RAJKOT MUNICIPAL CORPORATION

RAJKOT

Augmentation Work With SITC Of Electrical, Mechanical Works With 2 Years Comprehensive Operation & Maintenance work for Existing WDS at Vinodnagar Pumping Station of RMC-Rajkot.(RE-TENDER)

Tender No: RMC/WATER O&M CELL/Aji Vinodnagar/01

VOLUME – II

YEAR 2024-25

Milestone dates for e-tendering is as under		
1.	Downloading of e-Tender documents	25-11-2024 to 09-12-2024 up to 18:00 hrs
2.	Pre-bid meeting Date:- 02-12-2024 at East Zone Office Room no.12 First Floor RMC at 04:00 PM.	Bidders shall have to post their queries if any on e-mail dytrivedi@rmc.gov.in before date 02-12-2024.
3.	Online submission of e–Tender (Tech. bid)	09-12-2024 up to 18:00 hrs
4.	Physical submission of EMD , e-Tender fee and all other documents should be submitted online.	16-12-2024 up to 18:00 hrs
5.	Verification of submitted documents (EMD, e - Tender fee, etc. and Opening of online tender (Tech.bid)	18-12-2024 (If possible)
6.	Opening of Price Bid (if possible)	20-12-2024 (If possible)
7.	Bid Validity	120 days.

Add.City Engineer
Water Mangenment Unit
Rajkot Municipal Corporation
Zaverchand Meghani Bhavan
East Zone Office – Room No -12
Bhavnagar Road – Rajkot
E mail : dytrivedi@rmc.gov.in

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SCOPE OF WORKS

Augmentation Work With SITC Of Electrical, Mechanical Works With 2 Years Comprehensive O&M For Existing WDS At VINODNAGAR Pumping Station of RMC at Rajkot. and there after 2 years Comprehensive Maintenance shall include Supply, Erection/Installation at site, Testing and Commissioning of various Equipment of Mechanical / piping, Electrical & Instrumentation works as specified here below and in BOQ and shall be complete in all respects as per Tender specifications at existing Pump house. The bidder shall note that the scope shall also include any other work or item / material as required to complete the work in all respects for the supply and for satisfactory installation, testing and commissioning & satisfactory operation of specified equipment / pumping station.

Scope shall include Inspection of equipment's as applicable as per tender specification at manufacturer's works by Third Party Inspection (TPI) agency/PMC and RMC representative. Expenses incurred towards the inspection like commercial fees, To & Fro charges, lodging & boarding, etc., delivery of equipment at site or store as instructed by Engineer In - Charge, unloading & storage at site, etc. shall be borne by contractor.

Scope of work shall include submission of Technical Datasheet duly filled-in for major equipment's in the format given in Tender Technical Specification at the time of Drawing/ Document approval.

A. The scope of Mechanical work shall include but not limited to the following:

SITC of 6 no. Horizontal Split Case Centrifugal Pumps having capacity 900 m3/hr and 35.0 m head coupled with existing electric drive/motor (Class 'H' insulation, duty type, IE3 for standard application) and all required accessories like drain rim type MSEP Base plate, Flex. Coupling, gland drain piping/arrangement, coupling guard, coupling, foundation bolts & nuts, etc. along with all required accessories as per specification and tender BOQ.

SITC of CI DF manually operated Sluice valve on Header drain pipe with all required accessories and hardware as per specification and tender BOQ.

SITC of CI DF manually gear operated Sluice valve on Suction of each HSCF Pump with all required accessories and hardware as per specification and tender BOQ.

SITC of CI DF Ele. Actuator gear operated Sluice valve on delivery of each HSCF Pump with all required accessories and hardware as per specification and tender BOQ.

SITC of CI DF Dual Plate Check Valve on delivery of each HSCF pump along with all required accessories and hardware as per specification and tender BOQ.

SITC of CI DF Pipes and Fittings on suction & delivery of pumps, 06 Nos. suction puddle with required fittings as per specification and tender BOQ & Drawings.

SITC of S.S. Metallic Expansion Bellows on Suction of each HSCF Pump, on Delivery of

each HSCF pump, at new Header, along with all required accessories, hardware and as per specification and tender BOQ.

The Supply, Installation& Welding of MS pipes and Fittings as required for header, on delivery of each HSCF pump, for header lines, any other to complete the work in all respects as per specification and tender BOQ & Drawings.

Supply, Installation &Weldingof MS Flanges as required& any other to complete the work in all respects as per specification and tender BOQ & Drawings.

The Supply & Installation of GI pipe and Fittings for delivery of dewatering pumps (dry well) and as per specification and tender BOQ & Drawings.

Structural steel for Electrical & Mechanical equipment's support on floor / wall / beam / brackets etc. as per specification and tender BOQ.

SITC of Monorail Electric Chain Hoist with Electrically Operated Trolley of 2 T capacity for handling HSCF Pumps with all required accessories and hardware as per specification and tender BOQ.

SITC of Dewatering submersible non-clog pumps (at dry well) having capacity & head as per BOQ coupled with electric drive (motors) and along with all related accessories as per specification and tender BOQ.

Dismantling & removal / shifting of existing mechanical equipment's installed in dry well of pump house like 6 nos. pump sets and it's associated all electrical cables, valves, expansion bellows, suction, delivery & header pipes & specials etc. as well as drain pump sets, etc. as required from its place carefully without damaging them and stacking them within the pumping station area as directed by Engg. In. of Charge of RMC complete in all respects and to permit the installation of new pump sets, other electro- mech. equipment including instrument items and other associated items of this tender scope / BOQ.

Dismantling of all existing Pump set foundation in dry well / pump house, support structure of pipe, valves and other equipment's as existing at site for dry well as well as on top of wet well slab or at other units of pumping station as applicable including breaking, removing & carting of debris and various material for carrying out necessary electro-mechanical upgradation / refurbishment work and for constructing new foundations/supports complete in all respect and as required for installation and satisfactory operation of all electro-mech. equipment and instrument items as per the tender scope / BOQ.

Constructing/casting New RCC Foundation block work for New HSCF Pump-Motor Set (6 Nos.) as per manufacturer's recommendation and approved drawings including all material (cement, sand, grit, kapachi, water, steel bars, etc.) and required scaffolding materials, curing, finishing, plastering, epoxy painting complete in all respect.

All miscellaneous Civil Work including modification, providing cut-outs, core cutting, minor repairing/finishing works etc. providing RCC support of valves, pipes & fittings, grouting work, Required civil works including modification, finishing work for existing pump house flooring, etc. in pump house and any other unforeseen / emergency work during dismantling of existing pump & during installation in existing running wet well / pump house etc. and all other as required to complete the work in all respects and as required for installation and satisfactory operation of all electro-mech. equipment and instrument items as per the tender scope / BOQ.

All under water (wetted) hardware shall be in SS-304 (Nuts, bolts, etc.) and non-wetted hardware shall be G.I.

B. Scope for Electrical work shall include but not limited to the following:

SITC of 11kV HT Cables along with required termination kits and cable trench etc. as per BOQ / tender.

SITC of PMCC/Main LT Panel including Soft Starters, Transformer no load losses fixed capacitors for Power factor correction, spare feeders etc. along with complete all Required accessories and hardware etc. as per BOQ / tender specification / SLD. Panel dimension/GA shall be as per site condition

SITC stand alone panel for existing soft starter along with complete all required accessories and hardware etc. as per BOQ / tender specification/SLD.

SITC of APFC Panel with 7%, 440V detuned reactor for power factor correction etc. along with complete all required accessories and hardware etc. as per SOQ, tender specification & SLD.

PDB, LDB for indoor and outdoor requirements, Power Sockets, Welding Receptacles, etc. as required, along with complete all required accessories and hardware etc. as per BOQ / tender.

SITC of LT Power and Control Cables with cable end termination and connection etc. along with complete all required accessories and hardware etc. as per SOQ & tender.

SITC of Cable Tray & Cabling System etc. along with complete all required accessories and hardware etc. as per SOQ & tender.

SITC of Maintenance free Earthing system etc. along with complete all required accessories and hardware etc. as per SOQ & tender.

SITC of Internal and External area LED lighting system etc. along with complete all required accessories and hardware etc. as per SOQ & tender.

Safety Equipment / Accessories as per statutory norms / requirements along with complete all required accessories and hardware etc. as per SOQ & tender.

Chequered plates with supports steel structure works as required for cable trenches in HT Room, LT rooms, Control rooms etc. rooms along with complete all required accessories and hardware etc. as per SOQ & tender.

Supports/Structural Steel works as required along with complete all required accessories

and hardware etc. as per SOQ & tender.

All miscellaneous work for installation of electrical equipment with making cut out in panel room/pump house wall/slab for erecting of cables entering / out going from room etc. with mini. 100/150mm (as required) GI pipes with fixing, grouting, sealing etc. work and unforeseen/emergency work during installation etc. complete work for all electrical equipment.

COMPREHENSIVE MAINTENANCE

The scope also includes comprehensive maintenance of all existing equipment and supplied under this tender including repairing, spares and maintenance of entire works under this tender along with administration & management charges including running office, cost of lubricants, consumables, spares, tools, statutory periodical approvals & testing of equipment's etc. as required in all respects and excluding supply of electric power, water for pumping/distribution, diesel for DG set supplied under this scope/tender during Maintenance period of 2 years. The scope also excludes day to day operation of pumping station.

ADDITIONAL SCOPE:

In addition to the above, following services are also included in the scope of the Contractor:

Alignment, Drilling, Core cutting and grouting/Concreting of equipment Drilling holes, zary work on walls/slabs for pipes and cables (if necessary), Clamping and supporting of all pipes, Cable tray, etc. Final painting of piping works, structural steel, etc. at site after installation.

Drawings, Operation and Instruction/maintenance manual so f each equipment-3 Set. Excavation, bedding and refilling as per requirement, Making good of the damage done to existing electro-mechanical installations & Civil work and Civil repairing work of the SPS pump house during execution of all Electro- Mechanical Work.

All structural steel/MS piping etc shall be provided with two coats of primer and epoxy paint each in black or other shade as in structed by engineer-in-charge.

Any other work as specified in various BOQ, tender specifications and other as required to complete the work in all respects and satisfactory operation of same. For installation of machinery, required dewatering in any manner shall be in the scope of contractor.

Obtaining Power from power supply co. (PSC) on behalf of client with preparation of all required documents/ procedure,required NOC from Electrical Inspector for power supply, NOC for the DG set from statutory body will be to contractors account. Only statutory charges @ actuals shall be paid/ reimbursed by RMC)**Note:** It is not the intent to specify herein completely all details pertaining to design, shop testing, installation,

field testing and commissioning. However, these shall conform in all respects to high standards of engineering design, workmanship, meeting the requirements of all applicable codes and standards including local statutory requirements. The scope shall include all the specified accessories as well as required accessories for satisfactory / safe operation of the system.

Bidders are requested to visit the site before bidding & himself get acquainted all the details related to this work very carefully, In this regard bidder has to submit the letter that they visited site & get all the details.

Signature of Contractor

A.A.E. (MECH.)	**A.E.(ELE.)**	**D.E.E. (MECH.)**	**A.C.E.**
(W.M.U. E/Z)	**(W.M.U. E/Z)**	**(W.M.U. E/Z)**	**(W.M.U.)**

SECTION:D1

TECHNICAL SPECIFICATIONS FOR MECHANICAL WORK

SECTION: D-1

INDEX: MECHANICAL

(A) SPECIFICATIONS FOR MECHANICAL WORKS (GENERAL)

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 are 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
ASTMA-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 which 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 cannot 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	**:**	**50 ° C**
Maximum Relative humidity	:	100 %

In damp situations and wherever exposed to the weather, precaution shall be taken against corrosion of metal work, cable armor 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 50 deg C in accordance with the appropriate regulations unless otherwise specified.
ii. All materials and equipment which are subject to certification by testing authority's etc shall be certified as being tested at 50 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 vapor 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.

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 strut or cross battens are preferably to be supported by cleats fixed to the case above and below to form ledges on 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.

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 color 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. Galvanized work which is to be stored in works or on site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining.

Small areas of the 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 with 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.

Galvanized 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 galvanized and of the non-slip type, not less than 10 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 galvanized 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 galvanized 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 less than 5 mm in thickness 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 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 of 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.

Spherical Graphite Cast Iron Pipe work and Fittings

All spherical 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 within 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 debarred.

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 equipment's 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.FG200.
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.

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. Doorsshall 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.

(B) DETAILED MECHANICAL SPECIFICATIONS

1.0 HORIZONTAL CENTRIFUGAL PUMPS (HSCF)

A. GENERAL

The Pump shall be Centrifugal, Horizontal shaft, Horizontal split case type designed and manufactured for pumping liquid like raw / potable water. Pump shall be directly coupled to motor through coupling, mounted on common base plate with foundation bolts and all other required accessories.

The pump shall be designed to operate satisfactorily without detrimental surges, vibration, noise or dynamic imbalance over the required Head-Capacity range. The head-capacity curve of the pump shall have continuously rising head characteristics with decreasing capacity over the whole performance range of pump. The shut off head of the pump shall be at least 120% of the total head.

The pump shall be selected in such a way so that operating point shall lie on best efficiency point (BEP) or within 15 % of BEP flow on either side meeting NPSH requirement. **Pump selected with duty point lying on right side of BEP beyond 15 % limit shall not be accepted.**

The pump shall be selected with intermediate diameter of Impeller. The rated impeller diameter shall be at least 10 mm smaller than the maximum Impeller dia. possible for the offered pump model. **The pump selected for rated performance below minimum Impeller diameter shall not be accepted.**

The manufacturer shall ensure while selecting pump that required Net Positive Suction Head (NPSHR) is less than available NPSH (NPSHA) to ensure pump's operation without cavitation's under the worst operating condition. The required NPSH at duty point and throughout the range shall be at least 1.0 m and 0.5 m, less than the available NPSH respectively at the lowest water level in the sump. However, the NHPSR of the offered pump shall not be more than 7.5m (meeting flooded suction conditions) or lower as per the design requirement / as per the conditions indicated in tender drawings.

Each pump must be capable of running satisfactorily in parallel with other sets in the system without throttling and by itself, without cavitation's or overload under all operating conditions within the system resistance indicated. All pump shall have identical performance.

The pump shall be designed to start with delivery valve fully open.

The unit shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to water returning through the pump at times when the power supply to the motor is interrupted and the discharge valve fails to close.

Pump's rotating assembly shall be statically and dynamically balanced as per ISO standards and shall run smooth without undue noise and vibration. The velocity of vibration shall be within the 4.5 mm/sec. Noise level shall be limited to 85 dB A at a distance of 1.0 m

The power rating of motors to drive pumps shall be suitable to meet maximum requirement of power for the rated impeller throughout its' performance range.

