase in the line pressure. Gasket shall be, with the outlet section having O-ring contacting the saddle body.

Nuts-Bolts-Washer: Stainless Steel Type 304, NC rolled thread, Tightening torque for ½" (M12) nut-bolt: 14-15 kgm.

OR

Specifications for Clamp Saddle for Service Connections

General Specifications:

Clamp saddles for service connection from water distribution mains shall be of wrap around design, wide skirt and wide straps support, which shall reinforce the pipe while providing excellent stability to the saddle.

Clamp Saddles for service connections shall be of fastened strap type with threaded outlet for service connection.

The service connection threading sizes shall be conforming to IS: 554

Clamp saddles shall be suitable for DI pipes of nominal size 3" (NB 80) to 12" (NB 300) with nominal service connection size from ½" (NB 15), ¾" (NB 20), 1" (NB 25), 1 ¼" (NB 32), 1 ½" (NB 40) and 2" (NB 50).

The straps shall be elastomer coated (insulated) type for firm grip on pipe as well as to protect the coating on the pipe and to insulate the un-identical metals. The saddles shall be single strap type up to pipe sizes of NB 600 and service outlet of ½", ¾" and 1".

The saddles shall be double strap type for pipe sizes above NB 600 or when the service outlet is 1 ¼", 1 ½" or 2".

Fasteners shall be of threaded nut-bolt-washer type. Nut-bolts of size ½" (M12) shall be used for saddles of size up to 4" (NB 100) and Nut-bolts of size 5/8" (M16) shall be used for saddles of size 6" (NB 150) and above.

The sealing between the saddle and mains shall be obtained by using a profiled elastomer seal matching to the curvature of the pipe.

The seal shall be of elastomer type, suitable for all potable water applications.

The Material of construction of the body, straps, fasteners etc. shall be of a non corrosive material such as engineering plastic (PE/PP) or stainless steel or a combination of both.

The design of the saddle body should be such that, the service connection outlet metal insert shall project out towards pipe side and align with the hole drilled on the pipe to ensure positive locking against rocking or creeping on the pipe, as might be caused by vibration, pressure or excessive external loading.

The clamp saddles shall be suitable for maximum working pressures upto 10 bars.

Material and Design Specifications:

Saddle Body: Non corrosive Engineering Plastic body moulded with Stainless steel threaded metal insert for tapping outlet. Also, the stirrup metal plate shall be duly embedded in the plastic body, except at the place of nut-bolt lugs. Threading size and dimensions shall conform to IS: 554. The body shall have retaining cavity housing for internal and external retention of the elastomeric seal. Sealing shall be achieved by pressure exerted by the body while fastening the saddle straps & body on the pipe.

Saddle Strap: Saddle straps shall be made of stainless steel 304 grade to prevent corrosion over the long service life.

Strap Insulation: Elastomeric (rubber) insulation / lining shall be such that none of the Stainless Steel Strap is in direct contact with the pipe. It shall ensure a firm non slip grip mounting on the pipe to prevent the saddle from rocking or creeping on the pipe, as might be caused by vibration, pressure or excessive external loading.

Saddle Seal: It shall be virgin rubber SBR Grade 30 / NBR (NSF 61 approved). It shall be of type pressure activated hydro-mechanical design. It shall be contoured gasket to provide a positive initial seal which increases with increase in the line pressure. Gasket shall be gridded mat, with tapered ends, with the outlet section having oring contacting the saddle body multiple o-rings contacting the pipe, preferably with a Stainless steel reinforcing ring insert moulded to prevent expansion under pressure.

Nuts-Bolts- washer: Stainless Steel Type 304, NC rolled thread, Tightening torque for ½” (M12) nut-bolt: 14-15 kg.m and for 5/8” (M 16) nut-bolt: 21-23 kg.m

The payments shall be made as per number basis.

ItemNo.5: Providing and fixing brass ferrule of approved make of following sizes inclusive of all taxes, insurance, transportation etc. complete.

- (i) 15mmdia.
- (ii) 25mmdia.
- (iii) 40mmdia.
- (iv) 50mmdia.

5.1 Thebrassferruleshallbe bestqualityandmakeasapprovedbyEngineer-in-charge.

5.2 Theworkshallbecarriedoutingoodworkmanshipmannerasdirectedbythe Engineer-in-chargewithproperfixingof ferruleasrequired.

5.3 Thepaymentshallbemadeaspernumberbasis.

ItemNo.6: Providing, supplying and fixing U PVC ball Valves with compression end on one side to connect PE Pipes and female threading on the other side for connecting BSP threaded fittings or pipes. The product shall confirm to ISO 4422-4 Standards. The rate shall be inclusive of all taxes, insurance, transportation etc. complete.

- (i) 20 mmdia.
- (ii) 32mmdia.
- (iii) 50mmdia.
- (iv) 63mmdia.

TheU PVCballValveswillhaveCompressionendon onesidetconnectPEPipesand femalethreading ontheothersideforconnectingBSPthreadedfittingsorpipes.The productshallconfirmtoISO4422-4Standards andpressure ratingwillbePN16.The productshouldbesuitableforuseindrinkingwaterforhumanconsumption.

Body,NutandThrustRingwillbeinjectionmoldedfromPolypropylene andUV stabilizedbody &thrustringblackincolor,NutblueincolorLipgaskets/ORingin FoodsafeRubber (NBR)blackcolormusthaveaconicalshapeoninsideofgasketfor easyinsertionofpipe&withtwolipsonbottomtoguaranteegoodsealing.UseofO ringnotpermitted. ClampringmaterialwillbePoly acetal(POM)whiteclouoredand shallnotbeconnectedto thrustring.

TheCompression Fittings&UPVCBallValvesfordrinkingwaterapplicationsshould haveundergonetypetestbyWRC-NSF,U.K.accordingtoBS6920andacertificate fromeitherWRC-NSForWRAS(WaterRegulationsAdvisory Scheme)shouldbe availableevidencingthisfact.

Thepaymentshallbemadeaspernumberbasis.

ItemNo.7: Providing and fixing Meterbox with built in lock as per the detailed specifications and as instructed by Engineer-in-charge.

METER BOX/VALVE BOX -8" x 12" in its properly buried installed position shall be designed to take load of human traffic and small vehicular load that usually appear in residential areas.

- The Meter Box should be Rectangular base in construction and Material of construction should be Weather Resistant Polyethylene (PE).
- Color : Blue.
- Base of the body should be designed in such a way that the box can be installed to the floor using anchor bolt/screws without grouting the entire base of the meter box.

- Reinforcement Ribs should be provided at the walls of the box.
- Provision for fixing aluminum name plate showing details of the Department.
- Meter Box should be of two components, comprising body and lid. Lid should be press fitted to the body. No hinges should be used for open/close operation.
- Meter Box should be provided with built-in lock OR with provision for lock.
- Cutouts for passing pipe: The body has inlet and outlet windows to pass the pipe through. Suitable for use with pipes of sizes up to 1”.
- Meter Box is compatible for AMR Water Meter Reading.

Installation:

METER BOX/ VALVE BOX - 8” x 12” can be installed permanently by fixing Anchor bolts/nails in the holes provided in base of body. The skirting can be additionally grouted with cement mortar for additional safety.

Payment

Payment shall be on number basis of the completed item.

6.20.11 ITEMWISE DETAILED TECHNICAL SPECIFICATIONS OF 24 X 7 WATER SUPPLY SYSTEM IN TP-19, TP-53(P), TP-7, TP-8, TP-33, TP-34 AND TP-64(P) OPERATION AND MAINTENANCE FOR 10 YEARS

Item No. 1 : The work of O&M will consist of operation and maintenance of Electro-Mechanical, Electrical, Mechanical, Electronics equipment / item, Instruments, SCADA System, Record keeping, measuring devices, minor civil works and maintenance of recharge bore. The firm has to operate the pumps as per SMC's requirements. The firm has to repair or replace pumps, motors, valves, pipes, screen, gate, gantry, electrical work including day to day maintenance as well as preventive maintenance as required. The work also includes operation and maintenance of MS / DI / CI transmission pipeline, rising main and distribution network. The firm has to repair or replace pipes / specials and all type of valves including repairing of leakages and solving of contamination problems, ensure water quality as per standard norms and repair to breakage of pipes repairs of road and valve chamber. NR Work also includes day to day maintenance as well as periodical preventive maintenance of all kind of valves

(I) Specification of Operation and Maintenance of WDS and ESR

- (1) The Contractor shall maintain all the civil works like, treated water sumps, pumphouse, ESR, roads, street light, drainage etc. at each WDS or at other locations in proper and good condition.**
- (2) The Contractor has to arrange to clean the treated water sump & ESR once per year and as and when felt necessary by SMC. The inside wall of sump shall be white wash as and when required by SMC. The contractor has to paint the all WDS and ESR once in five year (i.e. Total Two times during O & M Period)
- (3) The Contractor has to keep a watch on overflow of treated water sump, ESR, leakages in manifolds in pump house etc. Under no circumstances, the water shall not be allowed to become contaminated or go to waste and also to prevent the possible damages to be caused to the surrounding areas / properties, under the influence, where this overflow/ leakages of water are likely to flow.
- (4) In treated water sump / ESR, the ventilation system shall be maintained in clean and good conditions.
- (5) All the storage facilities WDS, ESRs shall be supplied water, as per the requirement to ensure 24 x 7 Water Supply.
- (6) The Contractor will also be responsible for –
 - Maintenance of electrical, ventilation, plumbing as well as drainage installations in neat and clean conditions.
 - Carryout the general building maintenance and house keeping in good and neat conditions.
 - Carryout site maintenance including the upkeep of landscaped area.
 - Regular periodical as well as preventive maintenance of sump, pumphouse, pipeline, ESR etc. in each WDS and to provide regular repairs to keep them all in working conditions.
 - Building services and house keeping maintenance shall be undertaken on all building and service installations.
 - Ensuring all unwanted or redundant items to be removed from the premises, as decided by SMC.

- (7) Pumps of all treated water pumphouse at WDS will run for 16 hours / day.
- (8) The contractor shall have to make necessary arrangements for the safety and security of all the structures, assets, pipeline, machineries, equipment etc. by taking services of Police or Security Agencies. No outside persons will be allowed to enter without permission. Only authorized personnel by SMC shall be allowed to enter the premises.
- (9) All required goods like CFL bulb, tube lights, flood lights, choke, starter, fuse wire etc. for O&M of WDS shall be kept ready in good working condition by contractor at his own cost.