B. FEATURES OF CONSTRUCTION

PUMP:
Pump shall be horizontal centrifugal, single / double stage; Horizontal split case Type suitable for dry-pit installation with wearing rings. The pump shall have side suction and side discharge nozzle located in lower part of delivery casing.

The SS heavy duty strainer shall be provided at pump suction so as to restrict the entry of oversize solids / floating material in order to run pump set without clogging and interruption. The strainer shall have sufficient suction area and openings throughout its surface to let water in easily. The size of the holes on strainer shall not be more than max. Permissible solid handling size/capacity of pump or lower as per the permissible solid handling capacity of pump and as recommended by pump vendor. The strainer shall be supplied by pump vendor only as per the area of opening and opening requirement to suit the offered pump design.

CASING:
Pump casing shall be of robust construction. Liquid passages shall be designed to allow free passage and finished smooth. The tongue shall be straight across and filed to a smooth rounded edge. Casing shall be provided with wearing rings. Casing drain connection with collard plug shall be provided at lowest part of casing. Tapping shall be provided at side center of suction and discharge nozzles for pressure gauge connection. These tapping shall be plugged by collard plugs.

IMPELLER:
Impeller shall be enclosed, single or double suction type or as per manufacturer design with smooth and large ways so as to allow free passage to the fluid being pumped. It shall be free from sharp corners and projections likely to catch and hold rags and stringy materials. Impeller shall be statically and dynamically balanced at rated speed as per applicable standard so as to avoid vibration.

SHAFT SLEEVE:
Replaceable shaft sleeves shall be provided and shall be securely locked or keyed to the shaft to prevent loosening. Necessary rubber 'O' ring or CAF / Teflon gaskets shall be provided between impeller and shaft sleeve to prevent liquid passage between shaft and sleeve. In no case shaft shall be in contact with liquid. The surface hardness of the shaft sleeve shall be minimum 250 BHN.

STUFFING BOX:
Pump shall be provided with **stuffing box arrangement as mentioned in specific requirement** for shaft sealing.

Pump when required with gland packed Stuffing box; same shall be of such design that they can be repacked without removal of any part other than gland and lantern ring. Stuffing box drain with pipe connection shall be provided at the lowest point so that no leakage accumulates in it. Lantern ring shall be sandwiched between packing and shall be easily

removable. Lantern ring shall be of axially split type and shall be sealed with self-liquid being pumped or as recommended by the pump manufacturer. Necessary pipe connections and piping for this shall be provided by pump manufacturer. Gland shall be of split type. Gland bolts and nuts shall be of SS.

Pumps required with Mechanical Seals shall be provided with necessary piping for cooling, flushing and lubrication of seal faces as recommended by seal manufacturer. Seal shall be designed and selected for the specified application in order to perform the equipment trouble free and working life not less than 40,000 hours of operation. Seals shall be covered with SS 304 mechanical seal cover and shall be tightened with SS fasteners as per the specifications.

Pumps shall be supplied with Rubber liquid deflector to prevent liquid entry to bearings, in case of failure of mechanical seal / leakage through stuffing box.

BEARINGS:
Pump shall be provided with anti-friction grease lubricated bearings. The whole rotating assembly of pump shall rest between minimum two bearings for smooth operation. Bearings shall be easily accessible for inspection and maintenance. Bearings shall be of SKF / FAG make only.

COUPLING:
The pump shall be coupled with electric motor mounted on a common base plate using pin bush type of KTR / Rathi / Fenner make only. Coupling shall be statically and dynamically balanced at rated speed.

COUPLING GUARD:
A stationary coupling guard shall be provided for the coupling conforming to all relevant safety codes and regulations. Coupling guard design shall be such that coupling is covered from both the sides as well apart from top cover. Guard shall be designed for easy installation and removal, complete with necessary support, accessories and SS fasteners.

BASE PLATE:
The pumping unit shall be provided with a common drain rim type base plate with 25mm dia. drain pipe, terminated to nearest drain pit/trench. The base plate shall be of sufficient size and rigid sufficient to maintain the pump and motor in proper alignment and position. Base plate shall be supplied by pump manufacturer only. The base plate shall be grouted on the RCC foundation with the help of "J" type foundation bolts of manufacturer's recommended / approved size.

C. MATERIAL OF CONSTRUCTION:
The specific requirement shall be considered as under:

Pump Casing	CI IS210 Gr. FG 260
Casing / Impeller wear ring	CF8M / Bronze, IS 318, Gr. LTB
Shaft	AISI 410
Shaft sleeve	AISI 410
Impeller	CF8M / Bronze, IS 318, Gr. LTB
Shaft Seal	Gland Packed. / Mechanical Seal
Lantern Ring	Bronze, IS 318, Gr LTB

Liquid Deflector	Natural Rubber
Gland	CI IS210 Gr. FG 260
Base Plate (Drain Rim type)	CI / MS - Epoxy Coated
Suction Strainer	SS 304
Bolts, Nuts, Fasteners, etc.	Wetted - SS 304, Non-Wetted - GI

The above MOC is min. requirement and if process requirement is higher as indicated in process data sheet the stringent MOC to be provided.

SUBMERSIBLE DRAIN / DEWATERING PUMPS (for dry well installation and such application)

General

The pump shall be non clog, horizontally or vertically-mounted, single stage with semi open / open-impeller type and close coupled to its fully submersible electric motors designed for dewatering.

The total head capacity characteristic of pump shall be continuously rising towards the shutoff with the highest at shut off. It shall be suitable for handling turbid water containing stringy materials. The pump shall be designed to handle solids up to 25 mm dia size.

The pump shall run smooth without undue noise and vibration.

The power rating of the pump motor shall be min.150% more than the power required from zero discharge to zero head.

Features of Construction

The pump casing shall be volute type and Impeller shall be non clog type, cast in one piece. Pump with Semi open impeller shall be with wear plate of matching profile. Pump impellers shall be designed to pass solids and shall be capable of pumping solids of up to 25 mm diameter.

The pump and motor shall be as one unit together with impeller mounted on extended shaft of motor and fixed with the help of SS 316 impeller screw or cap top type impeller nut with helical insert and washer in such a way that impeller doesn't get loose during rotation of pump in either direction.

Pump shaft /stuffing box shall be sealed with double mechanical seal- one between Motor & Oil Chamber and second between Oil Chamber & pump unit, suitable for sewage and shall have minimum 20000 hrs life. Pump shall be designed for intermittent & frequent operations.

Pumps shall be supplied with all necessary pipe work to discharge to nearby surface drainage / sump as required. 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 / when installed in dry well .

Pumps in general shall be without guide pipe, and duck foot bend but with required CI/GI stool / support arrangement to place the pump in location in dewatering pit of dry well or in bottom of sump as required.

Pump if required to be supplied with starter panel with under current protection to prevent no load run ELCB/RCCB the starter panel shall be comprising of MCCB as isolator and required Thermal Over Load Relay, contactor etc. (Vendor can also consider to provide MPCB) as per Type 2 co-ordination. Starter panel shall be installed near the pump. Starter panel shall be provided with A/M and L/R selector switches as required such that when L/R selector switch placed in local mode it shall be possible for manual operation through panel mounted on/off push buttons when A/M selector switch placed in manual as well as in auto mode through in-built level switches or other applicable method when A/M selector switch placed in AUTO

mode and shall be possible to operate from remote location through PLC/SCADA when L/R selector switch placed in Remote Mode.. Pot. Control circuit shall be suitable for on/off operation from remote and shall also provide potential free contacts for remote monitoring of pump status viz. on/off status, A/M & L/R selector switch status, Trip status, etc. feedback signals to PLC and on/off command. Panel shall be provided with required on, off & trip indications and local panel mounted digital type ammeter & voltmeter. Vendor to refer specification for LT panel for other general requirement for panel and for make of switch gear as specified under electrical specification / tender specifications

The dewatering pump shall operate in auto mode through in-built Low & High level float switch 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.

INDUCTION MOTOR (Submersible)

The submersible motor shall be Induction, Squirrel Cage, and Dry type, designed for continuous operation (S1 duty) capable of working satisfactorily in water immersion. Motor shall be capable of giving rated output without reduction in the expected life span when operated continuously under the following electric supply conditions:

Supply voltage	:	415 Volts, 3 Phase, 50 Hz AC supply
Voltage variation	:	± 10%
Frequency variation	:	± 5%
Combined variation of Voltage & Frequency	:	± 10%

The Motor shall be generally designed to have performance characteristics like nominal efficiency, Locked rotor current, etc. in line with IS: 12615:2018. (Efficiency minimum IE2 of IS: 12615)

Degree of protection of motor shall be IP 68 . The power rating of the motor shall be min. 110% of power required by the rated impeller on its entire performance range. Further, the minimum power ratings for motors to drive pump / sub. pump / driven equipment should be selected as per table of safety factor provided for Squirrel cage induction motors under electrical specifications and higher of the two ratings shall be provided.

Motor shall be suitable for full voltage & star-delta starting. Motor shall be capable of

starting and accelerate the load with the applicable method of starting, without exceeding acceptable winding temperature, when the supply voltage is in the range 85% of the rated motor voltage to maximum permissible voltage. Motors shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage, in either direction of rotation. The motor vibration shall be within the limit specified in applicable standard unless otherwise specified for the driven equipment. Except as mentioned herein, the guaranteed performances of the motor shall be met with tolerances specified in applicable standards.Any joints in the motor insulation such as at coil connection or between slot and end winding section, shall have strength equivalent to that of the slot section of the coil. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid and tropical climate. The tropical treatment shall be as per the applicable standard.

The stator winding shall be made from high conductivity annealed copper conductor, super enameled insulated winding wires confirming to IS 8783-1978 (Latest IS) for dry type motors. The stator winding shall be of high conductivity annealed copper enameled insulated wires conforming to IS 4800 (part-VII): 1970(Latest IS) for dry type motors. The corresponding Class of insulation shall be Class F with temperature rise limited to Class B.

As the cable resistance method, due care is taken to account for the correct hot and cold resistance of windings.

Terminal box shall be of IP 68 type construction to eliminate entry of water and dust. The terminal shall be the stud type with necessary plain washer, spring washers and check nuts. They shall be substantially designed for the current carrying capacity and shall ensure ample phase to phase to ground clearance.

Material of Construction

Casing/Casing Cover/Wear plates/Oil Chamber/Motor Housing	CI, IS 210 GR FG 260
Impeller	CI, IS 210 GR FG 260
Shaft/ Shaft Sleeve	AISI 410
Shaft Sealing	Double Mechanical seal
Cable length (each run)	Min. 10 mtr
Lifting Arrangement	SS-304 chain or wire rope with lifting hook, min. 5m length if the pump weight exceed 40 Kg

2.0 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 water shall be of a corrosion resistant grade of stainless steel.

Valves shall be free from sharp projections.

Valves shall have pressure rating min. PN 1.0 in general.

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.

For valves with extended spindle/shaft following shall be considered / provided:

- Extended spindle MOC and size to be confirmed by valve vendor
- Head stock / bracket supply shall be in valve vendor scope only. Valve vendor also to provide details and MOC of the same in GAD.
- For extended spindle the coupling & guide bracket details shall be provided by vendor. Generally it is desired to have two nos. universal Couplings (one on top / below headstock and one in bottom above gear box). In case of long spindle lengths muff couplings at about every 3 m distance. Shaft guide bracket /support shall be provided if extension spindle is more than 3 m long.

2.1 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 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.
2. The Valves 600 mm & above size shall have channel and shoe arrangement as per IS 14846.
3. The Valves above 500 mm size shall have by pass arrangement as per IS 14846 and BOQ.
4. The Valves 350 mm size & above shall have spur / bevel gear arrangement as per IS 14846.
5. 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:

- 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.

2.2 NON RETURN VALVES

Design Requirements and Construction Features
Valve shall be free from sharp projections which are likely to get clogged with stringy materials.

For Valve size 50mm and above end connection shall be flanged and for sizes below 50mm shall be flanged / threaded type The valve shall be suitable for mounting on horizontal pipe line.

The internal parts shall be easily accessible for inspection through inspection hole.

Hydraulic passages and doors shall be designed to avoid cavitation's.

Valve body shall be designed for 1.5 times the rated pressure.

Valve shall be of swing type or ball type. Ball type valve must house a freely moving ball in such a way that return flow is effectively prevented.

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

Flow direction shall be clearly embossed on the valve body.

Valve flange face shall be parallel to each other and shall be at right angles to valve centerline. Flange back shall be machined or spot faced for proper seating of bolt head and nut.

Valve shall be rated to PN 1.0 / PN 1.6 bars

Accessories shall be provided as under:

1. Valves above 300 mm size shall be provided with by-pass arrangement as per process requirement as per IS 5312
2. Valves above 300 mm size shall be provided with drain plugs as per IS 5312.
3. Valves above 450 mm size shall have support foot as per IS 5312.

Materials of Construction

a) Body, Cover, Doors & Hinge	:	CI to IS 210 Gr FG 200
b) Body Ring	:	SS to BS 970 Gr 304 S16
c) Door Ring	:	SS to BS 970 Gr 304 S16
d) Bearing bushes	:	bronze to IS 318 Gr LTB2
e) Ball (if applicable)	:	to be with EPDM Rubber

However, Valves 15 mm to 40 mm size shall generally as per API 6D/API 602 and having Carbon Steel Body (Body: forged carbon steel A105 / cast carbon steel Gr WCB, Trim: 13% Cr) in Class 150 or higher rating and shall be screwed / flanged ended

2.3 DUAL PLATE CHECK VALVE

A. GENERAL

All double flanged dual plate check valves shall conform to API 594-1997 and API 598 or its latest amendment for pressure rating PN 1.0 / Class 125. 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 internal dimensions and shape of the body, plates, 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 as per manufacturing standard.

The designs of the plates, hinge pin, stop pins, etc shall ensure free swinging of the plates. The spring action shall optimize the equal closing rates of each plate. The dual plates face shall have close face contact with the body seat ring in close position. Valves shall be

designed for horizontal and vertical mounting position. The plates shall not vibrate under full or partial flow condition.

Valve shall be quick closing type with non-slam characteristics. The non-slam characteristics shall be achieved by providing suitable combination of plates, springs and hydraulic passages.

B. FEATURES OF CONSTRUCTION

BODY:

Valve body shall be double flanged. The minimum thickness of metal for body shall be as per directives given in the API 594 and shall be maintained throughout any section uniform. The Flange to flange dimensions shall be in accordance with manufacturing standard (tables 2A & 2B).