(II) Specification of Operation and Maintenance of all D.I. Rising Mains and Piped Distribution Networks Including Operation of Valves

- (1) The water is to be supplied to the consumer on 24 x 7 basis (i.e. continuous water supply).
- (2) All the materials required for O&M works are to be procured by the firm at their own cost.
- (3) The contractor has to deploy **supervisor having diploma in civil engineering with 2 years experience in water supply, who will be in full charge and responsible for all activities of O&M work assigned to the firm.**
- (4) **Periodical preventive maintenance of the entire pipeline work and distribution system including online valves etc. shall be carried out by the contractor.**
- (5) The contractor to deploy specified number of O&M gangs, each consisting of **one fitter with one helper and mazdoors with necessary equipments and tools etc.**
- (6) The contractor has also to **provide vehicle and mobile phone facilities to the Supervisor in charge for speedy communications and actions for any complaints received from the SMC for leakages / breakdown etc. in the water supply system.**
- (7) The contractor to **keep a register of presence of all the personnel, engaged for O&M.**
If the presence of these personnel is found less than the prescribed personnel, an amount equal to double the rate (as mentioned in Table No. 1 and 2) per day will be deducted from the fees to be paid to the firm by SMC.
- (8) Any complaint from the consumers regarding leakage, low pressure, less quantity of water supplied, breakage of pipes etc. are to be attended immediately within prescribed period and the action taken for each complaint to be reported to SMC regularly, as decided by SMC. The contractor shall create a Toll Free Number (working 24 hours) for register the complaint from consumer for O & M period.
- (9) The contractor will be totally responsible during the implementation work for any accident or mishap etc. as well as any compensation thereof. Such occurrence shall intimate to SMC immediately.
- (10) Monthly bill should be submitted by the contractor giving details as shown below :
 - (a) **Register showing the number of persons present during the month and engaged exclusively for this contract.**
 - (b) **No. of complaint attended with copy of register.**
 - (c) **Length of MS / DI pipeline (diameterwise) replaced for each category showing the location on the plan.**

- (d) **Number of valves.**
 - (e) **Valve chamber with surface box.**
 - (f) **Valve chamber cover.**
 - (g) **Any other special item, if any.**
- (11) The maintenance of rising mains, distribution pipeline shall be carried out by the contractor. If any leakage is found, it shall be repaired within the prescribed time limit under intimation to SMC.
- (12) The contractor has to immediately inform to SMC, if any illegal connection is found in distribution system, for further necessary action, as per instructions of SMC.
- (13) The contractor shall be liable to maintain and update assets register, as decided by SMC.
- (14) The contractor shall calibrate / service all flow meters installed at sump, ESRs,
- Water
Distribution Systems etc. as and when require and also maintain the register for the same. He shall ensure that all the flow meters are always in working condition.
- (15) The responsibilities for accidents / legal problems shall rest with the contractor.
- (16) The rising main and gravity mains as well as network distribution pipelines including chambers, valves etc. shall be maintained and repaired by the contractor.
- (17) Servicing of all valves, cleaning of all pipelines, specials etc. shall be carried out regularly.
- (18) Leakage repairing shall be carried out in proper way and in technically workmen like manner.
- (19) All the gardens, lawns, plans situated at the work sites shall be supplied water regularly and maintained properly by the contractor. No extra payment on this account shall be made.
- (20) In case of breakages of MS/DI/CI/MDPE lines/ valves/ specials / valve chambers etc by other agency or utility providers, the damage shall be immediately repaired by the bidder under the scope of this work and reported to the Engineer-in-Charge of Surat Municipal Corporation.
- While arranging for permanent repairs, the contractor shall take immediate steps to stop the water losses and in terms financial losses to the contractor and Surat Municipal Corporation.
- (21) In case of negligence of Contractor and/or operator/ staff of the contractor, any W.D.S./E.S.R./U.G.S.R/Transmission lines/Network lines/Connections etc. over flows/leakages, the contractor will be penalized at the INR5/- Per Kilo liter for the loss of water over and above the prescribed percentage wise water loss penalty. This penalty will be considered at the discretion of Engineer-in-charge. The quantity and amount of penalty for wastage of water will be decided by Engineer-in-charge and shall be accepted by the contractor.
- (22) A project manager exclusive for the work having minimum 5 (five) years experience having qualification of B.E. Civil/ Mechanical /Electrical field shall be deployed to execute, liaison and Coordinate all the activities mentioned in the tender. The project manager shall be engaged full-time for this work, shall be available from 9.00 am to 6.00 P.M. and in other hours as per emergency.

The project manager shall carryout all the coordination and liaison with SMC for this particular tender work.

- (23) All tanks shall be cleaned once in a year and also during emergency.
- (24) Contractor will be responsible for any damage to network due to another agency and compensation for the same will be recovered from the concerned agency.
- (25) Before starting of the work following works will be completed by the SMC

All network flushing
Repair of all leakages

Pre-monsoon cleaning of the premises of WDS and ESR shall be carried out under intimation to SMC.

SPECIFICATION OF O&M OF ELECTRICAL / MECHANICAL / INSTRUMENTATION AND SCADA WORKS

The contractor will be responsible for smooth, efficient and satisfactory operation and maintenance of the entire work included within the scope of contract including 3nos. WDS, 10 nos. ESR, Distribution network including metering, Zonal and Master Control SCADA, etc. under SMART City Project for Surat Municipal corporation , Surat on round the clock basis for the entire period of O&M contract (i.e 11 years for Part-1 (2.89 sq.km. area) and 10 years for Part-2 (5.87 sq.km. area) from the effective date of the contract.

SMART CITY PROJECT comprises of following major units for which contractor shall be expected for effective operation and maintenance

- i. WDS including various electro-mechanical equipment, Instrumentation with PLC/SCADA with remote data transmission / data acquisition system, etc.
- ii. ESR including various electro-mechanical equipment, Instrumentation with PLC with remote data transmission, etc.
- iii. Zonal SCADA with remote data transmission / data acquisition system
- iv. Master Control SCADA with remote data transmission / data acquisition system
- v. Lease lines and GMS/GPRs based data transmission system for remote data transfer
- vi. Distribution network including metering, etc.
- vii. Any other forming part of the scope of work of this contract

The operation and control philosophy including monitoring, alarms and control for entire 24 x 7 shall be designed. Operated and maintained by the successful experienced bidder to ensure that all monitoring data for water audit purpose and required flow and pressure as per design are maintained to ensure proper and equitable water distribution.

1.1 SAFETY: The contractor shall be responsible for safety on site during the O & M of the works by the contractor. The contractor's duties with respect to safety shall include the following:

- 1.1.1 Contractor shall be in strict compliance with Factory Act, 1948. Facilities to staffs, operators, helpers, etc. should be in accordance to that.

- 1.1.2 Provision of First Aid Kit with all necessary updated materials
 - 1.1.3 Provision of Shock proof hand gloves, helmets for all staffs, shock proof shoe for all staffs, eye glass for each operation and maintenance staff – to be made available by contractor
 - 1.1.4 Ammonia Torch
 - 1.1.5 Personal Protective Equipments like Safety Gloves, Canister Masks
 - 1.1.6 Other than above safety apparatus / equipments, all other apparatus SCABA set, air line respirator, fire extinguishers etc. shall be provided by SMC. Contractor remains to ensure and update all such safety apparatus all the time. Necessary refilling and maintenance shall be done by contractor.
 - 1.1.7 Utilize safety awareness procedures in every element of operation.
- 1.2 Data / Record keeping:** Following minimum records expected to be maintained without fail by contractor:
- 1.2.1 Daily WDS/WSS Record which comprises of treated water flow / pressure, water level at WDS/ESR/Tanks, chemical consumption, opening and closing stock data related to chemicals, etc. This register / record to be maintained by shift chemists / operators and to be verified by Project-in-charge of contractor. Format shall be given by Surat Municipal Corporation
 - 1.2.2 Water Flow & Pressure Monitoring Records for which Format shall be given by Surat Municipal Corporation
 - 1.2.2.1 **WSS / WDSs MAINTENANCE REPORT:** Contractor shall furnish monthly Water Supply System (WSS) including WDS, etc. about proper functioning of all electrical /mechanical /electronic /instrumentation /equipment of WSS / WDS to concern Officer in charge. He shall clearly spell out all ‘running’ and ‘out of order’ equipments with detail reasoning thereof and expected time period of sorting out of the problem. Frequency of reporting and record keeping should be in strict adherence of Electrical / Mechanical Maintenance Schedule.
 - 1.2.2.2 The contractor will be responsible for keeping up-to-date record of document(s) including History Card for equipment(s) and maintaining day-to-day logbook relating to various analyses performed.
- 1.3 Supervision / Monitoring and Manpower Requirement** - Please clearly note that O & M job being handed over to contractor is not merely labour contract. SMC seeks to have expertise of contractor in the field, therefore, ‘Experienced Person’ from contractor’s end must Check the site, periodically at least Twice in a month (or as and when necessary) and bring forth necessary suggestion for improvement and also discuss the water quality/quantity/flow distribution issues with concern counter part of SMC and he will render suggestion, to improve the efficiency and working of the supply system. Please note that “carried out the job as per SMC’s instruction/tender” should not be attitude nor will it be considered as acceptable argument in case of any quality related issues/dispute. Further, if, as consultant, contractor finds any controllable/ uncontrollable parameters/factors that might have impact on water quality/quantity/distribution must be brought to notice of SMC well in advance timely and discuss thoroughly with probable solutions. The visit must be recorded at Corporation's document like visit book without which the visit shall not be considered. In certain cases, outcome of the visit/minutes of meeting should be got signed, if required, by Corporation's authorized representative.
- 1.3.1 During the visit and even before the visit, “Experienced Person” shall have inferences derived from the recent past data as well as prevailing data and he shall

- sense, observe, interpret and diagnose the situation / operational scenario accordingly.
- 1.3.2 Based on diagnosis, he shall suggest remedies to project manager or Project-In-Charge.
 - 1.3.3 He shall also suggest possible resources required / available to Project-In-Charge.
 - 1.3.4 He shall help Project - In - Charge to device the program with expected process time, expected results, possible milestones and symptoms, possible alternatives, possible undesired results in case of negligence during the process etc.
 - 1.3.5 He shall explain all of the above to SMC officer in charge / chemist in charge who in turn shall device implementation program.
 - 1.3.6 Normally, contractor shall be responsible for effective operation and maintenance of WDS / WSS such that water supply distribution objective of 24 x 7 supply is achieved and meets required criteria. Any deviation in WDS / WSS which leads to not acceptable criteria, accountability during such situation would be of contractor.
 - 1.3.7 Contractor is expected to understand the holistic view of the intent behind the entire work including O&M contract and shall act accordingly throughout the contractual period.
 - 1.3.8 Last but not least, under no circumstances 'unfit' water shall reach from underground storage tank of water treatment plant to distribution network or any act of contractor shall result into improper water supply. Before raising any issue related to quality / quantity of water, he must ensure that entire water supply system is as per criteria defined under tender. He should bring to notice to Plant In-Charge – SMC & concern staff regarding poor water quality / quantity timely (with acceptable data) so that corrective action or further course of action can be decided but under no circumstances, 'unfit' water shall reach to public. Expertise needs to be rendered in all areas of operation and maintenance of WDS / WSS in general and in following areas in particular;
 - 1.3.8.1 Appropriate formulation & optimization of Process Inputs.
 - 1.3.8.2 Chlorine dosage
 - 1.3.8.3 Appropriation of disinfection frequency
 - 1.3.8.4 Testing frequency
 - 1.3.8.5 Analysis of water supply data (level, pressure, flow, etc.) based on performance data of individual and formulation of action plan based on analysis.
 - 1.3.8.6 Provision of sufficient knowledge inputs via training to chemists/operators/helpers
 - 1.3.9 **MANPOWER/STAFF PATTERN:** The contractor shall provided experienced managerial, technical, supervisory, administrative & non- technical personnel & labour necessary to operative & maintain the water supply system property, safely and efficiently on a continues 24 X 7 basis for full term of the O & M contract period.
 - 1.3.9.1 The qualification and capability of the contractor's personnel shall be appropriate for the task they are assigned to perform. The staff provided shall be fully trained in the operation of water distribution station as well as distribution network including ESR, network, metering, data acquisition system and remote data transmission system, etc. before being giving responsibility for operating any part of the water supply system. If in the opinion of the engineer, any member of the contractor's staff is considered to be insufficiently skilled or otherwise inappropriate for the task he is required to perform, the contractor shall replace him with a person with the appropriate skills and experiences for the task, to the

approval of the engineer. The contractor will be required to submit to the corporation the schedule of “Manpower and Organization Chart”.