Body of the valve shall be fitted with removable 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 check valve shall carry an embossed AERROW to indicate the direction of flow.

FLANGES:

Valve flange faces shall be parallel to each other and shall be at right angle to the valve centerline. The finish on facing shall comply with MSS SP-6 / ASME B 16.5. The flanges and their dimensions of drilling shall be in accordance with the requirements of IS 1538, Table IV & VI.

PLATES & HINGES:

Plates and hinges shall be designed so as to withstand satisfactorily the repeated impacts likely to occur during service. Plates shall be securely positioned on body seat face with the assistance of required nos. of spring or other devices. Plate seating face shall be renewable or uniformly deposited weld metal machined and lapped using good manufacturing process so as to provide leak less seating on body face ring.

The spring action shall optimize the equal closing rates of each plate. The plates shall be totally vibration free under full or partial flow condition.

INTERNAL WETTED PARTS:

Internal wetted parts shall be suitable for the specified service conditions. The term shall include but not be limited to hinges, pins, bolts, bearings and any other part in contact with the fluid medium other than the body, plates, trim, springs and pipe plugs.

OPTIONAL ITEMS:

1. Valves above 300 mm size shall have lifting eyebolts.

C. MATERIAL OF CONSTRUCTION

a) Body and Plates	:	CI, IS 210 Gr FG 260
b) Plates / doors	:	Cast Steel, Gr. WCB
c) Body Ring	:	SS to BS 970 Gr 304 S16
d) Plate Ring / Face	:	SS to BS 970 Gr 304 S16
e) Hinge Pin / Stop pin	:	SS, AISI 410
f) Springs	:	SS, AISI 304

D. 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.

2.4 DELETED

2.5 DELETED

2.6 ELECTRIC ACTUATOR (APPLICABLE FOR VALVES / GATES)

All local controls shall be protected by a lockable cover.

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 headstocks 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”.

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 No. 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 starter

j) 1 No. Set "Open", "close" and "Stop" buttons as applicable

l) 1 No. Local – Off –Remote switch with padlocking facilities as applicable

m) Space heater, 220V rated

n) Position transmitter with 4-20mA analogue output for valve open/close position.

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 (if required / specified)

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 at least 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 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 and24V DC rectifier supply for local control for integral starter is also acceptable). The commonconnection 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.

WIRING AND TERMINALS:

Internal wiring shall be of grade PVC insulated stranded cable of 650 V and of minimum 1.5 mm^2 copper for control circuits and of minimum 4 mm^2 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:

The actuator enclosure shall be Weather Proof to IP-68.

REDUCTION GEAR UNIT:

Reduction gear unit shall be of the totally enclosed oil bath lubricated type. The gear box shall be provided with the first charge of oil lubricants and appropriate filling and drain connections. Gearing shall be adequate to open and close the sluice gates under full indicated maximum operating pressure differential at a speed sufficient to cover the full extent of travel.

The sluice gate operating equipment shall have a hammer-blow device to loosen stuck sluice gate or retrieve jammed sluice gate position.

The gearbox shall have suitable stops to prevent movement of shaft beyond fully open / close position. The gearbox shall also be designed for 15% more torque than maximum sluice gate / valve torque.

TORQUE & POSITION LIMIT SWITCH MECHANISM:

Each actuator shall be provided with both Open and Close torque limit switches, open and close (end position) limit switches for remote indication and interlocking plus two sets of auxiliary limit switches in each direction for intermediate position indication and interlocking if specified above for minimum provision in starter. Means shall be provided to prevent the open torque switch tripping during initial hammer blow effect. Torque protection reset shall not allow repeated starting in same direction when the control signal is maintained.

The torque switch mechanism shall function as follows to stop the motor on closing or opening of the sluice gate, upon actuation by the torque when the sluice gate disc is restricted in its attempt to open or close.

The torque switch in the closing direction shall interrupt the control circuit if mechanical overload occurs during the closing cycle or when the sluice valve is fully closed. The torque switch in the opening direction shall interrupt the control circuit if mechanical overload occurs during opening cycle or when the value is fully open.

The mechanism shall facilitate adjustment of the torque at which the switches are required to Operate.

HANDWHEEL:

A hand-wheel shall be provided for emergency operation. The hand-wheel drive shall be mechanically independent of the motor drive and any gearing should be such as to permit emergency manual operation in a reasonable time.

4.0 METALLIC EXPANSION BELLOWS.

Expansion bellow shall be shall be in accordance with the EJMA/ ASME standard.

The bellows shall be metallic corrugated design of MOC as specified and shall have double flange with liner / internal sleeve. The Fatigue life expectancy considered for the Expansion Bellows shall be min. 3000 cycles. The drilling standard of expansion joint flange shall be matched on piping side to ensure proper alignment and bellows is not subjected to torsional forces due to misalignment. The expansion joint shall be single bellow design and shall be generally suitable for axial movement of up to total 30mm (20mm axial compression & 10mm axial extension). Further it shall be suitable accommodate angular misalignment of piping for up to min. 5mm / 3 degrees for installation.

To achieve maximum flexibility coupled with required resistance to pressure, bellows shall be formed with single or multiple walls using a number of concentric cylinders (multi-ply construction) of specified MOC, each longitudinally welded. However for the blower application the bellows shall be of multi-ply construction only.

The expansion joint overall length shall be min. 300mm.

Generally the expansion joint is provided of single bellow design as a dismantling / disassembly joint in piping near valve or pump or flow meter or such device or equipment for ease of removal and jointing. Tie Rods / Threaded draw bars attached to expansion joint assembly shall be provided for this application.

In case of bellows used for air piping application / in air blower discharge piping or such

application witnessing vibration and temperature variations the expansion joint shall be single bellow with or without limit rods as recommended by manufacturer suitable to absorb axial movement and to suit this requirement.

In case of bellows used for diaphragm type dosing pump or such pulsating service the expansion joint shall be single bellow with or without limit rods as recommended by manufacturer suitable to absorb axial movement and to suit this requirement.

The austenitic stainless steel shall be welded using the T.I.G. welding method.

The weld end pipe shall be suitable for design pressure (Min. PN 10 or higher as per design) and for CS / MS weld end pipe shall be with min. corrosion allowance of 3mm for water /waste water application. However for blower application the bellows shall be designed for a working pressure of min. 1 Bar or higher as per design and for a temperature of min. 115 deg. C or higher as per design and for a velocity of min. 25 m/sec or higher as per design and the liner thickness shall be suitable for the same.

During installation the bellows as a practice shall always to be placed between two fixed points. Thrust block or saddle welded to pipe to make it fixed must be provided on both sides of EB. For blower application generally after the bellow the first support (saddle or suitable) shall be provided at 4D distance and second support 14D distance from bellows to dampen the vibrations.

MATERIAL OF CONSTRUCTION

Component Description	**Water / Sewage / Sec. Treated Indl. Effluent / Air Application**
Bellows	SS 304 (ASTM A 240 Tp. 304)
Internal Sleeves / Liners	SS 304 (ASTM A 240 Tp. 304)
Weld End Pipe	CS / MS
Flanges	IS:2062 with drilling as per IS:1538, PN10
Tie / Limit Rods	Carbon Steel (CS) as per IS 1367
Nut, Bolt , Hardware	CS as per IS 1367

5.0 CI / MS / GI / CI / uPVC / PVC (Every Type) PIPE & 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 equipment's. 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 confirming 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, bents 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 freesly 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 applied with a hand force pump or suitable method up to required test pressure as per IS 3114 or its latest addition. If the pipe is laid on an appreciable gradient, the test shall be carried out at the lower 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
Sr. No.	**Size of pipe line for joint**	**Consumption of lead in kgs.**	**Depth of lead joint in cm.**
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 liters 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.

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	610.0
700	711.0
900	914.0
1000	1016.0
1200	1219.0
1400	1422.0

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:

Nominal Size	Tolerance
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	8
above 1000 to 1500	10

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 interol 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

corrosivewater 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 1.0 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, flangeswith 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/cm^{2}g.

- **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.

(i) **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/cm^2.

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.

6.0 ELECTRIC CHAIN HOIST AND EOT Travelling on MONORAIL(Double Girder type)Capacity 2 ton

The design, manufacture, inspection and testing of Monorail, Electric chain Hoist and 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 confirm to IS6547-1972 and shall be designed for duty service Class–II. Other internationally acceptable standards/codes which ensur equal or higher performance than those specified, shall also be accepted.

Lift 10 mtr OR as per site
req.Runway 33 mtr OR as per site req.

IS:6547-1972	: Electric Chain Hoist
IS:2429	: Round steel short Hand link chain
IS:6216	: Short link Load chain grade 80, Alloy Steel
IS:15560	: Points hooks with shank and safety Latch
IS:808	:IndianStandard Medium Weight Beam
IS: 210	: CastIron castings

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

(a) Electrically operated Chain Hoist, motor with motor cable, hoisting block and hooks complete.
(b) Limit switch to prevent over hoistingand over lowering.
(c) Erection hardware.
(d) Pendent control station suspended from hoist.
(e) Control panel mounted on wall or crane/ hoist 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 1865, accurately shaped pockets ensuring smooth operation of load chain.
Motor driven by squirrel cage, Face mounted 3 phase, class F, RPM 960

Chain hoist shall be suitable to Fix with supporting/monorail Girder at fix location at the top/bottom flange of beam (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 15560 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.

Drive motors shall be suitable for crane duty (S4) application and generally conforming to latest IS:12615 / IEC:60034-1 standards as applicable.

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 / thrust 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 confirm to relevant Indian standard. Surface hardening of steel is not acceptable.

All running shafts and wheels shall be lifted 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.

(C) GENERAL REQUIREMENT FOR MECHANICAL ITEMS / EQUIPMENTS:

- **PAINTING**

MS / CI / DI BODY OR PARTS OR STRUCTURE (GENERAL FOR PIPING AND PUMP / BLOWER / EQUIPMENT IF NOT PROVIDED AS SPECIFIC)

Shall be provided with one coat of red oxide / epoxy primer followed by two coat of epoxy paint after proper surface preparation as recommended by paint manufacturer / shot blasting prior to dispatch, to a total DFT of minimum 150 microns inclusive of priming.

Zinc rich epoxy primer and epoxy paint of approved quality shall be used for external and

internal painting as applicable. The max of zinc rich epoxy primer shall be prepared at work site not earlier then 15 minutes before applying the same on pipes and special surfaces. One coat of zinc rich epoxy primer of DFT 75 micron shall be applied along with two coats of epoxy paint DFT 40-45 micron and DFT 30-35 micron respectively. No thinner shall be added to ready mix paint without previous approval of the Employers' representative and the finishing coats on top of the primer coat shall only be applied after allowing the film to cure for at-least 48hrs.

After application of zinc rich epoxy primer the surface should be cleaned by duster and inspected. If during inspection any portion is found rusting the same shall be removed by emery paper and coated with zinc rich epoxy primer.

Mixed paint should be used within 3 to 4 hrs. of mixing or as recommended by manufacturer and fresh mixing shall be done for every new application. Every successive coat of paint shall be applied only after 48 hrs. of previous coat. Before applying the next coat the surface should be properly cleaned by duster

OPEN CHANNEL GATES / SLUICE GATES (THIMBLE MOUNTED GATES)
Following painting procedure shall be adopted for the gates:

Surface Preparation:	Blast clean to near white metal finish using shot blasting.
Priming:	1 coat of red oxide primer.
Finish Painting:	Black bituminous paint for gate assembly. Minimum DFT 200 microns inclusive of priming. Yoke & Headstock to be provided with red oxide primer and epoxy Grey paint having minimum DFT 150 microns inclusive of priming.DOCUMENT SUBMISISON

In general, the minimum document submission for various items shall be as described below to be submitted by vendor for review and approval during detailed engineering / execution & prior to manufacturing and manufacturing shall be carried out as per approved documents only and after complying comments as applicable:

PUMP SET (CENTRIFUGAL / POSITIVE DISPLACEMENT / PROGRESSIVE CAVITY (SCREW) / RECIPROCATING (DOSING), ETC.):(HSCF)

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

1. Product Technical data sheet.
2. Preliminary outline dimensional drawing (GA Drawing) showing the details of pumps and motor, Suction, discharge connections and foundation details.
3. 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.
4. Typical cross sectional drawing showing internal features of pump, parts and their material.
5. Torque – Speed curve of the pump.
6. Catalogues showing type of construction.
7. Quality Assurance Plan.

VALVES (SV / NRV / DPCV / BFV / KGV/ BALL VALVE / AIR VALVE)

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

1. Product Technical data sheet.
2. General outline dimensional drawings.
3. Cross sectional drawing showing constructional details with part list with their qty & MOC confirming relevant standards.
4. QAP of the product.
5. 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 of Electric actuator.
3. Valve Torque Calculations.
4. Product catalogue.

SLUICE / OPEN CHANNEL GATE

The manufacturer shall submit following drawings.

- Product Technical data sheet.
- General outline dimensional drawings along with part list with their qty & MOC confirming relevant standards.QAP of the product.

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 of Electric actuator.
3. Valve Torque Calculations.
4. Product catalogue.

EXPANSION BELLOWS

The manufacturer shall submit the following drawings.

- Data sheet.
- G.A. Drawing
- QAP of the product.

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:

- Product Technical data sheet.
- Preliminary outline dimensional drawings.
- QAP of the product.
- Wiring Diagram of panel

PIPES (CI / DI / MS, HDPE, PVC, ETC. MOC)

The manufacturer shall submit the following drawings / documents:

- Bill of Material
- QAP of the product.

Note: The data sheet and GAD as specified for equipment shall also be considered to include coupled items like electrical drives / motor including it's performance curves, electric actuators including it's wiring diagram, pneumatic actuators, etc. as applicable.INSPECTION AND TESTING REQUIREMENTS:

The material shall be cleared for dispatch based review of documents / test certificates or by carrying out inspection and testing at manufacturer's works as per requirement specified in tender for various equipment and as per approved Quality Assurance Plan. Client reserves the right to waive inspection at manufacturer's works or ask for inspection at manufacturer's works even though not specified in tender but in client's opinion is required and contractor shall hold no objection to the same.

Inspection & testing of mechanical equipment at manufacture works shall be conducted for equipment / components 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 / as per applicable IS.

All instrument and equipment required for such tests shall be provided by the Contractor / Vendor. The instruments shall be calibrated and certified by an approved independent testing authority with valid calibration certificates as on date of inspection.

All the tests shall be carried out as per the relevant standard & codes.

The inspection category and brief description of tests to be carried out for various equipment is as follows:

CENTRIFUGAL PUMP:(HSCF)

HYDROSTATIC TEST:

- A standard hydrostatic test shall be conducted on the pump casing with water at 1½ 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.

WITNESSING OF PERFORMANCE TESTING OF PUMP

Pump Rating	Pump performance Testing to be witnessed for each duty and type (Also see Note below)
up to 15 kW motors	Visual / 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 up to 75 kW motors	25 % Qty. or min. 1 No. whichever is higher per duty / type.
> 75 kW up to 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. (2) Vendor shall Parallel operation curve for pumps where more than two pumps are incorporated in BOQ along with individual pumps performance testing witnessing.	

VALVES (SV / NRV / BFV / DPCV/ KGV/ 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 MSS SP-81 1995 for 2 minutes duration minimum.

BUTTERLY 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.

NRV / DPCV

Valve shall be subjected to hydrostatic body and seat tests at appropriate test pressure specified in applicable standard (i.e. IS-5312 / API 598- Table – 2 & 3) for minimum 2 minutes duration.

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.

EXPANSION BELLOWS

Each Bellows shall be subjected to following tests:

- Hydrostatic tightness test for 1.3 times of design for 15 minutes duration minimum.
- Compression and expansion test as per data sheet for 1 No. of each size
- Dye Penetration (DP) Test for weld joints
- Dimension and Visual check

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)
up to 300 mm dia.	Visual / 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.	10 % Qty. or min. 1 No whichever is higher per size / rating and type for hydro test and rest shall be review of internal Documents
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 / Review for each type & capacity
(Ele./Manual) CPB/HOIST/HOT-monorail/Chain Hoist	Visual / 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

(D) 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, 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

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.The equipment shall also confirm to the IS : 12615 (2011) or latest applicable standards.

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

(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 n 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 of 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 that one erector, one shall be in charge and the contractor shall inform the engineer'sRepresentative in writing which erector is designated as his representative and is in charge. Erection engineer is to report to Project Manger.

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 net 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. shallbe 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.

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 him 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 documentationare duly compiled and submitted in final formats in duly bound volumes.

TECHNICAL DATA SHEET FOR MECHANICAL EQUIPMENT'S

(TO BE SUBMITTED DURING EXECUTION STAGE)

GENERAL NOTES / GUIDELINES FOR BIDDERS / VENDORS

1. The technical vendor data sheets for various electro-mechanical items shall be submitted by contractor during execution / respective equipment approval stage as per provided format as a minimum (and with additional details as required separately) for review and approval.

2. The design ambient temperature shall be considered as 5°C min. and 50°C max.

3. The specific gravity of various service fluids shall be considered as under:

Service Fluid	Sp. Gravity, g/cc
Clear / Potable Water, Tertiary Treated Sewage	1.00
Raw Water (river, Canal, etc.), Sec. Treated Sewage	1.01
Sewage	1.02
Sec. / Return Activated Sludge	1.03
Primary / Thickened / Digester Sludge	1.05
Any other	As per fluid properties and concentration

4. For painting, document submission and inspection & testing requirements bidder / vendor to refer the "GENERAL REQUIREMENT FOR MECHANICAL ITEMS / EQUIPMENT" section provided with specifications or other as specified elsewhere in tender.

5. The selection of motor operating characteristics and it's mounting to suit the equipment shall be responsibility of contractor / vendor.

6. The data sheet shall be submitted separately for each type / capacity of pump; for each size / type of valves & gates & it's type of operation; for each equipment, etc. as applicable.

DOCUMENT: DATA SHEET OF HSCF PUMP SET

PARTICULAR	DATA TO FILL BY CONTRACTOR / VENDOR
LIQUID DATA	
Liquid handled	Water
Specific gravity	
Temperature	
PUMP DATA	
Make	
Pump type	
Pump Model	
Number of pumps	

Type of duty	Continuous
Design capacity-m^3/hr.	
Head-m	
Shut off head-m	
Rated Speed of pump- RPM	
Pump efficiency at duty point -%	
Pump Input Power (BKW) for Rated Impeller-kW	
Recommended motor rating- kW	
Guaranteed Overall efficiency of Pump set-% (w/o -ve tolerance)	
Full Load Motor Efficiency, %	
Full load speed of motor-RPM	
Reco. Drive motor rating- KW	
Full load speed of motor-RPM	
N.P.S.H. required-m	
Location – Indoor / outdoor	
CONSTRUCTIONAL FEATURE	
No. of stage	
Casing	
Impeller	
Impeller dia.- mm (Max. / Rated / Min.)	
Shaft / Drive Transmission	
Shaft sealing	
Mounting Orientation – Horizontal / Vertical	
Nozzle orientation & size-mm	
Suction	_____mm / _____Side
Discharge	_____mm / _____Side
Flange drilling	As per IS 1538, FF
Direction of rotation	
Type of Starter	
MATERIAL OF CONSTRUCTION	
Pump Casing (M)	
Impeller (M)	
Shaft (M)	
Shaft Sleeve (M)	
Casing/Impeller Wear Ring (M)	
Strainer (M)	
Gland Bolt & Nuts	
Hardware in contact with liquid / Non-wetted	
Liquid deflector	
Gland	
Base plate (Drain rim type)	
ACCESSORIES & SERVICES REQUIRED	
Pin Bush Type Coupling	YES

Coupling guard	YES
Set of foundation bolts & Nuts	YES
Base Plate	YES
WEIGHT	
Weight of pump-kg	
Weight of motor-kg	
Reco. Crane capacity-Ton	
PAINTING	Refer General Requirement for Mechanical Items / Equipment Section / Tender Specifications
DRAWINGS / DOCUMENT SUBMISSION	As Above
TESTING	As Above

Note:

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

02. Bidder shall refer electrical specifications for motor requirement and shall offer accordingly.

03. **Bidder shall submit the manufacturer's under taking / Back Up guarantee for whole contract period as per ANNEXURE-X-1 for all pumps on 300 Rs. Stamp Paper duly notarized.**

ANNEXURE – X-1

FORMAT OF UNDERTAKING BY PUMP MANUFACTURER
(To be made on Rs. 300 stamp paper and notarized to be submitted)

(For HSCF/VT/HNC/VNC/Subm.CF / Subm. Non-Clog / Etc. Type of Pump Set as available

To,
City Engineer (_____)
Rajkot Municipal Corporation
Rajkot, Gujarat.

Name of Work: (*Bidder / Vendor to specify as applicable*)

We, the pump manufacturer, M/s. ……. (Name of Company) (Hereinafter referred as `……') a company incorporated under the Companies Act 1956 with a Registered Office at ……., one of the approved vendor for _____ Pumps(***Bidder / Vendor to specify type of Pump as per BOQ***) as per tender have agreed to offer our pumps having capacity of:

(1) _____m3/hr at ___m Head as per tender Price Bid / Specifications,
(2) _____m3/hr at ____m Head as per tender Price Bid/ Specifications, ….
(***Bidder / vendor to specify each type / capacity of pump as offered by Vendor for said work***)

for above referred Work to the bidder M/s …… , a company incorporated under the Companies Act 1956 (or a Partnership or Proprietor Firm as applicable) with a Registered office at ……., (herein referred as '.....').

In this regards we confirm / undertake to offer services to the bidder M/s. ..... as under:

1. We undertake to supply pump of rated capacity and head as per tender with pump / overall pump set efficiency of (1)……%, (2) ……% , ….etc. (***Bidder / Vendor to include and specify as applicable***) without negative tolerance which is equal to / better than the minimum efficiency specified in financial bid / tender and meeting the tender specifications in general.
2. We have understood the requirement for pumping fluid as specified in tender / application for onwards supply with working pumps as indicated in tender / drawing and confirm to provide parallel operation performance curve of the selected pump that will be observed while running all working pumps in parallel discharging flow in the system and same shall be sum of all pumps discharge (i.e. duty point flow x no. of working pumps as per tested curves) maintaining the design total head and proportionate power consumption during execution stage for review and approval in line with this and other tender requirements.
3. We confirm to provide supervision / assistance during erection, commissioning, performance testing and trial runs of the pump sets at site at no extra cost.

4. We confirm to provide backup guarantee for the offered pump set during entire **24 months guarantee / defect liability period**. We understand and confirm that offered pumps shall be suitable for continuous operation on round the clock basis.
5. We also confirm the availability of the offered pump model and any spare of the offered pump model during entire O&M period as well as during service life of pump of min. 15 years from the date of successful commissioning and acceptance of these pump sets at site.
6. We also confirm to depute our engineer to carryout periodical operation & maintenance check of pump at least once during each year of O&M at no extra cost to the bidder / contractor and shall ensure operating rated flow, head & power consumptions are maintained throughout its working life during defect liability / O&M period. If pump flow reduces by more than 10% of rated flow at any point of time during defect liability / O&M period then we along with contractor shall carry out corrective measures including replacement of required parts by original parts and shall regain the rated performance without any extra cost to client.
7. For the sake of correspondence following addresses and the persons concerned are to be contacted:

For M/s. ..... (Bidder)	**For M/s. ..... (Pump Manufacturer)**
(Authorized Signatory)	**(Authorized Signatory)**
Name:	**Name:**
Designation:	**Designation:**
Address for Correspondence:	**Address for Correspondence:**

Remarks: Further the bidder shall also take note of below and consider in their scope of work:

(1) Bidder shall provide parallel operation performance curve of the selected pumps that will be observed while running all the working pumps in parallel discharging flow in the system and same shall be sum of all pumps discharge (i.e. duty point flow x no. of working pumps as per tested curves) maintaining the design Total head and proportionate power consumption during detailed engineering for review and approval. Bidders shall note that all the total nos. of pumps to be supplied as per price bid / as indicated in tender.

(2) Bidder shall submit guaranteed pump efficiency without negative tolerance as per tender along with supporting backup documents of pump manufacturer. The pump set offered during detailed engineering shall be equivalent or of higher efficiency during execution stage of any approved make specified in tender and subject to meeting flow, head and all other requirements as per tender including required undertaking of pump manufacturer of approved make and any other requirement specified in tender & addendum (if applicable).

(3) The pump manufacturer shall provide supervision / assistance during erection, commissioning, performance testing and trial runs of the pump sets at site at no extra cost. The pump sets / pumping station shall be taken up for trial run and commissioning by contractor only after obtaining necessary certification from pump manufacturer regarding satisfactory installation of all pump sets.

(4) Contractor shall carryout yearly corrective maintenance check of pumps and shall ensure operating rated flow, head & power consumptions are maintained during entire backup / O&M period. If pumps flow reduces by more than 10% of rated flow then contractor shall

carry out corrective measures including replacement of required parts by original parts and shall regain the rated performance without any extra cost to client.

SUBJECT: DATA SHEET FOR SLUICE VALVE

PARTICULARS	DATA TO FILL BY CONTRACTOR / VENDOR
Make	
Manufacturing Std.	
Size in mm and Qty.	
Pressure Rating	
Stem Type	
Ends - Flanged	Flanged, FF as per IS-1538 having off center bolt holes
Bonnet	Bolted
Disc	Solid Wedge
Max. Valve Torque-Nm	
Type of Operation - as per Specifications / BOQ	
Seat- Body & Disc	Renewable
Direction of Closing	CW - Marked on Hand Wheel
Repacking /Back Seat Bush Arrangement - Required for 350mm and above	
Channel & Shoe in Arrangement - Required for 600mm & above	
Gear Box arrangement - Required for 350 mm & above	
Material Of Construction	
Body / Bonnet /Disc (M)	
Stem (M)	
Body & Disc seat (M)	
Stem nut & Stuff. Box Bush	
Stuffing box & Gland	
Channel & Shoe lining	
Gland Packing	
Bolts, studs & nuts	
Hand wheel /Cap	
Details for Electrically Operated Valve	
Actuator make / model	
Actuator Torque capacity/ RPM	
Power supply	
Valve opening/closing time	

PAINTING	Refer General Requirement for Mechanical Items / Equipment Section / Tender Specifications
DRAWINGS / DOCUMENT	As Above
SUBMISSION	
TESTING	As Above

M – denotes material test certificate required

SUBJECT: DATA SHEET FOR DUAL PLATE CHECK VALVE

PARTICULARS	DATA TO FILL BY CONTRACTOR / VENDOR
Make	
Mfg. Standard	
Size in mm / Qty.	
Pressure Rating	
Ends	Flanged, FF as per IS-1538 having off center bolt holes
MATERIAL OF CONSTRUCTION	
Body (M)	
Plates (M)	
Body Seat	
Plate Seat / Face	
Hinge Pin / Stop pin (M)	
Springs (M)	
Bolts, studs & nuts	
ACCESSORIES	
Drain Plug	Not Required
Lifting Eye Bolts	Required
Support Foot	Not Required
By Pass Arrangement - Not Require	Not Required
PAINTING	Refer General Requirement for Mechanical Items / Equipment Section / Tender Specifications
DRAWINGS / DOCUMENT SUBMISSION	As Above
TESTING	As Above

M – denotes material test certificate required

DOCUMENT: DATA SHEET FOR METALLIC EXPANSION BELLOWS

PARTICULARS	DATA TO FILL BY CONTRACTOR / VENDOR
Make	
Mfg. Standard	
Size in mm and quantity	
Overall length in mm	
Pressure Rating	
Axial expansion in mm	
Axial compression in mm	
Fatigue life expectancy	
Mode of installation – AS per Design / SOQ / Tender Drawing	
Ends - Flanged, FF as per IS-1538 having off center bolt holes	Flanged, FF as per IS-1538 having off center bolt holes
No of Convolution	
Thickness of Weld End	
Thickness of internal sleeve	
Qty. & Position of Rods	
MATERIAL OF CONSTRUCTION	
Bellows (M)	
Internal Sleeves (M)	
Flanges (M)	
Lugs	
Rods	
Hardware	
PAINTING	Refer General Requirement for Mechanical Items / Equipment Section / Tender Specifications
DRAWINGS / DOCUMENT SUBMISSION	As Above
TESTING	As Above

M- Denotes material test required

(E) APPROVED VENDOR LIST FOR MECHANICAL EQUIPMENTS

ITEM	APPROVED MAKE
HORIZONTAL SPLIT CASE PUMPS (HSCF)	KIRLOSKAR / JYOTI / M & P (WILO) / WPIL / GRUNDFOS
DRAIN / DEWATERING PUMPS (SUBMERSIBLE / HORIZONTAL)	AQUA / KIRLOSKAR / KISHOR / KSB / ABS / ITT-FLYGHT / MBH / WILO (M&P) / SU / PULLEN / JAI PUMPS / JASCO
LT / INDUCTION MOTORS	SIEMENS / ABB / B_BIJLEE / CROMPTON / JYOTI / ALSTHOM (MARATHON) / KEC /
SLUICE VALVES	IVC / KIRLOSKAR / R&D MULTIPLE / FOURESS /IVI/GM
DUAL PLATE CHECK VALVE / NRV	IVC / IVI / KIRLOSKAR / R&D MULTIPLE / FOURESS / DALUI / DURGA/KARTAR
KINETIC AIR VALVE	IVC / KIRLOSKAR / KEYSTONE / R&D MULTIPLE / FOURESS / DALUI / DURGA/ KEJARIWAL /
ELECTRICAL ACTUATOR	ROTORK / AUMA / EMERSON
EOT CRANE & ELECTRICAL HOIST	WH BRADY / SAFEX / INDEF/ MORRIES / JAPS / / D R Equipment
BEARING	SKF/NBC/FAG
C.I. PIPE & FITTINGS	ORIENTAL CASTINGS / ELECTRO STEEL / UPADHYAYA VALVES / BIC/ KEJRIWAL /NJMW / ESKAY (HOWRAH)
M.S. / G.I. PIPES	ARCELOR MITTAL (ESSAR) / TATA / JINDAL / SAIL / ZENITH / ASIAN / ANY REPUTED MFG. USING APPROVED MAKE OF MS OR GI PLATES & SHEETS
M.S. / G.I. PLATES & SHEETS	ARCELOR MITTAL (ESSAR) / TATA / JINDAL / SAIL / ASIAN
uPVC / cPVC PIPE	ASTRAL / ASHIRWAD/ DUTRON / SUPREME / PRINCE
EXPANSION BELLOWS	DHRUV / PRECISION / TECHNOFLEX / PRECISE ENGG. / FLEXICAN BELLOWS & HOSES / FLEXPERT BELLOWS / SUR INDUSTRIES (SURFLEX) / ATHULYA BELLOWS

A.A.E. (MECH.) (W.M.U. E/Z) **A.E.(ELE.)** (W.M.U. E/Z) **D.E.E. (MECH.)** (W.M.U. E/Z) **A.C.E.** (W.M.U).