- 1.3.9.2 The CV/Resumes of the contractors personal shall be submitted to the engineer in charge within 15 Days after receiving of work order. Any change of personnel shall be promptly informed to the engineer within a day’s time. Normal time duty hours for the contractors’ operation & maintenance personnel may be modified as necessary and the contractor and agreed by the engineer who will ensure that an adequate number of the contractor’s staff, fluent in Gujarati as well as Hindi is on duty at WDS/WSS location /SCADA Room 24 hours per day, 7 days per week, including all holidays.

Minimum Men Power Required at Water Distribution Stations / Control Room / ESR

Sr. No	Designation	Qualification	Experience	No of persons
1.	Electrician/ Wireman	ITI (Electrician/ Wireman) having permit of Government of Gujarat.	Minimum Two Years experience of Operation & Maintenance.	03
2.	Fitter	ITI (Fitter Trade)	Minimum Two Years experience of Operation & Maintenance.	01
3.	Helper	Standard 7 th Pass Should be physically healthy & able to read & write (only male)	Exp. in water Pumping Station operation is preferable OR Exp. in other such type of organization.	06
			Total	10

Note: The above is minimum manpower and contractor shall require to depute any additional staff as required to ensure smooth and trouble free O&M

- 1.3.9.3 Relaxation in qualification and number of staff shall not be allowed. If it is observed and found that WDS/ WSS is run by under qualified staff except Helper categories then “He/They” is/are treated as absent. And Penalty for the “absence of the staff” is applicable as mentioned in tender documents. The above staff shall be distributed in three shifts as per mutual agreement between Contractor and Corporation.
- 1.3.9.4 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.
- 1.3.9.5 The contractor shall comply Labour Act and necessary weekly off, holiday etc. as per Act of provision remains to be extended to the deployed staff. However, in any case, above required staff remains to be made available for 24 hours.
- 1.3.9.6 The presence of staff in each shift should be marked in muster (to be brought by the contractor) to be maintained at office of shift in charge at Water Works, which shall be considered as final. The contractor's staff must mark their presence in this muster only. The contractor may maintain a separate register for his own purpose.

- 1.3.9.7 Please note that computer system is to be operated and maintained by the contractor's staff and therefore it is in the interest of the contractor to employ project in charge/ shift chemist who is proficient in the computer operating system.
- 1.3.9.8 Unsatisfactory and inefficient running of the WSS/WDS, supported by the reason(s) that are under control of contractor will be highly objected. In such case(s) Competent Authority decision will be final and binding to the Contractor.
- 1.3.9.9 Contractor will comply with all statutory rule(s) and regulation(s) and all inter-disciplinary measure(s) as followed by the Corporation.
- 1.3.9.10 The Corporation will not be responsible for any accident/ injury to the staff of the contractor. Further, the Corporation will not provide any insurance or medical facility to the staff of contractor.
- 1.3.9.11 Key personnel (Project-in-charge, Shift in-charge) deployed by the contractor must be having true dedication the plant O&M works as per scope. Frequent turnover of the staff in this category shall not be allowed and hence these personnel are expected to have on permanent basis for 3 years at least. Also, shift in-charge specifically during night hours shall be expected to have vigilant monitoring and works in plant. In absence of project-in-charge, sole responsibilities of WDS / WSS O&M shall be on shift in-charge and hence, shift –in charges shall not be allowed to do activities other than their core duties (studies etc.). In case of such observation, shift in-charge shall be marked absent and contractor shall be given notice to remove such persons with an immediate effect.
- 1.3.10 **General Administration and Reporting**
 - 1.3.10.1 The staff of contractor will always remain in contact with the Plant-In-charge / Electrical Supervisor In charge/ Chemist of the shift at Water Works of the Corporation and follow their instructions.
 - 1.3.10.2 All deployed staffs are expected to discharge their duties in discipline manner. Uniform, I-Card, Safety Shoe, Helmet etc. which are essential to maintain discipline. Staff without these measures shall be considered as absent.
 - 1.3.10.3 All operational activities and process matter, trouble shooting etc. remains to be reported to SMC Plant-In-Charge – Operation through shift chemist. Satisfactory report of operation on monthly basis supported with necessary evidence, documents etc. remains to be submitted along with Bill. Without this, operational activities shall not be considered as satisfactorily done for the claimed time period.
 - 1.3.10.4 All Electrical / Mechanical / Instrumentation breakdown / preventive / routine maintenance activities as per schedule / instruction from SMC Plant-In-Charge – Maintenance remains to be carried out by contractor. Also, such activities remains to be reported to SMC Plant – In –Charge – Maintenance (AE / JE / Plant & Eq. Engineer of SMC) through Maintenance Assistant or Supervisor – Electrical. Satisfactory report of maintenance supported with necessary evidence, documents etc. remains to be submitted. Without this, maintenance activities shall not be considered as satisfactorily done for the claimed time period.
 - 1.3.10.5 As per norms, deployed staffs needs to be covered under EPF and Insurance, hence, time to time, receipt towards payment of EPF and Insurance remains to be submitted along with O&M Bill
- 1.3.11 The duration of contract shall be as mentioned above from the date of placing the order for operation & maintenance. However, Corporation reserves the right to

extend and or reduce the contract period depending on the performance and will be absolutely at the discretion of the competent authority of the corporation. Further, Corporation will give 3 month advance notice to contractor for the extension in the contract period.

- 1.3.12 Please note that stipulated period to start the work after 10 days of work order date. SMC will not be responsible for postal delay if any.
- 1.3.13 The handover/take over procedure is to be done by agency within stipulated period of 10days to start work.
- 1.3.14 **NOTICE BOARD/ DISPLAY BOARD:** - The contractor shall provide a notice board / display boards at appropriate locations detailing precautions to be taken by operation and maintenance personal in work as per safety rules and regulations.

B. SCOPE OF WORK

The job involves the smooth operation & maintenance of entire work within the scope of this tender for a period as mentioned above.

The water distribution station / water distribution network comprising of various electrical / mechanical equipments / instruments like; **All** pump sets of various head & flow, with suitable motor and allied accessories like **NRV, butterfly valve, sluice valve, KGV, Actuator**, dewatering pump set, H.O.T/ E.O.T crane, Chlorination Plant(s), etc. The Electrical system LT panel board having ACB/ SFU etc with capacitor banks, motor control panel (starter), DOL/ star-delta starter, LT distribution boards etc, streetlight & building light etc. Instrumentation system comprises of various types of instruments like as Flow, Pressure, Level, PLC/SCADA & remote data transmission & lease lines & such communication facilities, etc., repairing & replacement of spare parts of above systems.

The scope includes All in All comprehensive maintenance of the entire work included within scope of this tender including 3nos. WDS, 10 nos. ESR, Distribution network including metering, Zonal and Master Control SCADA, etc. and is including materials/spares for routine, preventive and breakdown maintenance. The Pumping Stations/network shall run 24 hINR, 365 days basis including men power.

All the operation/maintenance activities such as WDS operation (running of pumps, numbers of pumps, pumping hours, etc.), ESR supply, network supply, etc. shall be done under the guidance of Site In-Charge.

The above list of equipment is in general. The equipments which are not described in the list but which are in existence in the plant are under contractor's scope of the operation & maintenance.

CONTRACTORS SCOPE OF SERVICES ALSO INCLUDES:

The contractor would be responsible for smooth, efficient & satisfactory operation & maintenance and repairing, replacement of spares, any work related to WDS / WSS / Water Works on round the clock basis.

- The scope of the contractor includes operation, maintenance & replacement of spare for pump sets & respective delivery piping/ piping network for lubricating / cooling of each vertical turbine pump sets etc.
- The scope of work also includes providing necessary tools & tackles for day-to-day O & M routine maintenance, preventive maintenance and break down maintenance.
- Also minor and major repairs to the equipment involved in the WDS/WSS have to be carried out by the contractor during the O & M period.
- The scope of the contractor includes operation, maintenance & replacement of gear mechanism for valve. Also operation, maintenance of chain pulley block of HOT/ EOT crane at WDS.
- Repairing & replacement of damage strainer of each pump sets, repairing of dewatering pump-motor set, etc
- The scope of work includes attending of all type of cable faults including end terminations of cable, changing of lugs or changing LT cable, etc. & required items shall be provided by contractor.
- The scope of work includes O & M of capacitor bank within WDS, panel, etc. All these capacitor banks must be kept in working condition to keep supply co. power

factor more than 0.98 by the contractor. Any spares required to keep these capacitor bank in working condition is in the scope of Corporation.

- The scope of work includes O & M of entire instrumentation works at various locations including PLC & SCADA system, communication devices, etc. The scope shall also include all required charges (all charges including registration, rental, monthly usage, etc. as applicable) for various lease lines, broad band connections, SIM Cards, any other remote data transmission system, etc. as applicable.

APPLICATION:

- The general condition of the contract shall apply to the extent that they are not superseded by provision in other parts of the contract.
- Most stringent condition(s) / specifications shall be followed.

ELECTRIC POWER:

Surat Municipal Corporation shall directly pay all the power bills but the contractor will be required to note/furnish electricity consumption in the various log sheets/schedules/ registers **Log sheet / Schedules / registers shall be provided by the contractor & its format shall be approved by the SMC.**

MAINTENANCE TOOL AND EQUIPMENT:

All miscellaneous items for example vehicles, tools, testing equipment, cleaning or housekeeping materials/ equipment and safety equipment, electrical equipment, etc. shall be provided by the contractor at his expense.

Nothing is to be provided by SMC excluding, chlorine, electricity & Water. All other items shall be in the scope of contractor including Major and minor spares repairing and / or replacement as well as consumables.

Further the contractor shall provide sufficient mobile phones (if possible in SMC's service provider group) at WDS / WSS location staff which shall be available 24 hours with site in-charge / various key O&M personnel.

SAFETY SECURITY WATCH & WARD

The contractor shall be responsible for safety on site for entire works during the O & M of the works by the contractor.

The contractor's duties with respect to safety shall include the following:

- a) Utilize safety awareness procedures in every element of operation & maintenance.
- b) Gives emphasis to site including:
 - (1) Safe working and safety procedures as per rule and regulation of government regarding use of protective clothing, gloves, Safety Shoes/ shock proof boots, safety belts, emergency light, torch and helmets etc.
 - (2) Cleanliness of the WDS/plant/installation location as a whole.
 - (3) Awareness of hazardous condition and accident reporting and necessary compliance.
 - (4) Safe practice in Water Distribution station / network.
 - (5) All safety equipment of WDS/WSS shall be maintain and operated by contractor. All equipment remains healthy & in working condition throughout the contract period.

The safety, security and watch and ward of all equipment/materials etc. within the Water Distribution Station / within the scope of this work shall be in the scope of contractor, but security for entire campus of WDS will be provided by SMC. Thus, campus security is not included in the scope.

1) MAINTENANCE:

Maintenance of installed equipments at Water Distribution Stations / Water Supply Network

All machinery, plants and equipment will be handed over to contractor in healthy and running condition at the time of commencement of the contract / on completion of successful testing, commissioning & acceptance of the entire system. Same way the contractor will have to handover all the machinery, plants and equipment to the SMC in healthy and running condition.

- The maintenance service provided by the contractor for the period specified in the contract shall ensure the continuity of All Water Distribution Stations/ Water Supply Network / Distribution Network locations that the breakdown or deterioration in performance, under normal operating conditions, of any items, of plant and equipment and component parts thereof is kept to a minimum.
- All routine maintenance like lubricating/ greasing of pumps and motors, valves, actuators, any other equipment, instrumentation works including PLC & SCADA systems, data transmission / communication systems, cleaning of fix moving contacts of starters/contractors/ Panels etc. shall be done on regular basis. The routine and preventive maintenance schedule shall be prepared and got approved by **Engineer In-charge** of the department. All the material like lubricating oil, grease, gland packing, nuts/ bolts/ washers etc. shall be supplied by contractor. The routine and preventive maintenance shall be done in most punctuality and in best engineering manner so as to minimize or eliminate any major breakdown of the machinery.
- For routine maintenance work Qty. of following consumable shall be maintain throughout the Contract period by the contractor.

Sr. No.	Description	Qty.
1.	Gland Packing	15 Kg.
2.	Lubricating Oil	10 Liter
3.	Rubber packing	15 Kg.
4.	Transformer oil	35 Liter
5.	Bearing Grease	10 Kg.
6.	Rubber Bush set with Bolt	Set for 1 pump of each category

- In the case of any major breakdown the maintenance shall be done by the contractor on highest priority basis and in no case Water Distribution network of such area to be interrupted.
- Root cause analysis for every minor as well as major fault must be done in details and to be well documented.
- All the electrical & mechanical installation including HT and its equipments in the Water Distribution Stations premise are in scope of work. Also the liasioning with Power supply co. and electrical inspector shall remain in the scope of contractor.

- If any motor(s) or Transformer(s) burns during the contract period, the contractor will have to at his cost get it restated using same quality of conductor/ insulating materials. Same is applicable in the case of burning of any transformers, starter panel.
- All the tools, tackles, Jigs and fixtures required for maintenance shall be brought by the contractors and shall be permanently kept at Water Distribution Stations.
- All the maintenance activities shall be done by qualified, experienced and skilled staff as asked in the schedule.
- The contractor shall adhere to the manufacturer's recommendation with respect to equipment maintenance, the type and grade of lubricants to be used, frequency of lubricant, adjustments to be made regularly and recommended spares to be kept in store.
- All the records and documentation shall be prepared and updated for all maintenance activities as per directed by Engineer-in-charge.
- Contractor shall have to supply free of cost and maintain 01 no. cupboard for safe storage of above consumable items and records throughout the Contract period at Water Distribution Station.

Maintenance of workshop equipments

Tools & tackles required by the contractors as a minimum are: Spanners set suitable to open vertical turbine pump/ Submersible pumps and other equipment like hammer, sling, D-shekel, screw driver set, master level, vibration meter, noise meter, dial gauge, welding machine, grinding machine, megger, multi meter, grease, grease gun, earth rod, safety glows for discharging HT panel etc.

In addition to above all other necessary tools as and when required must be with the contractor for satisfactory operation & maintenance of Water Distribution Stations.

Maintenance of Buildings & site.

The contractor shall be responsible for:

- a) The maintenance of electrical, ventilation, plumbing & Hydraulic installation.
- b) General building & compound maintenance as well as cleanliness, including gardening & housekeeping.
- c) Full maintenance of the site services, cabling, and earthing system together with the site road street lighting system.
- d) Site maintenance including approaches and gate.
- e) The building services and housekeeping and cleanliness maintenance shall be undertaken on all building including HT Substation, Switchyard, roads, open spaces and services installation etc. within the premises.
- f) The contractor shall ensure that all unwanted or redundant items are removed from the building and site. Depending on their condition such items shall either be placed into storage or disposed off site.

APPLICATION:

- The general condition of the contract shall apply to the extent that they are not superseded by provision in other parts of the contract.

General Routine Maintenance:-

General routine preventive maintenance scheduled for various equipment shall be adopted from O & M manual. However the general routine maintenance to be carried out by the contractor's personals will include but not limited to the following: -

- a) If it is observed that power consumption per MLD of Water Distribution Station water pumped is increased, the contractor has to trace out the fault and rectify the same to bring it the standard/normal value.
- b) De – watering and cleaning of the transformer yard and other places.
- c) Drying and refilling of silica gel in the breather of the transformer.
- d) Regular watering on the earth – pits.
- e) Check for any oil leakage in the transformer and initiating and repairing of the same.
- f) Air blowing of motors, HT & LT panel etc.
- g) Check for any loose connection in all electrical equipment and rectification of same.
- h) Replacement of gland packing for the sluice valves / knife gate valves, etc., whenever required.
- i) De-watering of all chambers on regular basis.
- j) Greasing of bearing and lubricating all moving parts as per the scheduled.
- k) Tightening of all loose nuts – bolts and other fasteneINR
- l) General cleaning of all equipment and buildings.
- m) Checking and replacement of bulbs, tubes, chocks, starters, switches, LED etc. Throughout the plant and including street and head lights.
- n) Watering of plants and tree.
- o) Cleaning of entire premise including toilets.

PREVENTIVE MAINTENANCE CHECKS: -

The contractor shall adopt a preventive maintenance check's scheduled as agreed mutually between the contractor and the corporation. The preventive checks and their tasks frequencies for major equipment are mentioned here in / shall be as recommended by manufacturer.

INSURANCE:

The contractor shall indemnify the corporation against all losses and claims in respect of

- a) Death of or injury to any person, or,
- b) Loss of or damage to any property (other than the work)
- c) Which may arise out of in consequent of the operation & maintenance of the facility and the rectifying of any defects therein and against all claims proceedings, damages, costs, and expenses whatsoever in respect thereof or in relation there to.

The corporation shall not liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the contractor or any sub-contractor, resulting from any act or default of the contractor, his agents or servant.

The Contractor shall take “All contract risk insurance policy” for all workers & labourers of contractor & client working at site & Third Party throughout the contract period.

The Contractor shall take “Workmen Compensation Policy” for all workers & labourers of contractor & client working at site & Third Party.

“Insurance Policy” must fully cover of all type risk. The Insurance policy so taken by the contractor for such purposes shall be in the joint name of the contractor & the client & the policy shall be deposited with the client & it must be taken by contractor before the start of contract.

SPARE PARTS AND STORAGE:

- The storage inventory, the issuing and recording of spare parts will be responsibility of the contractor.
- The contractor is also responsible for providing spare parts and material required for the operation & maintenance during the operation period, including the cost of storing and safeguarding.
- The contractor will make all necessary arrangements to ensure the continuous supply of spare parts and material for the work, and the rate of supply of these material shall be in such quantities amounts as would ensure uninterrupted operation.
- The contractor shall supply spare parts and the same will be used during operation & maintenance contract period. Any parts not used during the O & M period shall be handover to the corporation.

PLANT VISIT:

Surat Municipal Corporation reserve the right to arrange the visit of VIP’s dignitaries, public representative and other person of social or political repute any organization as and when necessary to the All Water Distribution Stations / Distribution Network Locations. The contractor shall offer co-operation to the Corporation on the occasions of such visit.

All disciplinary measures as observed by Corporation and rituals being followed by SMC shall also be adopted by the concern employee of contractor’ staff.

COMPLETION OF THE CONTRACT:

On the date of contract completion or if contract is terminated, all the installations, works and equipment placed under the contractor’s responsibility shall be handed over to the corporation in good working order. The corporation may perform any inspection, test or expert appraisals he shall consider necessary with a view to checking that the property is in good working order and will certify to that effect to the contractor while taking over.

A joint visit shall be made by officer in charge and concern counter part of SMC well before the completion date of contract and all points needing rectifications/replacements shall be noted and shall be set aright by the contractor. A Minutes of Meeting is to be created indicating that all machineries mechanical, electrical and others are in order and no part is needs now to be replaced. If any defects found during handing over, the cost of rectification shall be recovered from final bill/ security deposit. This formal document must be created in presence of Engineer-in-charge, the contractor and manufacturer and duly signed and sealed by all of them. Further following shall be noted:

- No accommodation /guest house/ transportation facility will be provided by the corporation to contractor.
- In case of any interruption of Water Distribution Stations / Water Supply due to any reason like failure of power supply etc. will be duly and immediately communicated to Engineer-in-charge. The contractor’s staff must remain in association with Engineer-in-charge responsibly till that interruption is removed.

- All operation required for Water Distribution Stations / Water Supply Distribution System must be done in accordance with the instruction of Engineer-in-charge and all instructions given by him must be followed-up by the staff of the contractor. Any dispute, emergency or disturbance raised due to non-follow-up of instructions given by Engineer-in-charge shall be viewed seriously and the contractor may be penalized for the same as decided by the Corporation.
- The contractor will be responsible for the operation and maintenance of all valves & gates up to common header line installed within Booster House of Water Distribution Stations.
- Contractor shall be attending any work as instructed by Station In-Charge Engineer with in the campus of WDS / at all distribution network locations.

DOCUMENT RECORDS / LOG BOOK:

The contractor will be responsible for keeping up to date records of documents including History Card for equipment and maintaining every day log book relating to various operational parameters like Water Distribution Station hours, Amperes, H.T. voltage, Power factor, energy meter reading, pressure; distribution network parameters like level, flow, pressure, valve status, etc. and other reading required are recorded in every shift at regular interval e.g. hourly or as agreed mutually by SMC.