SECTION: D2

TECHNICAL SPECIFICATIONS FOR ELECTRICALWORK

INDEX:

ELECTRICAL

SPECIFICATIONS 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 and International Standards except where modified and/or supplemented by this specification. Only in absence of Indian standards International standards shall be followed.

The equipment shall meet the requirements of Indian Electricity Rules, CEA Notification, CPWD guidelines 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, hot dipped GI 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, Epoxy 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 and for 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	:	47°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 2003
- The Indian Electricity (Supply) Act, 1948
- Regulations laid down by local statutory authorities and CEA, CPWD, 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 equipment's / items of Electrical Equipment's:

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 dis-connectors (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
IEC 60947	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 60831(1&2)	Shunt capacitor of the self- healing type for AC systems having rated voltage up-to and including 1000V
IEC 61921	Power capacitors -Low-voltage power factor correction banks
IS 16636	Automatic Power Factor Correction (APFC Panels for voltage Rating up-to and including 1000V
IS-2959, IEC-158-1	Contactors
IS-1822, IEC-292	Starters
EN 50081-1,50082-2	Microprocessor Soft Starter

&60204-1	
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: 2018	Energy efficient induction motors-three phase squirrel cage.
IS 15999 (part 1)	Rotating electrical machines: part 1 Rating and performance
IS 15999 (part 2)	Rotating electrical machines: part 2 Method of tests, standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)
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 1554 part1	PVC insulated (heavy duty) LT electric cables up to 1.1 KV
IS: 7098 Part I	XLPE Insulated LT Electric cables (heavy duty) up to 1.1 KV
IS : 7098 (Part II)	XLPE 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: 3961	Recommended current ratings for 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 Alluminium 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
IS- 16101	General lighting LED and LED modules
IS-16102 (Part-1)	Self ballasted LED lamps for general lighting service-Safety Requirement
IS-16102 (Part-2)	Self ballasted LED lamps for general lighting service-Performance Requirement
16103(Part 1)	LED modules for General lighting-Safety Requirement
16103 (Part 2)	LED modules for General lighting-Performance Requirement
16107 (Part-10	Luminaries Performance-General Requirement
16108	Photo biological safety of lamps and lamp systems

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 +10%
Frequency	50 Hz +5%
Voltage and Frequency Combined variation	+10%
Fault Level at 11 kV	350 MVA symmetrical (1 sec)or higher as per Statutory requirement
System Grounding	Solidly Earthed
Fault Level at 415V (Design)	50 kA Symmetrical (1 sec)
Control circuit voltage	230V AC via Constant Voltage Transformer for LT panels and 110V DC for HT Panel via power pack
HV Cabling	3C XLPE,11 kV (E), Extruded Inner sheath
LV Cabling	Alu./Cu. Stranded Conductor XLPE / PVC insulated, Extruded Inner sheath cable
Earthing	Earth Pit: Cu Plate/ G.I. Pipe electrode (Maintenance free Chemical Type) as per IS: 3043 / Specification / Drg.
Induction Motor	Energy Efficient Design of IE3 as per IS:12615-2018 amended up to date.(Latest IS)
Soft starter	DOL starting, Soft starter De-rated current for 50º C operating conditions > min.110% of rated motor current, with in-built or external bypass contactor,(WE MENTIONED INTERNAL BYPASS CONTACTOR IN SOQ(with in-line contactor & semi-conductor (fast acting) fuse protection, required protection parameters, etc.as SLD, BOQ, Tender specification

11kV HT existing Power shall be retained obtained from power Supply Company HT metering panel / 11kV GOD structure and the scope of work shall commence from this point. From PSC 11kV metering panel / 11kV GOD structure, HT power shall be transmitted through HT cables buried underground and terminated at incomer of 11kV HT Panel & then transmitted to respective Transformers, located in substation

This LT Panel shall in turn feed downstream APFC, MCC, LDBs, PDBs, etc. for feeding various loads.

Existing 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 (where ever LCS is not applicable) / 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 Hot Dip Galvanized Iron (GI) Strip Cable Tray.

Earthing system design and installation shall be generally as per IS: 3043. Earthing system shall be carried out by Hot Dip Galvanized 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 Item 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 equipment's.
- Assembling various item as per requirement.
- Checking of operation & wiring before commissioning.
- Testing & commissioning of equipment's. Supply of necessary spares required for commissioning

DRAWINGS / DOCUMENTS

Successful bidder shall submit documents, **Technical data sheets in the tender format given**, 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) Capacitor Sizing Calculations
c) SLD and control diagram of complete electrical system
d) GA drawing, SLD, Sectional drawings, BOM, Wiring / Schematic Drawings etc., as applicable for complete electrical system (PMCC 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	GA Drawings with sectional view, door open view, top & bottom view, Rear view, Mounting plate details etc/B.O.M. / SLD / Wiring & Schematic diagram for Power & Control circuit for / LT Panel / Starter / APFC panel/ Bus duct		*	*
5	Technical data sheet/Catalogue of ACB, MFM, Soft starter,APFC relay, Detuned Reactor		*	*
6	GA drawing /B.O.M/Technical details for LCS/indoor & outdoor light fixtures /LDB/switch board/safety equipment		*	*
7	Data sheet & BOM for cable tray.		*	*
8	Cable Schedule / Data sheet / BOM for HT /LT Power & Control Cables.		*	*

9	RCC foundation details for various electric equipment.		*	*
10	Inspection Schedule & QAP for major equipment		*	
11	Test Certificates		*	*
12	O&M Manual (If applicable)		*	*

B DETAILED TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

SPECIFICATION FOR LT PANEL – PCC / PMCC / MCC / APFC / OTHER LT SWITCH BOARDS

- Panel shall confirm to Indian Electricity Act and rules CEA Notification/ Guidelines, CPWD guidelines 2019 as amended up-to date and shall be as a minimum.
- The MV switchboard panels shall be floor mounting, free standing, compartmentalized, extensible, 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 double door and additionally provided with canopy or weather shed for protection.
- Panels shall be complying toForm-3b as per IS/IEC 61439. Only metallic sheet shall be used for compartment separations / partitions, Hylam/PVC sheets shall not be allowed.
- MV switch boards sheet steel shall be CRCA mini. 2.0 mm for load bearing members, mounting plate, partition, doors/covers, Canopy. Gland plate shall be CRCA sheet min. 3.0 mm thick. 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 arrangement with L angle welded at top for PMCC/MCC/APFC etc. shall be provided on each panel or on each shipping section for ease of lifting of switchboard.
- A base channel of 100mm x 50mm x5 mm thick shall be provided at the bottom of the panel on all four sides of each shipping section.
- 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. 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.: Folding type stand of minimum height 500mm with folding CRCA cover/sheet of 1.6mm thick all around the stand shall be provided. Operational height of starters and control switch gear shall not exceed 1800 / 1900 mm above FFL (irrespective of overall height of panel) for ease of operation.
  - Shipping section length shall be maximum 2500mm. Each shipping section shall have full side sheets of 2mm thick on both the sides. Vertical partition of Incomer/ Bus coupler/ Outgoing feeders etc. shall be of full depth of the panel. Detachable gland plate shall be provided at the top on both the ends of the shipping sections for connecting/ joining of bus-bars.
- Minimum dimension of Incomer, Bus-coupler, Starter, MCCB cubical compartment shall be as per the latest IS. Height of Main Horizontal Bus bars chamber shall be minimum 300mm up to 630A rating and 350mm or higher for 800A & Above, Vertical bus bar shall

be Min. 300mm or higher as per KA level and temperature rise required. Minimum width of cable alley shall be 350mm or higher as per number of cable.

- All type of meters shall be digital type. Ampere meter and Voltmeter shall be single phase and Separate selector switches shall be provided. Meter with inbuilt selector switches is not acceptable.
- Control MCB shall be provided for control wiring circuit. Panel shall be of Fuse less design.
- CT on Y phase with Ammeter to be considered for 7.5KW to less than 15 KW starter feeder.3Nos.CTs with Ammeter and ASS to be considered for motors rated 15KW & above and less than 30KW. For 30KW and above MFM shall be provided.
- LT Panel shall be of fixed type, single/double front. LT Panel shall be single tier for all incomers, bus couplers, Soft Starters and multi-tier for other outgoing feeders. Soft starter feeders rated less than 22KW may be in single tier or two tier. Vacant space on incomer and bus coupler panel shall not be used for mounting the starter, switch gear modules, MCB feeder. Fixed capacitor/reactor may be housed below bus coupler with steel sheet separation/barrier.
- 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. Metering cubicle shall be separate/independent of ACB/ MCCB incomer feeder.
- Circuit breakers capability/suitability 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 shall be TPN/4P,Microprocessor based release/TM release as specified elsewhere. All MCCB's shall be suitable for Ics= 100% Icu. The rated service short- circuit breaking capacity (Ics) of MCCBs shall be more than or equal to the specified fault level. MCCB shall be supplied with extended rotary handle, Terminal spreader, Auxiliary C/O + Trip contact as applicable.
- Rating of MCCB/MPCB, Contactors, relay etc. of motor feeders as recommended by Equipment manufacturer and shall comply with Type-2 Coordination as per IS: 60947.
- Panel shall have Main horizontal and riser bus bars air insulated, with colored Heat shrinkable sleeves, housed in a separate compartment, segregated from all other compartments, with sheet steel barriers, sufficient louvers with wire mesh for air circulation.
- The LT panels 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 mm^2 FRLS PVC copper flexible wires (Grey). C.T. secondary wiring shall be carried out with 2.5 mm^2 FRLS PVC copper flexible wires (Color coded).
- 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

(where Start PB provided at Panel End), to monitor & operate MCC or LCS, ICP / PLC.

- All ACB's, MFM, Soft Starters where provided shall have inbuilt RS485 port to communicate with PLC/SCADA for monitoring and control. RS 485 terminal shall be wired up to External TB with shielded wire.
- 240V AC control supply shall be fed from 415/240V AC Constant Voltage/control voltage Transformer, one number on each bus of minimum 1.5 KVA rating or higher suitable for connected total working load. Suitable control logic through contactors shall be provided such that Control supply is available to all feeders based on Incomer -1 & Incomer-2 status. Only one control transformer shall be ON at a time**. Separate control transformer of suitable rating shall be provided for Incomers. DP MCB of suitable rating shall be provided on both Incoming as well as outgoing side of control transformer.**
- All CTs, PTs and Constant Voltage/Control transformer shall be cast resin type with terminals. CT shorting link type control terminal shall be provided. Only Ring type lugs shall be used for CT termination.
- 2Nos. auxiliary contactors to be considered for PLC interface.
- All capacitors generally shall be at 415V or 525V if provided with detuned reactor or as specified in BOQ, Heavy duty type with discharge resistors and with dielectric losses ≤ 0.2w/kVAR.
- Following Communication RS 485 Modbus, DI, AI and DO, AO to be considered for various type of feeder for PLC/SCADA interface:

	INCOMER (ACB/ MCCB)	**SOFT/ SD STARTER (MPR)**	**MOV**
Communication	Inbuilt Modbus RS 485 (only for ACB) for (1) Control (2) Monitoring Metering, energy & protection parameter	Modbus RS 485 Monitoring and control (SS & VFD) & MPR –Only monitoring & Trip. In VFD: PF, energy saving also to be monitored.	-
Digital Input (DI)	Breaker ON/OFF/TRIP	Motor Run	Valve Open
		Motor Trip	Valve Close
	Auto/ Manual	Auto/ Manual	Local/ Remote
		Local/Remote	Trip/ Fault
Digital Output (DO)	Breaker ON/OFF (latched type)	Start/Stop(latched type)	Valve Open
			Valve Close

Analogue Input (AI)		Speed Feedback (only for VFD)	Valve Position feedback
Analogue Output (AO)		Speed Reference (Only for VFD)	Valve Position Reference (only for VFD)

In addition to above MFM &Temperature scanner with RS 485 Communication MODBUS shall be taken for interfacing with PLC/ SCADA for Monitoring & for controlling further as required.

Bus Bar

- Bus bars shall be of high conductivity, electrolytic aluminum (E91E), 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.
- Aluminum bus bars shall be sized for maximum 0.8 A/mm² & for Copper Bus bar shall be 1.4 A/ mm2 current density only.
- Whenever Incoming supply is through BUSDUCT, Incoming Bus-bar of Incomer shall be extended till the top end of panel and phase positioning/ orientation of bus bars shall be suitable for Transformer LT terminal arrangement to avoid additional Phase cross over chamber.
- Bus bars for risers shall be rated to carry minimum 80% or higher of the rated current of all feeders connected to the risers as per the design of the system/loading.
- The current rating of neutral shall be min. half that of phase bus bars. For LDB neutral rating shall be equal to that of phase bus bar
- 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 **High Tensile Steel Bolts, Nuts and Washers duly** zinc passivated or cadmium **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 85 deg C for normal operating conditions.
- All bus bars shall be insulated with heat shrunk PVC sleeves of 1100V grade.
- The bus bars shall be arranged such that minimum clearance between the bus bar for 50KA fault current shall be maintained as below:
    - Between phases : 27 mm minimum
    - Between Phase and Neutral : 25 mm minimum
    - Between phase and Earth : 25 mm minimum

For the requirement of 65KA for 1 sec, necessary clearance as per the relevant IS shall be maintained.