Log books/ routine maintenance books / registers and all printed necessary stationery required for maintaining records of O & M will be prepared under the guidance and will be provided by Contractor free of cost and also maintain these books in order will be the responsibility of Contractor.

Notice Board/ Display Board: -

The contractor shall provide a notice board/ Display boards at appropriate location detailing precautions to be taken by operation and maintenance personal in work conforming to Industries and Labor Regulation and Department of Explosives.

PAINTING:-

This work is inclusive of painting of Elect. & Mech. machinery like Motor Pump Sets, NRV, Sluice Valves, Bellows, BFV, pipe line, MCC Panel, MCC & LT-HT Panel, Transformers, Street Light Pole, Checkered Plate, EOT & HOT crane with accessories (girder, I Beam) window grill etc. once in 24 month contract period instructed Engineer In charge. (Time schedule for it, well be decided by SMC). **All buildings of water distribution station shall not be in the scope of painting works.**

Specifications for painting material:

Civil work outer side: ACE Exterior Emulsion.

Civil work inner side: White wash for water retaining structure & Distemper for pump house & buildings.

Doors, Windows, Street light, Flood Light: Synthetic Enamel.

All type of Electrical & Mechanical machineries and structures like Pump sets, valves, C.I. fittings, Sluice gate, M.S grill, transformers etc.: Synthetic Enamel.

Note: - 1. 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 Executive Engineer.

Important Note :-

- [1.] Please note that during the work, all required and necessary Electrical Safety Rules must be followed by the contractor. Corporation will not take any responsibility towards any damage/accident caused to workmen deployed by the contractor. Therefore, it is in the interest of contractor to ensure all safety precautions before commencement of the work.
- [2.] Schedule for painting should be submitted to Engineer in-charge before starting the work.
- [3.] It is the responsibility of contractor to keep all the installation and system up-to-date & well maintained & to comply & execute all the short falls, suggestions given by concerned government authority like elec. inspector and factory inspector etc., within stipulated time. All the such activities shall be done by contractor free of cost.
- [4.] In case of continuous operating equipment like electronic equipment, capacitors etc. for which, supplier certify that, it is unrepairable, replacement is must, and SMC's competent staff also suggested replacement, the said equipment shall be supplied by SMC for replacement. In such case the Life span as suggested by supplier/manufacturing Company must be got over or the detritions of the equipment like capacitor is of up to unusable level. However, if in case of unrepairable breakdown of equipment due to negligence of contractor or misuse etc. on part of contractor, such replacement shall be supplied by contractor.

MAINTENANCE ACTIVITIES:

It includes maintenance of the all equipments, electrical /mechanical /electronic /instrumentation / equipments / pipelines etc. and Cleanliness of plant and surroundings **with all kind of spares and equipment.**

These activities includes: -

1.OVERALL MAINTENANCE OF ALL EQUIPMENTS:

Overall maintenance of all equipments electrical / mechanical / electronic / instrumentation / equipments / pipelines with **all major & minor spares.** These activities includes shall be in the scope of Contractor. Tools and tackles necessary for the efficient maintenance shall be arranged by contractor. The good workman ship should also be ensured supported by fundamental technical knowledge. Therefore, qualification as mentioned must be met with for various categories of staff.

1. **DAY TO DAY OVERHAULING AND CLEANING, TROUBLE SHOOTING:**
The maintenance activities also include day to day overhauling and cleaning, trouble shooting of all instruments / equipments in adherence to Maintenance Schedule or as per the requirement aroused due to any breakdown.
2. **BREAKDOWN:** Whereas good overhauling and maintenance of equipment shall ensure long trouble free operation, therefore, breakdown shall be viewed seriously. Where spare (extra or standby) equipments have been installed, breakdown more than 7 days shall attract strict actions. All other equipments are expected to run continuously trouble free. Any serious effect on the day to day activities of WDS/WSS hampering quality and/or quantity of treated/filter water due to lack of poor operation and maintenance shall be viewed seriously and actions as deemed fit shall be initiated by competent authority of corporation and shall be binding on part of contractor.

Maintenance Schedule

Sr. No	Items	Preventive Maintenance	Frequency
1	Sluice Valve	1. Leakage through Stuffing Box/Gland.	Monthly
		2. Noise/Vibrations while Opening or Closing the valve.	
		1. Lubricating of Exposed Moving Parts	Every Three Years During O/H
		1. Condition of Body Seat Ring/Wedge Seat Ring faces- scratches, dent marks, intactness	
		2. Condition of Spindle & Spindle nut/Yoke sleeve threads	
2	Butterfly Valve	1. Leakage through DE/NDE ends	Monthly
		2. Noise/Vibrations while Opening or Closing the valve.	
		1. Lubricating of Exposed Moving Parts	Every Three Years During O/H
		1. Condition of resilient Disc Seal-for cuts, deformation & resilience	
		2. Condition of Shaft Seals-for cuts, deformation & resilience	

3	NRV	1. Leakage through Valve Seat.	Monthly
		2. Noise/Vibrations while Opening or Closing	
		1. Condition of Door Face/Body Ring faces-scratches, dent marks, intactness.	Once in Three Year of O&M Contract
		2. Condition of Hinge Pin	
4	Air Valve	1. Leakage through gasket for small orifice nipple	Every Three Month
		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
5	Pump Sets	A. Self priming pump set	
		1. Check priming time	Monthly
		2. Check pump noise	
		3. Check All pipe connections	
		4. Check suction- strainer (if any)	Yearly
		1. Open the pump. check & clean interior parts	
		1. Check impeller	
		2. Check clearance between impeller and wearing plate (Range:0,25 & 0.35 mm)	
		3. Check shaft sleeve. Replace if workout	
		4. Replace Gland potting	
		5. Replace wear plates, if worn out	
		B. Submersible Pump Set	
		1. Check delivery pressure, current and voltage	Daily
		2. Check Noise and vibrations	

		1. Check the oil in the chamber once in every 1000 operating hours	Quarterly
		1. Check the condition of the Mechanical seals	Six Monthly
		1. Check clearance between Impeller and setting plate	Yearly
		1. Overhauling for all pump sets having operating Time <=8 Hours per day (This work is to be done by Autho. personnel only.)	Every Three Years
		1. Overhauling for all pump sets having operating Time >8 Hours per day (This work is to be done by Autho. personnel only.)	Yearly
		E. VT Pump Set (Dirty Water Pump sets, Backwash Water Pump sets)	
		1. Check Oil / Grease in thrust bearing housing (If applicable)	Monthly
		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 Oil / Grease in thrust bearing housing (If applicable)	Six Monthly
		2. Change of Gland packing	
		1. Overhauling for pumpsets having operating hours more than 8 Hours per day	Once in Five Years of O&M Contract

6	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 Clearance between trolley and runway beam flange (range : 5 to 10 mm)	Yearly
		2. Check wearing in chain	
		3. Seeking safety license / certificate / load test certificate from consultant / authorized agency	
7	Chlorinator (Vacuum feed)	1. Check all the joints by Ammonia for any leakage	Daily
		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
16	Air Conditioner	1. Cleaning of air filters	Yearly
		2. General cleaning with air blower	
		3. Thermo-state Checking	
		4. Compressor checking	

Sr. No	Items	Electrical & Instrumentation preventive maintenance required to be done			Frequency
1	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	
				Check operating mechanism for mechanical functions	
				Check auxiliary switch and re-tighten / replace	
				Check protection relay, replace if required	
				Check fix and moving contacts, erosion	
		2	MCCB	Tighten if found loose	Once in Year
				Check fix and moving contacts, erosion	
				Take necessary action if not found OK	
		3	Soft-Starter & its cubical	Check for operation of all Electronic Cards and tighten terminals	Monthly
				Take necessary action if not found OK	
				Blow dust by Air blower	
				Take necessary action if not found OK	
		4	Contactor, Fuse Unit, Bus bars, Meters, ON/OFF Switch, MCB Etc.	Clean the contact by using smooth Emery paper or CRC spray	
				1. General Cleaning	
				2. Cable Lugs Tightening	
		5	Auto-Transformer	3. Check of Earthing	Yearly
				Tighten if found loose	
				If megger value not achieved, placed for heating & re-varnishing if req.	

				Filter the oil & replace if required.	
				Take necessary action if not found OK	
		6	Capacitor	Check Capacitance Value and replace if not found OK	
				Tighten bus bar / wires	
				Check resistors	
				Take necessary action if not found OK	
		7	Panel cubical	Blow dust by Air blower	Monthly
				Re-tighten if found loose	
				Replace if required.	
				Take necessary action if not found OK	
		8	Earth resistance	Take suitable action if earth resistance is high	Yearly
				If found damage, replace/repair the earth strip.	

Sr. No	Items	Electrical & Instrumentation preventive maintenance required to be done			Frequency
2	Motor	1	Terminal Box	Tighten if found loose	Quarterly
				Clean with compressed air & clean the accessible parts by dry lint free cloth.	
				Replace if not found OK	
		2	Winding	If megger value not achieved, placed for heating & re-varnishing if req.	
		3	Earthing Strip	Replace if not found OK	
		4	Heater	Replace if not found OK	
				Take necessary action if not found OK	

3	LT / HT Cable	1	Terminal	Tighten if found loose	Once in Year. Diagnostic testing to detect faults in cable & cable joints once in two yearNR
		2	Cable Insulation	Take necessary action if not found OK	
		3	Earthing Strip	Take necessary action if not found OK	
				Tighten if found loose	
4	Flow-meter			1. Physical cleaning, 2. Physical condition of sensor, 3. Display checking of Indicator 4. Gland and cable connection checking	Monthly
5	Level Indicator / transmitter			1. Physical cleaning, 2. Physical condition of sensor, 3. Display checking of Indicator, 4. Cable connection checking	Monthly
6	Pressure Transmitter or any other instrument in scope of work			1. Physical cleaning, 2. Physical condition of sensor, 3. Display checking of Indicator, 4. Cable connection checking	Monthly
7	PLC / 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.	Monthly
8	APFC Panel			1. General Cleaning 2. Cable Lugs Tightening 3. Check operation and tightness of Contactors, Fuse Unit, Bus bars, Meters, ON/OFF Switch, Earthing. Relay operation checking in auto mode	Monthly

3. Operation and maintenance of 3 nos. WDS, 10 nos. ESR, Distribution network including water meters, 2 nos. Zonal SCADA and 1 no. Master Control SCADA under the scope of maintenance work. Therefore, in order to maintain SCADA system in operational mode all the time, contractor remains to produce adequate evidence towards successful operation and maintenance of SCADA system of entire smart city project. Contractor remains to have MoU with agency (**Authorized System integrator of same PLC/SCADA**) who got hands on experience in SCADA implementation and maintenance in water distribution station / water distribution network. Contractor shall be responsible for smooth operation and trouble shooting of entire SCADA system, whereas in case of any breakdown intimation shall be given by contractor to SMC.

- a) SCADA System Control Panels all Hardware & all Software.
- b) PLC System Hardware & Software
- c) Communication

Preventive maintenance: The contractor shall adopt a preventive maintenance checks scheduled as agreed mutually between the contractor and the Surat Municipal Corporation. Please note that during the work, all required and necessary Safety Rules must be followed by the contractor. Surat Municipal Corporation will not take any responsibility towards any damage/accident caused to workmen deployed by the contractor. Therefore, it is in the interest of contractor to ensure all safety precautions before commencement of the work.

Maintenance activities and frequencies for SCADA systems and their components remain to be carried out without fail. Preventive maintenance schedules for SCADA components and subsystems should be coordinated with those for the systems they serve to minimize overall scheduled down time.

Activity	Frequency
Pneumatic systems/Components/Instruments	
Calibrate Level Transmitters	Yearly
Calibrate Flow Transmitters	Yearly
Calibrate Pressure Transmitters	Yearly
Calibrate LOH/ROF transmitters	Yearly
Electronic System	
Lamp Test/Verify Indicators	3 months
Inspect Enclosures for Dirt, Water, Heat	3 Monthly
Run PLC Diagnostics	3 Months
PLC Communication Modules	3 Monthly
PLC Batteries	Yearly
Test Automatic control Sequences	3 months
Software Maintenance and patching	3 Months
Inspect Wire, Cable and Connections	3 Monthly

Communication Network	3 Monthly
Dead Bus Relays	3 Months
UPS setting with SCADA	3 Monthly
Historian Package(capacity)	3 Months
Data Archiving	3 Monthly

Many components of SCADA systems, such as dead-bus relays, are not required to function under normal system operating modes. For this reason the system should be tested periodically under actual or simulated contingency conditions. These tests should approach as closely as possible the actual off- normal conditions in which the system must operate.

Periodic system testing procedures can duplicate or be derived from the functional performance testing procedures.

The SCADA software, PLC programming software maintenance should include timely updates of any new versions from the supplier and testing to verify proper installation on the SCADA computer. In addition, software antivirus updates should be maintained. This should be performed any time after the computer is connected to the Internet or the antivirus patch should be downloaded as and when the updates are available. Normal operation requires that the SCADA computer not be connected to the Internet.

Scope of work of System Integrator (To be appointed by O&M agency through MoU):-

- Routine services: Quarterly visits for cleaning, routine checking & testing entire system software & hardware.
- Breakdown/shutdown services/ other than routine services: contractor shall have to identify & rectify faults in entire project hardware and software including reloads any software if required and application program, if required.
- Telephonic/personal technical support at any time. Engineer will have to provide existing system software backups on compact disk during each quarterly visit. Also you will have to keep one set of back up at your works for emergency use if required.
- Contractor shall have to carry out all the repairing/ replacement of defective hardware/software on top priority. However the decision for replacement shall always be taken with SMC's consultation.

- Replacement of defective hardware to reduce WDS/WSS down time on a replacement basis.
 - Contractor shall have to carry out any *minor* changes in existing application *software/logic* to accommodate any process requirement with no extra costs during the contracted period. However such requirements shall be communicated to contractor in advance.
 - The maintenance work includes each and everything mentioned or not mentioned herein but required for running the system in healthy condition shall be included in maintenance scope.
- 3.1 In order that SCADA system remains all the time in healthy condition, all essential components related to SCADA system like, Level , Flow , Pressure, Actuator etc., communication line, software etc. requires to be maintained by contractor.
- 3.2 Deployed Instrumentation Technician by Contractor should have knowledge of maintaining SCADA system. Necessary training records towards such knowledge remains to be submitted by contractor. In absence of this, it is desirable to have association with SCADA implementing agency for three years for smooth operation and maintenance of SCADA system.
- 3.3 REPLACEMENT OF AN ITEM: If due to poor Operation & Maintenance or so, any item is causing frequent troubles and demanding frequent repairs, same item will be needed to be replaced instead of repairing.
4. **INVENTORY OF SPARES, CONSUMABLES:-** All necessary consumables like Oil, Grease, Gland Packing, Cotton Waste, Rust removing spray, PU Pipe, PU Connectors, Limit Switch, oil Seal, seal kit, O rings, Coupling rubber bush, Indicating lamp, Nut-Bolts, Lighting Materials, fuse & switches, Maintenance of Entire Electrical Lighting system with materials / consumables like wire, switch board, lighting – fittings, fixtures, HPSV / Mercury lamps / tubes / CFLs, pole(s), HOT/EOT cranes with materials etc. of Electrical / Mechanical machineries/ Equipments shall be in the scope of Contractor. Hence, proper inventory management with consumption records remains to be generated time to time.

Sr. No.	Description	Suggested Qty of Consumable to be kept in Inventory.
1.	Gland Packing	15 Kg.
2.	Lubricating Oil	10 Liter
3.	Rubber packing	15 Kg.
4.	Bearing Grease	10 Kg.
5.	Rubber Bush set with Bolt	Set for 1 pump of each category
6	Tubes as actually deployed on site	15
7	Tube light with fittings	20 sets
8	Petrol for cleaning	5 liters

5. All the materials / spares, which are required for maintenance shall be supplied by Contractor without any cost to SMC
6. **Tools and Tackles:-** All Tools and Tackles like megger, spanner sets, screw driver sets, grease gun, multi-meter, hammer, earth rod, vibration analyzer, noise measuring meter, etc. requires for routine, breakdown and preventive maintenance remains to be arranged and deployed by contractor.
7. **Maintenance of Buildings & site:-** The contractor shall be responsible for:
 - 7.1 The maintenance of electrical, ventilation, plumbing & drainage installation.
 - 7.2 General building maintenance & housekeeping.
 - 7.3 Full maintenance of the site services, cabling, and earthing system.
 - 7.4 The building services and housekeeping maintenance shall be undertaken on all building and services installation.
 - 7.5 In order that WDS/ESR/Control Rooms/Instrument Locations are maintained neat and clean inside and outside, the contractor shall ensure that all unwanted or redundant items are removing from the building and site. Depending on their condition such items shall either be placed into **storage or disposed off site** as per instruction of Engineer-in-charge.
8. **PAINTING:-** This work is inclusive of painting of Elect. & Mech. machinery like Motor Pump Sets, NRV, Butter Fly valves, Sluice Valves, Bellows, pipe line, MCC Panel, MCC & LT Panel, Starter panel, Light Pole within WDS premises, Chequered Plate, HOT / EOT cranes with accessories (girder, I Beam) etc. Painting works shall have to be carried out in professional manner once in 60 months of contract period. Schedule for painting, will be decided by SMC. Painting shall be carried out with two coats of Red Oxide and Two Coats of Synthetic Enamel Paint. MS Grit on Clarifier Inlet Chambers, Agitator & Flash Mixers with Girders and angles to be painted with two coats of Red Oxide and Two coats of Epoxy Paint. At any point of time, if this painting works is found not satisfactorily done on above machineries, the Contractor remains to repaint the same under the instruction of Executive Engineer – HWW

Monthly bill Payment for Contractor during O & M:-

Contractor is required to enclose bank certification of salary payment to his employee with the monthly bill. Contractor is instructed to make arrangement of salary/ payment (as per minimum wages Act-1948 & Rules) through bank account only, and copy of the bank payment transaction must be submitted with certificate of bank at the time of summation of monthly bill.

If Payment/salary of any employee of contractor is not deposited in bank account of any of employee, the amount of salary/ payment of said employee will not be paid to contractor in monthly bill till the bank certificate is not submitted.

TABLE NO. 1
MINIMUM MAN POWER REQUIRED

Sr. No.	Designation	Qualification	Experience	Component wise Manpower to be deployed						
				Form and Billing	WDS-1	WDS-2	WDS-3	Existing ESR SE-11, E-9A and E-10	Rising Main WDS to ESR and Distribution Network	Water Meter Connection
				Staff Required						
1	Project Manager	Minimum Graduate (B.E. Civil / Electrical / Mechanical)	Minimum five years experience for similar field	01						
2	Assistant Engineer	B.E. Electrical	Minimum two years experience for similar field	--	01			--	--	
3	Instrumentation Engineer	B.E. (Instrumentation)	Minimum two years experience for similar field	--	01			--	--	
4	SCADA Monitoring Engineer	B.E.	Minimum two years experience for similar field	--	05			--	--	
5	Instrumentation Technician Engineer		Minimum two years experience for similar field	--	05			--	--	
6	Diploma Engineer	Diploma in Mechanical / Electrical Engineer	Minimum two years experience for similar field	--	01 (Mechanical) + 01 (Electrical) = 02		--	--	--	
7	Diploma Engineer	Diploma in Civil Engineer	Minimum two years experience for similar field	04	01		02	--	--	
8	Mechanic of Water Meter	ITI Mechanical	Minimum one year experience for similar field	--	--	--	--	--	01	

Sr. No.	Designation	Qualification	Experience	Component wise Manpower to be deployed						
				Form and Billing	WDS-1	WDS-2	WDS-3	Existing ESR SE-11, E-9A and E-10	Rising Main WDS to ESR and Distribution Network	Water Meter Connection
				Staff Required						
9	Meter Reader	Minimum HSC pass	Minimum one year experience for similar field	08	--	--	--	--	--	--
10	Computer Operator cum Clerk	Minimum BCA	Minimum one year experience for similar field	03	--	--	--	--	--	--
11	Fitter	ITI in Fitter Trade	Minimum one year experience in Water Distribution System	--	--	--	--	--	04	05
12	Helper	Should be physically healthy & able to read & write (only male)	Minimum one year experience in Water Distribution System	--	06	06	06	08	--	02
13	Security Guard	Should be physically healthy & able to read & write (only male)	Minimum one year experience as Security Guard	--	06	06	03	09	--	--
14	Electrician	ITI (Electrician / Wireman) having Liscence of Govt. of Gujarat.	Minimum one year exp. for O&M of Govt. of Gujarat.	--	03	03	03	--	--	--
15	Fitter	ITI in fitter Field	Minimum one year exp. for O&M in Similar Field	--	02			--	--	--
16	Chemist	B.Sc with Chemistry	Two years exp. in similar field	--	02			--	--	--
17	Helper for Sampling	S.S.C.	Two years exp. in similar field	--	01	01	01	01		

Payment Conditions

Payment of Part-A

For initial twelve months (0 year of O&M Schedule) will be paid to the contractor based on the components handed over for Operation and Maintenance of the area of existing 24 x 7 Water Supply System (TP-19, TP-53(P) and TP-64(P)).

Manpower for each component shall be as per the Table No. 1 and Table No. 2 mentioned above.

The Quantity mentioned in Schedule is the total quantity of water supplied at the consumer end.

The payment shall be made on the basis of water supplied as per Item No. (1) of Operation and Maintenance phase. The payment shall be made every month.

Mode of Payment :

The payment shall be made on basis of water supplied as per Item No. 1 of Operation and Maintenance Phase.