Auxiliary Supply Bus-bars

- **Auxiliary bus bar of Tinned copper of suitable size shall run through- out the length of the Main bus-bar alley/ Vertical bus-bar alley and supply shall be tapped to individual feeder directly from the Bus and shall not be looped between the feeders. Control MCB shall be provided for individual feeder. Separate control transformer of suitable rating shall be provided for Incomers**

- Auxiliary bus shall be provided for following application. Exact size/capacity of bus bar 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 MFM, Meters, starter, and voltage operated relays, etc.

Power and Control Wiring and Terminal Blocks

- All wiring shall be done with IS approved FRLS PVC copper flexible wires. The insulation grade for these wires shall be 660V grade. The control wiring shall be enclosed in plastic channels/Race way and neatly bunched together.
- Control circuit wiring shall be FRLS PVC copper flexible wire of minimum 1.0 mm² size and CT circuit wiring shall be minimum 2.5-mm²size. CT wiring shall be R Y B BK color coded and Terminals shall be CT Shorting link type only. Power wiring inside the starter module/ MCCB/MCB shall be rated for full current rating of Feeder MCCB/MCB.
- All feeder modules shall be provided with neutral link. Suitable size & Rating Terminal blocks shall be provided for all outgoing feeders in the cable alley for connecting Power & Control cables. Cable shall never be connected directly to MCCB/ MCB terminal.
- Flexible wire shall be used only up to& including 100A MCB/MCCB, above 100A bus bar shall be used. Minimum size of FRLS Copper wire shall be up to & incl. 16A: 2.5 mm²; 20A: 4 mm²; 32A: 6 mm²; 40A: 10 mm²; 50A: 16 mm²; 63A: 25 mm²; 100A: 35 mm².
- Each wire shall be identified at both ends by PVC ferrules.
- Inter panel wiring shall be done through 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

- The minimum earth bus size shall be minimum **65x10mm (Hot dip galvanised strip) or 40 x10 mm (Aluminium) or** higher to suit the Fault Level/ KA requirement.
- All doors and movable parts shall be earthed using minimum 1.5 mm² FRLS Copper flexible wires (Green color) 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 diameter hole shall be provided on the earth bus for termination of earth strip / wire.

Name Plate

- Name plates shall be provided as per standard.
- LT Panel shall be with details like name of client (on first row / top row), project name (second row), name of contractor (third row) & panel manufacturer (in fourth row) all with equal of descending order letters size on top of front side of panel.
- LT Panel shall be with name plate (on front side of door of I/c) having minimum details like (1) Power supply voltage (2) control supply voltage (3) frequency (4) Panel fault level (5) Panel protection class (6) Panel manufacturing IS standard considered etc. details.

Painting

- The LT Panel shall be treated with seven tank/ Nine tank process with Degreasing, Water rinsing, De-rusting, Water rinsing, Phosphating, Water Rinsing, Passivation.
- After seven tank process the external paint shall be powder coated with Siemens grey RAL-7035 for inside and outside of LT Panel.
- Mounting plate shall be painted Glossy white.
- Thickness of paint shall be between 100 Microns to 120 Micron.

Switchgear Modules

Air Circuit Breakers

- Circuit breakers shall be air break, Electrical Draw Out type for feeders 630A and above. All ACB shall be with Microprocessor based release with Overload, Short circuit and inbuilt Earth Fault protection. Only for APFC incomer Thermal Magnetic type can be accepted.
- The ACB shall be min. 50kA (1 Sec.) or higher as per fault rating, I_{CS} = 100%$I_{CU=}$ Icw. All ACBs shall comply and tested as per IS – 13947 / IEC 60947-1 and IEC 60947-2 standards.
- ACB for all Incoming, Bus coupler should be Four Pole Type. PCC outgoing feeders shall be Four Pole / Three Pole + Neutral (TPN) Type.
- ACB for Incoming and Bus-coupler shall be identical and inter-changeable.
- ACB Models shall be: Schneider - Master pact NW or Siemens -3WL or L&T U power or ABB E-Max; or Equivalent model from Vendor Approved list. Data sheet with parameter comparison shall be submitted for approval.

- ACB shall be with **inbuilt Communication Module** RS 485 for MODBUS for communication with SCADA/PLC for both control and monitoring.
- Electrical and Mechanical interlocking shall be provided between ACB Incomers and Bus coupler with required Key Locks, Under-voltage coil, auxiliary contactors etc. as per the system requirement.

ACB Trip Release LSIG (Micro Processor based) 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
- LSIG Fault record Display (ONLY FOR INCOMER & Bus-coupler)
- Metering & Energy display (ONLY FOR INCOMER & Bus-coupler)

- Ammeter display (For Outgoing feeders)

ACB shall be fitted with following

- Heavy duty switches having not less than 4 NO + 4NC contacts
- Built in resin cast current transformer
- Shunt and under voltage tripping device.
- The ACB shall be suitable for locking the breaker in various positions. Interlocks shall be provided to: Prevent the breaker from being isolated unless it is in the 'OFF' Position; Prevent the breaker from being racked in to the service position unless it is in the 'OFF' position; Prevent the breaker from being accidentally pulled completely 'OFF' the guide rail.
- Safety shutters of an insulation material shall be provided to prevent access to all live contacts, when the breaker is in the inspection position or completely withdrawn.

Molded Case Circuit Breakers (MCCB)

- All MCCBs shall be comply and tested as per IS - 2516 / IEC 60947-1& IEC 60947-2 standards.
- Incomer MCCB's shall be 4P, 50 KA or higher (and Ics = 100% Icu) with Micro-processor based release with in-built O/C, S/C and E/F protection.
- Outgoing MCCB TPN for power feeder up-to and including 200A shall be with thermal magnetic release with adjustable O/L and Adjustable/Fixed S/C protection. Outgoing MCCB's from 250A &above shall be with Microprocessor based release with in-built Adjustable O/C, Adjustable S/C and Adjustable E/F protection.
- All MCCBs shall be 50 KA or higher, Ics = 100% Icu and with Extended Rotary Handle and Terminal Spreader. Auxiliary change over contact 1 No + 1 NC and Trip Contact shall be provided as per the requirement.
- **MCCB of Soft Starter shall be TPN with Microprocessor** release with overload/ short circuit and inbuilt Earth fault release.
- MCCB as part of DOL/Start Delta starter motor starter module shall be current limiting type, TPN, (rating and protection type as indicated above) and type tested for Type-2 co-ordination as per IS: 13947 / IS/IEC: 60947.
- MCCB Models shall be: Schneider NSX / CVS (for ≥ 250A)& CVS (for ≤ 200A) or Siemens 3VL or L&T D Sine or ABB T-Max; or Equivalent model from Vendor Approved list.
- Electrical interlocking shall be provided between MCCB Incomers and Buscoupler with required Under-voltage coil, auxiliary contactors as per the system requirement.

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. All contactors shall be 3 Pole, AC3 duty except for lighting feeder where-in the contactor shall be 4Pole and AC1 duty. External Bypass

contactor used for Soft Starter shall be AC1 or AC3 as recommended by Soft Starter manufacturer.(Contactor must be one size higher)

- 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.
- **Contactor used (One size higher)** for capacitor feeder shall be Capacitor duty contactor with inbuilt leading contact with wiper function for limiting/ damping the capacitor inrush current with NO NC Auxiliary contact.

Bimetal Relay

- All bimetal overload relays shall be with in-built single phasing prevention and with Manual / Auto reset type (selectable) with at least 1NO and 1NC contact with reset type push buttons in the front, mounted on door such that it shall be possible to reset the O/L relay without opening the compartment door.

Motor Protection Relay (MPR)

- Motor Protection Relay (MPR) shall be provided for 30 KW & above Star delta starters. MPR not required for VFD/ Soft starter Motor feeders. Motor Protection Relay (MPR) shall be Numerical type with Overload, short circuit, Earth fault; under current, unbalance, Phase loss/reversal, Stall, Locked Rotor, No load running.
- Single Phasing prevention with adjustable Under/Over voltage protection shall be provided separately if the same is not inbuilt feature in MPR.
- **MPR shall be Numerical with adjustable parameter with inbuilt MODBUS over RS 485 interface if specified in BOQ/elsewhere in the tender**. **MPR shall be Din Rail mountable Base Module and LCD Display module shall be Panel door Mountable. ZCT/CBCT shall be provided for Earth fault/ leakage protection (range 0.1A to 2A). Shall have Programmable 2 DI and 2 DO.**
- MPR shall display 3 Phase current, Unbalance 10% as minimum and Earth current monitoring.

- MPR shall store Fault records/ Start- Stop records/ Motor run hours/ Maximum starting current etc.
- For motors 30KW and above external CT (3 no) 5A, Resin cast of suitable VA shall be used
- Data sheet with parameters comparison shall be submitted for approval from approved vender list.

Motor Starter

DOL starter to be considered for rating less than 7.5 KW rating, Star-delta starter to be considered from 7.5KW rating to less than 75KW rating. Soft starter to be considered for 75 KW & above rating. Soft starter shall be provided for lower ratings also if specifically asked for / as per the requirement.

MPCB with overload protection, Short circuit protection and Single phasing protection, AC3 duty contactor for DOL feeders and Start Delta feeders up-to and including 15KW.All PCB shall be with rotary switch.

MCCB (with adjustable overload, adjustable Short circuit, Earth Fault) Microprocessor release or Thermal Magnetic release (with adjustable overload, adjustable Short circuit)as

per the MCCB rating , AC3 duty contactor Numerical Motor protection relay as applicable, A/M switch, L/R switch, indicating lamps, pushbutton etc. shall be provided. Provision for door mounting PMU shall be provided in the Starter of Submersible Pump motor. Wiring shall be done up to Terminal connector for PMU input from field.

Minimum 8 Channel or higher Temperature scanner shall be provided in starter feeder for 90KW and above rated feeder wherever motor is supplied with RTD & BTD. Temperature scanner/Thermister& PMU (as applicable) shall be interlocked with starter feeder with control/tripping Circuit of Starter feeder. Temperature scanner shall be door mounted. Soft starter with input terminal for RTD (PT 100) and Thermistor for Motor Temperature (winding and Bearing) monitoring/ protection.

Specification of Temperature scanner shall be as specified below:

Temperature Scanner:

- Temperature scanner of required channels with min. 2 spare channels 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^{o} C
3	Alarm Contacts	Adjustable 4 Nos. (High temperature and very high temperature) for motor winding and bearing
4	Type of Relay contacts	One Single Pole Double Throw per set point (Relay)
5	Input Signal	From RTDs for each Motor winding and bearing
		winding
6	No. of channels	6 Nos. for Winding + 2 nos. Bearing + 2 spare
7	Accuracy	± 1^{o} C
8	Communication	RS-485 for Instrumentation panel interface if specified to be provided in BOQ / elsewhere in the tender.

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. All CTs shall be Resin cast type and secondary 5A. APFC feedback CTs, MFM CTs, MPR CTs shall be of Class-0.5 and 10VA. CT's (80A and above) of Digital Ammeter, APFC panel metering shall be Class : 1 and 5 VA. CTs less than 80A shall be Class 1.0 and 2.5VA.
- 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 Digital type and 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, 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 switch board. 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 Ammeter and Voltmeter shall preferably with separate Selector switches instead of meter with Inbuilt Selector switch. Wherever 3 phase Digital Ammeter/Voltmeter provided, same shall be with 3 line display.
- Digital type Multi-function Meter shall be with 3 line display, Accuracy Class: 0.5 Suitable for measuring and displaying the following parameters: A,V,F,PF,KW,KWH, KVA, KVAR, KVARh, Md (for PCC/PMCC incomer feeder MFM only), Harmonic & with inbuilt RS 485 communication port.(Schneider- EM 6400NG; L&T –MFM 4420; Secure – Elite 443 ; equi. model of other approved make). Data sheet with parameter comparison shall be submitted for approval.
- MFM shall be provided for all Incomers (PCC/PMCC), all Motor starter feeder Rated 30KW & above and all outgoing power feeders of PCC/PMCC rated 100A and above. For motor starters and outgoing power feeders provided with MFM, separate Ammeter / Voltmeter / PF meter are not required.

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
- Illuminated PB is not accepted.

Push button color shall be as follows:

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

Indicating Lamps

- Color 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

FIXED COMPENSATION:

- Fixed Capacitor for transformer compensation (for no load as well as leakage reactance)

shall be provided. MCCB 50 KA or higher as per specification mentioned elsewhere along with Ammeter, CT 3nos, Capacitor duty contactor, ON Delay timer, Heavy duty capacitor unit of suitable rating as per TFR KVA rating. Capacitor shall not be mounted below incomer feeder. Capacitor, if provided below buscoupler, capacitor housing/compartment shall be fully separated with steel sheet. Proper ventilation shall be provided.

- 7% Detuned Reactor with thermostat, 440V shall be provided in series with 525V capacitor or as per BOQ, KVAr rating of capacitor shall be suitable for reactor rating.

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 local language with a sign of skull and bones as per IS 2551.

SHOP DRAWINGS

- Prior to fabrication of the Panels the supplier / contractor shall submit for consultant's approval the shop / vendor drawing consisting of Technical data sheet duly filled in (as per Annexure-1) G.A. drawing, GA drawing with front door open with mounting plate details and equipment, sectional elevation, single line diagram, Power/ Wiring drawing, bill of material etc. and design calculations indicating type, size, short circuiting rating of all the electrical components used, bus bar size and calculation, Power/ control wiring size, Panels dimension, colour, mounting details etc. in 6 sets..
- The contractor shall submit manufacturer technical catalogue of major equipment like ACB, Soft Starter, MPR of offered make/model for approval along with drawings.
- Soft starter selection indicating Rated FL current, Derated current for design Ambient temperature, Full load current of motor, 110% rated FL current of motor as per IS 12615 shall be given by SS OEM. Derated current of SS shall be equal to higher than 110% FL current of motor as per IS 12615 / BOQ. Power drawing and control drawing of SS shall be got vetted from SS OEM before submission of drawings.