Item No. 2 : The work of O&M will consist of operation and maintenance of water meter connection. The firms have to repair or replace pipes / specials, valves, water meter, breakages of pipes, repairs of road and valve chambers including day to day maintenanc as well as periodical preventive maintenanc of the assembly of water meter connection as required.

2.3 Scope for Maintenance Work:

- 2.3.1 On receipt of the complaint, the representative of the bidder should go to the site, of the work with all spares, necessary tools and tackles, tested meter and remove the defective water meter and replace the same with tested working water meter. Any works like replacement of MDPE pipes / Specials, cutting gland and breaking of the concrete, etc., shall be carried by the contractor at his cost.
- 2.3.2 The removed water meters shall be preferably inspected at site and all minor repairs/replacement of parts, strainer, etc. which shall not affect the performance of water meter will be done at the site itself in case the totalizer is found damaged, the same shall be take for repair as shown below:-
- 2.3.3 The defective water meters should be removed and new tested water meter should be installed immediately after receipt of intimation from the S.M.C.
- 2.3.4 Complaints regarding abnormal/subnormal readings will also be treated as defective meteINR The bidder has to arrange for the replacement of such water meters with duly tested meters which is supplied by SMC.
- 2.3.5 If the factory seal of the company/S.M.C. seal is found tampered with water meter, then the signature of the departmental personal and the consumer should be obtained on the complained sheet and cost of such repairs will be charged to the consumer and paid to the bidder directly by the consumer.
- 2.3.6 Minimum team for maintenance : One mobile unit (four wheeler) equipped with minimum 10 Nos. tested meters and spares for meters, seals, tools, fitter, valves, strep saddles, MDPE pipe, ferrule and necessary manpower shall be available at the office of Contractor at Surat (No reimbursable). The absence will be liable to penalize INR 5,000/- per day.
- 2.3.7 The item also includes all necessary material, tools- tackles, along with skilled/ unskilled labour, supervisor etc complete for the maintenance of installed Water meteINR

- 2.3.8 The item also includes the periodic preventive maintenance, if required of the installed connection with water meters to avoid any defect during its working and for the better performance of the connections.
- 2.4 This item also includes:
- 2.4.1 Cost of all labour required for excavation for this job work in all strata including dewatering (also dewatering by Pump if necessary).
- 2.4.2 Testing and Commissioning of Volumetric Domestic/Bulk water meter.
- 2.4.3 This item also include labour cost for lowering, laying, carting of materials and refilling the trenches for this work. The prior permission required from S.M.C. for replacement, shall be the responsibility of the Contractor.
- 2.5 Terms of Payment:

The payment shall be made on monthly basis of all in all maintained meters in good condition in all respect.

Item No. 3 : Taking reading bimonthly from all the water meter connections preparation, printing and distribution of bills to all consumers in different administrative zones of Surat city. The item also includes AMR meter reading software, Handle Unit with latest version of computer for software programme, Data entry and same shall be transferred to SMC system.

Note:- SMC supplied (Elster / Itron / Baylan / Zenner / Arad / or equivalent) Automatic Meter Reading (AMR) mechanical water meter for which reading, billing to be done by contractor so he has to obtain compatible software as well as Hand Held Unit (HHU) which must be approved by SMC.

- 1.1 This includes taking the bi-monthly reading of groups of consumer meters installed in this contract. Contractor will have to submit the program of meter reading and details of method proposed to be used. The details shall be exhaustive and distinctive, elaborating about the instrument/gadgets and all other paraphernalia and methodology adopted, which shall be compatible for any type, size and make of meter.
- 1.2 Meter Reading:**
- (a) The contractor will have to take the bi-monthly reading of the consumer meter installed in this contract.
- (b) Contractor will have to submit the details of the method adopted. The details shall be exhaustive and distinctive, elaborating the instruments/gadgets and other paraphernalia.
- (c) The methodology adopted shall be compatible for any type size and make of meter.
- (d) The date of first reading shall be followed in taking reading of consecutive months.

1.2.1 Meter Reading (AMR)

- a) The successful bidder shall submit a detailed scheme for obtaining and recording remote reading of the AMR water meters to be installed.
- b) The scheme of remote reading shall be formulated by forecasting the required nos of hand held units (HHU) & easy route host, etc, to collect & upload data for the respective region.
- c) The meter reading (AMR) scheme shall be formulated keeping, in the view the AMR water meter readings to be obtained by RF based AMR technology, which shall be appropriate for the make & size of the water meters & its software and the output. Format

shall be compatible with the system of SMC. The bidder will be responsible to integrate their system with existing system of SMC for printing of bills.

- d) The SMC reserves the right to accept or reject any/ all such AMR water meter reading schemes.
- e) It will be mandatory for the successful bidder to provide the demonstration of his remote AMR water meter reading and the bill preparation scheme to the SMC staff and appointed officers as & when required during the contract period .
- f) The system of AMR and HHU shall be maintained in proper working condition for the water meters during the Post installation period for 10 (ten) year INR
- g) The agency will be responsible for taking reading of AMR water meters in bimonthly billing cycle I/c uploading the reading data in SMC billing unit and integration with existing system of SMC for generation/ printing of consumer bills by SMC during the contract period i.e installation and 10 yrs maintenance period thereafter. Distribution of bills will also in scope of agency.
- h) The reading of MAR meter for generation of the bills shall be commence with 2 months from the date of installation of each meteINR
- i) The reading shall be done progressively as the installation work progresses.
- j) In case of all AMR meters eligible for the reading, are not read during the billing cycle then no deduction from due payment will be made so far the number of unread meter do not exceed 0.5% of the readable meteINR
- k) A deduction of INR 10 (Ten rupees only) for reading in each billing cycle shall be made for number of reading not collected / taken exceeding 0.5% of the readable meteINR

1.3 Preparation and printing of bills:

- (a) Billing system shall be computerized based on Oracle and Developer or latest version of application software wherein the consumer data shall be stored and the bill shall be processed and printed in the pre-printed stationary.
- (b) Contractor will have to develop suitable software based on the existing water rate which can be tailored in case of revision in water rate byelaws. The software shall be compatible to the existing billing software of S.M.C. with regards to down loading and uploading of consumer data.
- (c) Contactor will have to demonstrate the billing software by printing the sample bills for all categories of consumers with different status of consumption before actually starting the billing.
- (d) The contractor will have to take approval of pre-printed billing format of Hydraulic Engineer.
- (e) The contractor will have to provide necessary hardware like server suitable to store and process the consumer data, computers for entering the data, suitable printer, stationary & consumables for printing bills at his own cost.
- (f) Contactor will have to maintain this billing system along with the hardware and consumables during the contract period.
- (g) The contractor will have to record the status/condition of meter and status on which the bill is issued at the time of billing.
- (h) The total work of billing specially with regard to input and output data through software will have to be compatible with present software of S.M.C. The data structure specification of S.M.C. will be provided to the Contractor for uploading and downloading of data. Copy of the bill format shall be finalized with Hydraulic Engineer after awarding of Contract.
- (i) S.M.C. will up-load the data from its system in respect of consumers who will be issued bills and will also get the data downloaded from billing machine to its

computer system, in respective zones and its centralized computer center at water works department. The hardware and software have to be compatible with the existing computer system.

- (j) The contractor shall have to submit the reports regularly as per the requirement of field offices.

Special conditions for billing

- Feature of the Billing Machine:
- The billing machines should not be editable in nature i.e. no data should be edited once it is entered into bill machine. The said provisions should be automatically invoked on issue of bill i.e. immediately after the print out of bill is taken from machine.
- The format of bill should be as specified by S.M.C.
- Complete security of S.M.C. data should be maintained by Contractor and updated data of S.M.C. should be downloaded on machine of S.M.C. only (respective Zonal office, etc.) The data security as well as data encryption should be provided in both the softwares. This will ensure, that no data is tampered by the unauthorised persons. For this, necessary algorithms such as check sum fields should be provided in the data download and upload software.
- Necessary reports as required by S.M.C. will have to be generated by the said Contractor whenever required as per Field requirement and as per Annexure enclosed.
- The basic software of billing machine (SBM) will be required to be developed centrally (field programmability of basic software not permitted). The said software will be required to be approved by the consultant and or expertise engaged by S.M.C.
- During the contract period, the contractor will have to make necessary changes in the software due to changes in act, rule and water rate Bye-Laws on account of Govt. directive or S.M.C. decision.
- Before actual start of work, contractor will have to first prepare the software compatible to the existing software program of SMC. The actual work of billing shall commence only after trial of billing is given by the contractor to the satisfaction of the consultant and / or expertise engaged by S.M.C. from the commencement implementation of order.

1.4 Distribution:-

This includes distribution of bills to the respective consumeINR

- (a) Bill shall be distributed within two days after printing of bills.
- (b) Receipt of bill shall be obtained from the consumer.
- (c) In case of connections to Govt. premises, it may be required to distribute the bill into the Govt. offices situated at places other than the places where meters fixed.

1.5 General:

- (a) It is mandatory to provide demonstration of his meter reading and bill preparations scheme prior to its final acceptance.
- (b) Meter reading should be generally taken between time period 7.00 AM to 7.00 PM.
- (c) All the data after processing of bill shall be down loaded to SMC data base at respected Zones / ISD Department.
- (d) Two hard copies of demand generated after entering the meter consumption of consumers shall be submitted every month immediately after printing of bills and one copy shall be obtained from SMC to incorporate the corrections before generation of bills for the next month.