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.
-

CUBILCE / FEEDER SIZE CRITERIA FOR LT PANELS

- **ACB MINIMUM Cubicle compartment size considering minimum height of 1800mm.:**

ACB Rating	Width of Compartment (I/C or O/G in mm)	Width of Compartment (Buscoupler in mm)	Depth (mm)	Remark
800A -1250A 4P	800	900	1000	Cable entry
1600A 4P	900	1000	1000	Cable entry
2000-2500A 4P	900	1000	1200	Busduct entry
3200-4000A 4P	1100	1200	1300	Busduct entry

NOTE: Dimension mentioned above is minimum. Height of ACB feeder 1800 excluding main Bus bar chamber. Breaker Feeder in Single Tier.

- **MCCB MINIMUM Cubicle compartment size:**

MCCB Rating	Width of Compartment	Height	Remark
Up to 100A	350	300	Copper flexible shall be used
125A -200A	400	350(3P)/400(4P)	Bus bar/ strip
Above 200 to 400	500	450	Bus bar/ strip

A			
Above 400 to 550A	600	500	Bus bar/ strip
Above 550A	600	600	Bus bar/ strip

NOTE: Dimension mentioned above is Minimum. Depth of panel as per required depending on cable size/ site condition and for ease of maintenance. Incomer MCCB shall be only single tier .

- **VFD & SOFT STARTER MINIMUM Cubicle compartment size considering minimum height of 1800mm.**

Motor Rating	Min. Width of Compartment (For VFD and for S/S with Ext. Bypass Contactor)	Min. Width of Compartment (For S/S with Int. Bypass Contactor)	Depth of Compartment
Less than75 Kw	700	700	800
75kw to &incl 132 KW	800	750	900
Above 132 to &incl 250KW	900	800	900
Above 250KW	1000	900	1000

NOTE: Dimension mentioned above is minimum S/S Feeder for 22KW and above shall be in Single Tier only**.**

ANNEXURE 1: TECHNICAL DATA SHEET FOR MEDIUM VOLTAGE PANEL BOARD

SR. NO.	PARTICULAR	DETAI
1.0	SITE CONDITION	
1.1	Type/Make	Indoor / As per tender
1.2	Mounting	Floor / Stand mounted as per BOQ / site condition
1.3	Design 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, Partition, Cover/door
2.2	Protection Class	IP-5X
2.4	Base channel	100 x50 x5 mm Channel
2.5	Shipping section length	2500mm (Max)
2.6	Side sheets for shipping section	Full side sheet on both side of shipping section
3.0	OPERATIVECONDITION	
3.1	Voltage	415V±10%
3.2	No. of phase	3
3.3	System	3phase,4wire
3.4	Frequency	50Hz,+5%/-5%
3.5	Fault Current	50kAas per SLD
3.6	Neutral Grounding	Solid
4.0	CONTROLSYSTEM	
4.1	Voltage	
	For Indication	230VA.C.
	For Metering	230VA.C.
	For Protection	230VA.C.
4.2	Control Supply Through Constant Voltage Transformer	230VA.C. for PMCC & APFC only

4.3	Wiring	Control wiring : 1.0mm² FRLS PVC Cu flexible Wire (Grey); CT wiring 2.5 mm² FRLS, Color coded: Door earthing: 1.5 mm² FRLS (Green)
5.0	BUSBAR	
5.1	Phase Bus bar Material	EC grade Aluminum
5.2	Neutral Bus bar Material	Same as Phase Bus bar.
5.3	Earth Bus bar Material	65 x 10mm(Hot Dip Galvanized Strip) OR 40 x 10mm (EC grade AL)
5.4	Current density (minimum)	1 sq.mm = 0.8 A minimum (For Aluminum) &1 sq. mm = 1.4 A for Copper. Size of busbar based on
5.5	Hard ware	High Tensile Steel Bolts, Nuts and Washers duly Zinc/ Cd Passivated shall be used for all bus bars joints and supports.
6.0	PLC Based System	As per SLD / BOQ.
7.0	**ACB**	
7.1	Type, Rating, No of poles	EDO, 50 KA, Rating & pole as per SLD
7.2	Protection	LSIG with Display& fault record display control and monitoring from remote location
7.3	Display of Metering	Basic (A,V,F) &Energy for I/C & Only current display of Outgoing.
7.4	Communication port	Inbuilt RS 485 (on MODBUS/ Ethernet/ -)
7.5	Model	Schneider Master pact NW or Siemens 3WL or L&T U power or ABB E-Max; or Equivalent model from Vendor Approved list
8.0	**MCCB (Ics= 100% Icu)**	
8.1	INCOMER & Bus-coupler MCCB	Microprocessor based release with Adjustable O/L, Adjustable S/C, inbuilt Adjustable E/F, 50 KA, 4 pole

8.2	Outgoing MCCB	
8.2.1	For rating above 200A	Microprocessor based release with Adj O/L, Adj S/C, inbuilt Adj E/F, 50 KA, 3/4 pole as specified in
8.2.2	For rating upto& including 200A	Thermal Magnetic based release with Adjustable O/L, Adjustable/fixed S/C, 50 KA, ¾
8.2.3	For SS/ VFD starter feeder MCCB	Microprocessor based release with Adjustable O/L, Adjustable S/C, inbuilt Adjustable E/F, 50 KA, 4
8.2.4	Accessories	Extended Rotary Handle, Terminal spreader, Auxiliary change over contact + Trip Contact : To be
9.0	Electronic Motor Protection Relay	
9.1	Type	Electronic MPR with LCD display (3 phase current), Record storage, DI/DO interface etc. as per detailed specification give above
9.2	Protection/ interface	Confirm the following
		1) overcurrent 2) short circuit 3) Earth Fault 4) Current unbalance 5) phase loss/ reversal 6) under current (dry run) 7) stall (bearing broken) 8) locked rotor 9)Ground/Earth fault /leakage (ZCT) 10) Single Phasing with Under voltage and Over Voltage 11) Over temperature (With PTC Thermister) 12) 3Programmable DI & 2 Programmable DO
10.0	PAINTING	

10.1	Sheet should be 7 tank processed,	Required
10.2	Colour& Shade & thickness: Panel Exterior & Interior	RAL 7035 100 Micron – 120 micron
10.3	Mounting plate	Glossy white
11.0	**Current Transformer**	
11.1	Type	Resin Cast
11.2	Class of Accuracy	Cl : 0.5 for MFM, APFC load sensing, Summation, MPR Cl: 1 for Ammeter
11.3	Burden (VA)	As per specification
12.0	Hardware	YES. For bus bar joints High Tensile With Zinc passivation/Cd
13.0	Space Heater	230VA.C.witht Thermostat
14.0	Pocket For Drawings at Door	YES.
15.0	Instrumentation compartment	Separate compartment for energymeter, Hour meter, level controller, etc. with necessary
16.0	Panel Internal Lighting	1 ft long LED panel light 3W or higher with Auto NO contact/switch with Panel door and control MCB for VFD/SS/Starter feeder/Incomer/Cable alley.

Note: Other specifications not mentioned in datasheet shall be considered as per tender specification/ SLD.

SPECIFICATION FOR AUTOMAITC POWER FACTOR CONTROL PANEL (APFC PANEL)

- APFC panel shall be floor mounting, free standing, compartmentalized, extensible, Modular type suitable for indoor installation
- The panel shall be IP 52 for Metering and switchgear Module and shall be IP 42 for Reactor/ Capacitor section. Full partition shall be provided between Switchgear components and capacitor section. Each feeder module shall be fully compartmentalised. Capacitor/ Reactor shall be mounted in separate vertical section/cubicle adjacent to

switchgear cubicle instead of mounting at the rear end/ backside of switchgear module as per availability of space.

- The control equipment including capacitors shall be mounted in a panel made of 2 mm CRCA sheet. Panel shall be fully compartmentalised, Extensible and with Main Busbars in Horizontal Busbar alley.
- APFC panel shall be operated on AUTO and MANUAL mode. Individual capacitor feeder shall be possible to be operated on AUTO / MANUAL mode even when A/M switch in Incomer feeder is on AUTO Mode.
- All capacitors shall be Heavy duty MPP / Heavy duty Gas filled with discharge resistor and as per the technical data sheet provided here-in.
- Heavy duty exhaust fan 8" with canopy shall be provided at the top. Louvers with wire mesh shall be provided at the bottom end of capacitor section.

- Minimum distance between two capacitors and from all sides of panel enclosure (including terminal) shall be 25mm.
- Earthing terminal of Capacitor shall be connected to Earth bus bar.

The Automatic control panel/ Fixed Capacitor panel (for Transformer compensation) shall comprise of the following:-

- MCCB/MCB for Protection of Each Capacitor Bank (MCCB should be suitable for Capacitor Switching & KA rating shall be as per main panel KA rating)
- Incomer MCCB shall be TPN, Microprocessor based/ Thermal magnetic (adjustable O/L and Adjustable S/C) as per LT panel specification.
- APFC Relay shall be microprocessor based with inbuilt RS 485 for sensing and correcting the power factor of the system with required no. of steps to achieve the specified power factor. Minimum operating current/ sensing current shall be 10 mA. Minimum 2 nos. additional spare relay contact shall be available for future use.
- Two numbers vacant feeders with mounting plate and cutouts shall be provided for future use.
- A/M switch with Auto/ Manual indicating lamp shall be provided in addition to R Y B indicating lamp.
- Each Outgoing capacitor feeder shall be provided with suitable rating MCB / MCCB, Capacitor duty contactor with inrush damping resistor, A/M switch, 'ON' and 'OFF' push with ON indication lamp, ON Delay timer (only for Manual mode of individual feeder), 415V Capacitor unit with discharge resistor. Control circuit of individual feeder shall have control MCB for protection and Indicating lamp shall be only through Auxiliary contact.
- MCB's for capacitor feeder shall be D- curve only.
- Any other components required for satisfactory and safe operation shall be provided.
- Capacitor shall be compact in size and hermetically sealed. In built fuses & surge suppressors shall be provided for protection of each capacitor element.
- Capacitor Banks shall comprise identical delta connected three phase units. Capacitor Banks shall be non-flammable, non – toxic, Non PCB, Dry Technology, Inert Gas (N2)/ PU Resin impregnated, MPP, Heavy duty type/ Gas filled.
- Only one wire shall be connected to each Contactor terminal. i.e. whenever more than one capacitor is controlled from Contactor suitable size Bus-bar Strip shall be provided and power shall be tapped. Else separate contactors shall be used for each capacitor unit.
- If Load is VFD driven and Working VFD driven load is more than 50% of total load or if

required as specified in BOQ then APFC panel shall be with Detuned reactors. 7% detuned reactor, 440V, AL wound with Thermostat shall be provided in series with Capacitor unit. Capacitor voltage shall be 525V or as specified in BOQ and KVAr rating suitable for Reactor KVAr rating. Filter rating (Reactor + Capacitor) shall be Rating of APFC panel**.**

- Except for the specific requirements of APFC panel specified here in, rest all specifications shall be as per LT Panel / MV Switchboard specifications specified above.
- APFC Panel / Capacitor rating generally shall be at 415V or 525V if provided with detuned reactor or as specified in BOQ & APFC Panel shall conform to IS-16636:2017

Three Phase Filter Reactor:

Anti-resonance three phase filter reactor, Aluminium wound, 440V detuned reactors (5.67% or 7%) as required are to be used in series with shunt capacitors to prevent harmonic resonance and harmonic overloading of capacitors, Transformers whenever Power electronic Equipment (Drives, UPS etc.) producing nonlinear currents are used. Detuned systems shall be such that the self-resonant frequency is below the lowest line harmonic.

Features of Reactors:

- High linearity, Low losses & noise level.
- High over loading capability
- Inbuilt temperature micro switch

Micro switch potential free contact shall be used in control ckt of respective capacitor feeder to trip the contactor in case of high temperature.

Reactor shall be kept in independent cubicle and adequate ventilation shall be provided.

Power Factor Correction Thyristor Switch Module:

Thyristor switching instead of Contactor switching shall be used when load variation is rapid. Semi conductor fuses shall be used for protection of Thyristor switches in addition to MCCB/MCB. HRC fuses shall not be used. Discharge reactors shall be used for fast discharge for fast reconnection of capacitor.
Technical Features:

- Suitable for real time power factor correction
- Switching time less than 5 milli seconds
- PIV : 2200
- Permanent self controlling of: Voltage parameter, capacitor current, temperature of the thyristor switch.
- Suitable for manual operation also.
- Automatic switch off in case of over current and over temperature.
- Display of : Operation, Faults, Activation.

APFC Controller with RS 485:
Microprocessor based intelligent control, menu driven, single/ 3 CT sensing, 1A/5A CT selectable, with RS 485 communication port and features as below:

- Display: LCD illumination, Large and multifunctional characters. Parameters: Voltage, monitoring of individual capacitor currents, Real time PF, Power KW, KVA, KVAr, Temperature, Energy KWh, KVAh, KVARh
- Steps: 4, 6, 8, 12,16 as required
- Mounting: Panel mounting (size: 144 x 144mm)
- Current input: 1 A or 5A selectable
- Operating temperature: 0 to 60ºC
- Supply voltage: 230V AC
- Target PF: 0.8 inductive - 0.8 capacitive.
- Minimum operating current: 10/50 mA

- Sensing: single / 3 CT. 3CT sensing for unbalanced load.
- Dual target power factor setting: for utility and DG mode operation.
- Facility of including " Fixed capacitor bank" for purpose of transformer compensation. This can be set such that the controller doesn't 'see' this capacitor.
- Potential free contacts/ alarm output: insufficient compensation, over compensation, undercurrent, overcurrent, over temperature, harmonics exceeded.
- Suitable for Thyristor switching if Thyristors are used instead of contactor.

- **Minimum rating of MCB/MCCB, Cable/ flexible wire size for capacitor feeder shall be as below:**
- **CABLE SIZE SELECTION CHART (MINIMUM)**

Sr. no	Capacitor rating in KVAr	MCB/MCCB Rating	FRLS Copper Cable/wire size (mm^2)
1	Upto& incl 5 KVAr	16A	2.5
2	10 KVAr	32A	4
3	12.5 KVAr	32A	6
4	15 KVAr	63A	6
5	20 KVAr	63A	10
6	25 KVAr	63A	16
7	30 KVAr	100A MCCB	25
8	40 KVAr	125A MCCB	35 mm^2 /busbar from bus to MCCB
9	50/60 KVAr	160A MCCB	50 mm^2/ busbar from bus to MCCB
10	75 KVAr	200A MCCB	70 mm^2/ busbar from bus to MCCB

CAPACITOR DATA SHEET

Sr. no	PARAMETER	unit	
	Capacitor type		Heavy duty MPP/ Heavy duty Gas filled type

1	Conformance to standard		IS 13340/ IEC 60831
1	Rated Voltage	V	415/440/525 as required/ Applicable
3	Inrush current	A	Upto 200. Ir
4	Maximum permissible current/ Over current	A (Imax)	1.5 Ir
5	Maximum permissible Voltage/ Over Voltage	V (Vmax)	1.1 Vr

6	Temp class	ºC	60
7	Losses (per phase)	W/Kvar	Dielectric : less than 0.2 Total : less than 0.5
8	Capacitance tolerance		-5%/ + 10%
9	Dielectric		Poly Propylene
10	Impregnation		Non-PCB PU Resin/ Inert gas Nitrogen
11	Number of switching operation		5000 as per IEC 60832
11	Useful life	Hours	125000 minimum
12	Maximum THD in Voltage		3%
13	Maximum THD in Current		15%

Note: Rest all construction features and other requirements shall be as per the specifications of LT Panel.