- (e) While recording the meter reading if the water meter is found damaged /tampered (seal broken) the same shall be reported immediately to the S.M.C. authorities of respected Zone. Such meter shall be replaced only after permission of S.M.C.
- (f) In case of improper/erratic/abnormal recording of the meter reading, the responsibility for variation in bills of consumer will vest with the contractor recording such false readings.
- (g) All manpower deployed by the Contractor should be suitably qualified and trained for the job intended to be performed by them.
- (h) The manpower should be conversant with Gujarati in addition to working knowledge of English, Hindi, so as to interact with consumeINR
- (i) The deputed manpower should be extremely polite with consumers and should be able to address consumer grievances about bills issued.
- (j) It will be mandatory for employees of Contractor to display the Identity Card issued by S.M.C to the employees of the Contractor. The expenditure of which shall be borne by the Contractor.
- (k) Sufficient number of coordinators will have to be employed by Contractor to ensure smooth working with different S.M.C. offices.
- (l) The contractor shall appoint coordinating officer/supervisor for keeping liaison with S.M.C. for said meter reading work.
- (m) The staff should use the photo identity card issued by bidder and counter signed by the S.M.C. authorities, while on duty.
- (n) In case of complaint of any consumer, the meter reader should take written complaint and hand it over the S.M.C., through coordinating officer. The contractor shall immediately inform to S.M.C. Engineer about any illegal water connections that come to the notice of his staff.
- (m) S.M.C. will carry out independent checks as and when required

HAND HELD DEVICE (HAND HELD UNIT)

- 1) Hand Held Unit or Reading device shall have the sufficient memory (minimum 4000 reading data)for storage of Maximum data/ reading along with sufficient power back up.
- 2) Hand Held Unit device shall have capacity to store 4000 nos. water meter reading at a time.
- 3) Hand Held Unit Should be adjustable back light, sunlight readable, colour and touch screen.
- 4) Hand Held Unit must be designed to be comfortable for hand held meter reading.
- 5) The Battery of Hand Held Unit or Reading device shall give power back up for at least 5 hours continuously.
- 6) The unit must have able to withstand three foot drop on concrete.
- 7) The read out device should be connected to the Hand Held Device and needs to be USB powered.
- 8) There must be audible beep when indicating key has been pressed, there must also be an auto repeat function on keys and rapid response between keying and seeing results on the screen.
- 9) Hand Held Unit should have the facility to create route, modify route on site and arrange in desired sequence as per site condition.
- 10) The HHU shall have the onsite search facility, to locate the exact physical location of water meter in particular area and to obtain the corresponding details of it.
- 11) The handheld must come with an integrated intelligent fast charge capability that allows full charge within 5 houINR

- 12) The hand-held must have a 3G/GPRS connectivity for real-time data communication with central server and integrated Global Positioning System (GPS) for route monitoring and configuration.
- 13) Remote reading of individual water meter, maximum distance of 200 meters with clear line of sight under submergence condition with lid of chamber enclose position, with Walk by and Drive by during field demo as well as after installation main work.

SOFTWARE

SMC supplied (Elster / Itron / Baylan / Zenner / Arad / or equivalent) Automatic Meter Reading (AMR) mechanical water meter for which reading, billing to be done by contractor so he has to obtain compatible software as well as Hand Held Unit (HHU) which must be approved by SMC.

- 1) Operating System:- Windows 7 or latest version of windows operating system.
- 2) The software shall give output, at least in XML/CSV/XLS format and the data should be in standard format compatible to the Surat Municipal Corporation billing system, Surat.
- 3) The software shall allow the PC operator to review and edit any account in Route Manager database. Also, the PC operator shall be able to generate route and activity reports. The 90 days historical data should be available in the route as well as the data along with historical data in the output in the XML/CSV/XLS format.
- 4) The software shall allow the PC operator to review and edit any account in Route Manager database. Also, The PC operator shall be able to generate route and activity reports.
- 5) The software shall upload routes from the reading device.
- 6) Password Protected, individually defined authorization level for each user.
- 7) The software shall enable the user to specify the data to be exported from the database from transferring to billing system.
- 8) Automatic data exchange between PC and hand held unit.(Consumer data, readout routes, read out data & manipulation user access data)
- 9) The software shall select the routes to be read, and assignment of routes to reading device and dynamic updating of routes and sub-routes to be enabled.
- 10) Software shall give outputs in format which can compatible to SMC billing System.
- 11) Software shall alert the meter reader for unread account in that route.
- 12) Software shall takes routes from an existing data base for loading in to reading device.
- 13) Data should be available in hand held unit and Base computer software both.
- 14) Software shall be able to set meter status on fly like, meter not okay, reading not reliable, meter maintenance required etc.
- 15) Software should have a radio configuration tool which can enable/ disable meter, set/read meter status.

1.6 Mode of Measurement and payment:

The measurement shall be per consumer basis to be paid after completion of activity for the consumers in the entire group. 100% payment will be made after completion of total activity.

PENALTY CLAUSE

PENALTY CLAUSE (PENALTY SCHEDULE) FOR O & M WORKS

During the O&M period penalty will be charged as per below :-

Penalty will be charged as per below:-

1.1 For absence of staff, following shall be levied

Sr.	Category	Penalty Amount
1	Project-in-charge	1500
2.	Electrical supervisor	600
3.	Chemist / Electrician / Inst. Technician / Fitter	550
4.	Helper	500

1.2 If average P.F. (Power Factor) of the monthly energy bill remains as bellow penalty, in addition to penalty loaded by DGVCL or Torrent Power Ltd. will be charged extra as bellow.

0.98 to 0.96	INR2000 per day
Less than 0.96 up to 0.90	INR3000 per day
Less than 0.90	INR3000 per day + penalty levied by DGVCL or TORRENT POWER LTD.

1.3 Power supply failure due to poor maintenance / any other reason in electrical yard / switch gear / LT panel , capacitor shall be highly objected & shall be rectified and restore within one hour by contractor. Otherwise penalty shall be levied @ INR 200/ Hr. till restoration of power supply.

1.4 If any Electrical/Mechanical machinery (Other than pumpsets) in working condition but their sub parts are damaged or in non-working condition than penalty per machinery will be applied as bellow

INR100/-per day	From the 16th days to 25 days.
INR200/-per day	After 25 Days penalty will be applied for whole the period of not working of machinery.

1.5 If any pump set remains out of order for more than 12 days penalty per pump set for the same will be applied as bellow

INR150/- per day	from the 12th day to 15 th day
INR800/- per day	from the 16th day to 25th day
INR1500/- per day	After 25 Days penalty will be applied for whole the period of not working of machinery.

1.6 For SCADA / automation system, any instruments / equipment shall not remain in non-working condition for the want of spares for more than 15 days from date of intimation. Otherwise, penalty @ INR500 per day per instrument equipment shall be levied. If any instrument / equipment remains out of order for more than 25 days, penalty @ INR500 per day per instrument / equipment since the date of out of order. Major instrument / equipment which is not in scope and if it remains out of order, engineer-in-charge / Instrumentation Engineer must be informed.

1.7 If contractor seems failed to do daily maintenance, housekeeping or periodic / routine works, the penalty levied will be INR500/- per day/work.

1.8 If painting is not done on order, actual cost of painting as decided by engineer in charge will be recovered from bills. Further, if Painting work is not completed within FOUR(4) month in all respect from the date of written intimation, penalty of INR800/- per day (max. up to 10%) of total order value will be recovered from payments.

1.9 Above all penalty will be deducted from relevant Running bill /security deposit

1.10 For circumstances out of control of contractor, Head of the Department is authorized to decide waiver of full/part of the above penalties listed above in clause 1.3 to 1.5.

1.11 If under ground water tank (UGSR) will be overflowed by any reason of negligence, Then penalty shall be levied at INR3000.00 per incidence.

1.12 INR100/-per day per person will be penalised in case of person on duty found not wearing the uniform.

1.13 In any case, total penalty exceeding 10% of monthly bill then maximum 10% of monthly charges will be consider as a penalty (excluding the charges towards damages and penalty towards absenteeism of manpower). If such a situation is continue for three consecutive months, SMC may terminate the contract without any prior notice

(4) Penalty for non attendance leakage in network.

If there is any type of leakage which is informed by SMC staff to authorized person of contractor, it will be repaired within 24 hours other wise penalty will be charged as below.

- 24 to 48 hours INR 2,000/-
- 48 to 72 hours INR 3,000/-
- More than 72 hours INR 5,000/- for each day

(5) Penalty for non-attendance of contamination in the network.

If there is any type of Contamination of water is found which is informed by SMC staff to authorized person of contractor, it will be solved within 48 hours other wise penalty will be charged as below.

- After 48 hours and up to 5 (Five) days, per day INR 1,000/-
- Then after For 5 (five) days and upto 10 days per day INR 2,000/-
- Then after For each day INR 3,000/-

(6) Penalty for delay in provision of water connection.

Water connection should be completed in all respect within 7 (seven) days after approval given from SMC. other wise penalty will be charged as below.

- (i) After 7 (seven) days, INR 1,000/- per day.
- (ii) If connection is not as per specification of the tender, penalty of INR 5,000/- for each connection.

(7) Penalty for delay in replace/repairs of faulty meter.

- (i) All the faulty meters shall be repaired within 48 hours from the time of intimation. On failing of attend the complaint within 48 hours penalty of INR 250/- per day shall be levied from the Running Account Bill.
- (ii) The faulty meter shall be repaired in such a manner that there will be no complain of the same at least for 3 (three) months. If within three month the same meter will become faulty the same shall be repaired at free of cost by the contractor.

(8) Penalty for delay of non-issue of bi-monthly bill to consumer.

At every even number of month, within the first week of the months contractor has to complete measurement reading, printing, sanction from approved authority, keeping all the bills ready to deliver to the consumer. In the second week of said month contractor should complete the delivery of all bills of water meter to the consumer. The proof of dispatch of bill / receipt note shall be submitted within third week of the same month to the Engineer- in-Charge.

If contractor fails to complete any activities mention above he will penalized INR 100/- per non-billing of each meter, for not issuing a bill bi-monthly.

Penalty for Not Submitting Demand / Recovery Statement / faulty meter detail / Temper Meter Detail, etc. within 10 days from the date of bill issue of billing cycle. Contractor will penalized INR 500 for each report.

Reading, billing complaint must be solved within 72 hrs from the receipt of complaint otherwise contractor will penalized INR 250 per complaint.

(9) Penalty for water losses.

- (a) The water losses upto 11% will be allowed without any penalty or bonus.
- (b) For the losses in water quantity more than 11% but up to 13%, one and half times penalty of production cost
 - Losses more than 13% to 15% - two times of production cost
 - Losses more than 15% to 20% - three times of production cost,
 - Losses above 20% - five times of production cost will be levied by Surat Municipal Corporation.
 - Production cost will be INR 3/- per 1000 liter will be consider

(10) Penalty for inadequate pressure.

8 m pressure at consumer end will be allowed without any penalty or bonus. Pressure less than 8 m penalty of INR 5000/- per incident.

6.20.12 APPROVED LIST OF VENDORS

Cement : Ambuja, Ultra tech, conforming to IS: 12269 of 53 grade (OPC only)

Steel : Reinforcement Steel: TMT Fe 415/ Fe500
TATA, SAIL, RINL (VIZAG),
Electrotherm (I) Ltd. &JSW Steel Ltd. (Conditional).

Butterfly valve: Indian Valve Co., Nasik
Kirlosker Brothers Ltd., Mumbai
Fouress Engineering (I) Ltd., Bangalore

Air Valve : IVC, Fouress, Kirloskar

Sluice Valve :

<u>Sr.No.</u>	<u>Name of Manufacturer</u>	<u>Brand Name/Make</u>
1	KIRLOSKAR BROTHERS LTD., MUMBAI	KIRLOSKAR
2	INDIAN VALVE CO., NASIK	IVC
3	FOURESS ENGINEERING (I) LTD., BANGLORE	FOURESS

Water stopper : Sinecos Profiles Pvt. Ltd. or equivalent., Arti

D.I. Pipe : Jindal, LANCO.

GI Pipe : Tata, Asian, Jindal

Note: Above Equipments / items / Products are indicative. The Product / Make shall have to pre-approve from the Engineer-in-charge prior to Execution / Procurement. The decision of the Engineer-in-charge shall be final and binding to the contractor.