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:

- GAD of APFC panel with elevation side view, sectional view and foundation details.
- Complete schematic and wiring diagrams for capacitor control panel.
- Detailed BOM and GTP
- Manufacturer technical data sheet of Capacitor and APFC relay.

SPECIFICATION FOR SOFT STARTER (FORMING PART OF LT PANEL OR STANDALONE 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.
- Soft starter shall have Current transformer/sensor in all the three phases for current monitoring.
- All phases should be controlled during start/stop.

- Soft starter shall consist of built-in RS485 MODBUS RTU for monitoring & control thro PLC/ SCADA.
- Soft starter should be built for continuous operation without need of by pass for any reason.
- Soft starter shall have feature which allows the soft starter to operate with only 2 controlled phases in case of short circuit of 1 set of thyristor. avoiding unplanned stop and possibility to keep running motor until the soft starter is repaired.
- Control terminals shall be easily accessible and located on the front bottom of the device.
- **Sizing / Selection Criteria for Soft Starters:**

  Soft starter de-rating factor for selection of soft starter shall be based on Design Ambient temperature (50°C), Altitude (up to 1000m above MSL as standard or higher as per site requirement), etc. declared by OEM as % de-rating in their published Catalogue available in the public domain only. Rating/model selection based on Design software/ certificate issued by OEM will not be considered for selection. Further the soft starter shall meet following conditions to be confirmed by soft starter manufacturer / OEM:

  Start current (cold start): 400% of In (rated current of motor) for 20seconds (Class 20 Tripping Class).

  Starting frequency: Up to 10 No. of starts per hour.

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 Full load current of motor as per IS: 12615 revised up to date or as per BOQ.
- Soft Starter shall be rated for DOL starting and shall have **In-built** Contactor of AC1 or AC3 rating as recommended by SS OEM.
- Soft starter shall be provided with breaker MCCB along with F.A. Semi- conductor fuse protection and with series contactor of required rating as recommended by OEM (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/Thermisters) 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 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
- 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 acceleration start ramp & stop ramp timers shall have individual adjustments from 1 to 60 seconds as a min..
- 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, Soft Start with Selectable Torque Boost, etc.), Bypass control & Bypass contactor mode with all the protection parameter working.

b) **Stopping modes** required for controller includes Linear Torque control for Stop, Pump Control (DOL/Coast to stop), Bypass control,DC/ Dynamic brake for fast stop of motor with high moment of inertia, etc.

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.
- 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.
- Soft starter shall preferably be with input terminal for RTD (PT 100) and Thermistor for Motor Temperature (winding and Bearing) monitoring/ control/ protection.

- **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 Ph. Voltage, Shaft Power in kW/HP (selectable), Motor thermal capacity, Motor Energy consumption (kWh), Power factor, Run time in hours etc.

Soft Starter model shall be: Schneider ATS-48 or ABB PSTX or DanfossMCD600 or equivalent model of Siemens or Rockwell or additional vendor such vendor from approved vendor list.

Notes:

1. Rest all construction features and other requirements shall be as per the specifications of LT Panel.
2. The soft starter features specified are in general and any manufacturer specific deviations in certain features can be reviewed and accepted based on merit / application requirement.

SPECIFICATION FOR HT & LT CABLES WITH LAYING DETAILS

All power and control cables for use on medium / high voltage shall be heavy-duty type, multi strand aluminum/copper conductor. PVC/XLPE insulated, Extruded inner sheathed, armored and overall PVC sheathed as described below.

The Power and Control cables shall have the following minimum overall cross sectional areas:

a.	Meduim Voltage Power	6 sq.mm (Aluminium) / 2.5 sq.mm (Copper)
b.	Control Cables	2.5 sq.mm (Copper)
c.	Lighting Cables	2.5 sq.mm (Copper)/6 sq mm aluminium

Cables shall be sized based on the maximum continuous load current and the voltage drop. The de rating due to ambient air temperature, ground temperature, grouping and proximity of cables with each other etc. shall be taken into account.

Below grade cables in paved areas shall be in concrete lined trenches with concrete covers having proper slope and suitable drainage arrangement to avoid water collection. In unpaved areas cables shall be in lined trenches or directly buries in gound. In hazardous areas and transformer bays, trenches shall be completely filled up with sand. Concret lined cable trenches shall be sealed against ingress of liquids or gases wherever the trenches leave a hazardous area or enter control room or

substation. The cable trenches shall be sized depending upon the number and voltage grade of cables. Where underground cables cross roadways, pipe sleepers at grade, etc., they shall be protected by being drawn through PVC sleeves/ducts or suitable

RCC Pipes to provide a permanent crossing. Pipes laid for mechanical protection shall be sealed at both ends.

High voltage, medium voltage, control and signal cables shall be separated from each other by adequate spacing or running through independent pipes, trenches or cable trays as applicable. Cable trays, racks and trenches shall be sized to allow for 20% future cables. Cable installation shall provide minimum cable bending radii as recommended by cable manufacturer.

Cable route markers shall be installed at every 30m interval all along the routes of directly buried cable trench and also at locations where the direction of cable trench changes.

All power and control cables shall be of continuous lengths without intermediate joints. Where joints are unavoidable, these shall be provided with the permission of Engineer-in-charge. All cables shall carry tag numbers for easy identification. In case of control cables all cores shall be identified at both sides by their terminal numbers using PVC ferrules as per interconnection diagrams.

Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing/engraving shall be legible and indelible.
Control cables having 6 cores and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers shall contrast with the colour of insulation with a spacing of maximum 50mm between two consecutive numbers. Colour coding for cablesup to 5 cores shall be as per IS.

A H.T. XLPE CABLES

Scope

- The scope shall cover supplying, laying, testing and commissioning of 3 core cables of circular stranded aluminum conductors, XLPE extruded dielectric, copper tape screened, armored, Extruded semi conducting compound inner-sheathed and PVC overall sheathed confirming to IS 7098 part 2 with latest amendments. 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 stranded compact circular Aluminium conductor, Conductor screen with extruded semi conducting compound, cross-linked polyethylene (XLPE) insulated, insulation screening with extruded semi conducting compound in combination with copper tape, GI Flat/ round wire armoured, PVC outer sheathed 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 11000 VOLT", cable size, IS specification No., identification of manufacturer and year of manufacture, sequential length marking etc., 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:

Manufacturer shall carry out Routine tests and acceptance tests in accordance with the relevant IEC standards / IS. Routine / acceptance tests reports shall be furnished before dispatch of cables / supply of cables at site. The copies of Type test results shall be submitted along with each drum length. .

B LT POWER & CONTROL CABLES

- The scope shall cover supply, laying, testing and commissioning of medium voltage 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.

XLPE Insulated Power/ Control Cables (Medium Voltage)

1.1 kV grade Stranded Aluminum / Copper conductor, XLPE insulated, Extruded Inner sheath, GI Strip/ wire armored (Aluminum armored for Single core cable) LT XLPE cable as per IS 7098 (part I) 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 requirement. 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 polycarbonate type 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: 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.

C Cable Accessories

All accessories like cable glands, lugs and terminal markings etc. shall be used conforming to relevant standards / as specified. The end termination for HT cables shall be heat shrinkable type. For 1100 V grade cables, Ni-Plated Brass Double

Compression type glands WP to IP-65 as a minimum and tinned copper crimping type lugs shall be used.

D Cable Laying

HV, MV and control cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cable trays.

Cable Laying and termination shall be such that chances of cable getting damaged are remote.

LT cable shall be laid in cable tunnel or tray racks or burried underground with appropriate protection. Black shall indicate the neutral, while red, yellow and blue for three different phases. All LT cables when laid on the cable racks shall be properly dressed and clamped as required without crisscrossing and unnecessary overlapping. Cables shall be properly dressed and clamped.

Laying of HT and LT under ground cables.

Minimum depth of cable trench shall be 750mm for LT cables and 900mm for HT cables. The cables shall be protected by filling trench bottom with a layer of sand after clearing the bottom from all rocks, stones and sharp objects, before the cables are placed. These sand shall be leveled and cables laid over it. These cables shall be covered with 150mm of sand on top of the largest diameter cable and sand shall be lightly compacted. A flat protective cover of 75mm thick second class red bricks shall then be laid and compacted and then remainder of the trench shall then be backfilled withy soil, rammed and leveled.

In routing, necessary barriers and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angles and these two shall not run in close proximity.

LT cables shall be bent in radius not less than 12 times their individual overall diameters, while HT cable shall have bends not less than 15 times their individual overall diameter.

Cable routing between cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45 Deg to the trench wall. Bending radii of pipes shall not be less than 8D. It is ensured that both ends of the GI pipe sleeves shall be sealed with approved WP sealing plastic compound after cabling. In places where it is not possible, cables shall be laid on smaller branch trays.

All cable shall be identified close to their termination point by cable tag numbers as per cable schedule. Cable tags shall be punched on aluminium straps (2mm thick, 20mm wide of enough length) securely fastened to the cable and wrapped around it.

Routes of these cables shall be arrived at on the basis of the relevant drawings and after consulting the Engineer in charge.

E Drawings and Schedules

Size of cables shall be given in singe line power diagrams. A cable schedule shall be prepared on the basis of relevant drawings. All cables and wires shall be adequately sized to carry continuously the normal currents expected on the relative circuits. All trenches for electrical cables shall be separate from water or sewage pipe line trenches.

F Splicing and Termination

Straight through joints shall be avoided. In case, these are absolutely necessary they shall be made at convenient locations suitably protected as approved and sanctioned by the Engineer in charge but in no case within the conduit pipes or ducts. Branch circuit wiring shall be spliced only in switch boxes, panel switch socket outlet boxes light fixtures outlets and circular junction boxes. They shall be made only with approved porcelain connectors.

Cables shall be tested in accordance with IS: 1554 / 7098

SPECIFICATION FOR OTHER EQUIPMENT AND ACCESSORIES

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 / Aluminum 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.
- Size 150mm and above shall be ladder type and below 150mm shall be perforated type.
- Collar size of the ladder type cable tray shall be 100mm and 50mm for perforated type.

Cable Glands:

- Cable glands shall be heavy duty double compression type of Ni-Plated brass. These shall be suitable for armored/Unarmored cables, which are being used.

Cable Connectors:

- Cable connectors, lugs/sockets, shall be of copper/aluminum 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 Aluminum 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./UPVC/RCC pipes shall be used.
- Pipe shall be laid at on 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.

SPECIFICATION FOR 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.
- The local push button station / local control station (LCS) shall have Polycarbonate/ FRP / die-cast Aluminum enclosure or as specified in BOQ, IP 65 with gland plate with knock out holes suitable for outdoor application.
- 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 1.0 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/ shall be transparent Acrylic.
- 20% spare or minimum 2nos. Spare terminals shall be considered.

Type of Push Button Stations

Type of LCS	**Application**	**Features required in LCS**
Type-A	Soft Starter Motor	Start & Stop PB
BOQ /		Scope of Work for Motor rated above 30KW.
Type-C	Motor above 30KW	Start, Stop PB. Ammeter if specified in BOQ / Scope of Work.
Type-D	MOV	Open, Close and Stop PB
Type-E	Reversible Motor	Forward, Reverse and Stop PB

SPECIFICATION FOR INTERNAL AND EXTERNAL ILLUMINATION.

General

The illumination system shall consist of lighting poles, lighting distribution boards, lighting panels / power panels complete with FSU/ELCB/MCB, Fixtures, Cables, Junction Boxes, terminal blocks, cable glands, 3 pin 5A/15A convenience socket outlets, conduits and accessories and supporting and anchoring materials, lighting fixtures with fluorescent tubes, sodium vapour lamps, wires, etc. All materials, fittings and appliances use in electrical installation shall conform to the relevant IS specifications, required area classification and environmental conditions and shall be anticorrosive painted / FRP enclosures.

The wiring for lighting circuits shall be done by wires run in PVC conduits for indoor areas. For outdoor lighting, wiring shall be done by armored cables.

Illumination Level

The following minimum levels of illumination (avg. lux level) shall be provided in the respective areas :

	Area / Building	Illumination Level
a)	Pump House / Centrifuge or Press Area / Sheds / Blower Room	150 Lux
b)	Control Room / Laboratory	300 Lux
c)	Office	200 Lux
d)	Switchgear/MCC Rooms	200 Lux
e)	Sub-Station (Switchyard)	50 Lux
f)	Toilet block / Wash Room etc.	100 Lux
g)	Roads / Walkways	10 Lux
h)	Yard / Outdoor Area	10 Lux
i)	General Process / Outdoor Eqpt. Area	100 Lux

The lighting fixtures offered shall comply with the following requirements.

a) Luminaries shall have high efficiency Lumen Output/Watts

b) Enclosures shall preferably be FRP/Cast Aluminum with corrosion resistance paints.

c) All indoor and outdoor lighting fixtures shall be power saving long life LED type only.

All lighting fixtures shall be supplied complete with control gear and lamps. Special fixtures, wherever required to meet operational requirements, aesthetics etc. shall also be provided by the bidder. Make of lighting fixture shall be embossed on each lighting fixture.

Lighting wiring between LDB/SB and lighting fixtures shall be done by PVC insulated, copper wire (phase, neutral and earth) for non-plant buildings which shall be through surface run / concealed conduit. All lighting cables shall be 3C x 2.5 sqmm, 660 / 1100 V grade, copper conductor, PVC insulated, armoured type. Conduit wiring shall be done in 25mm dia minimum 16 gauge black enameled steel structure conduit or PVC concealed conduit, with 1100V grade PVC insulated copper wire of min. size 2.5 sqmm for fixtures / 5A receptacles and 4 sqmm for power sockets. Not more than 7 wires shall be accommodated in each conduit. All lighting fittings / convenience outlets shall be earthed through the third wire / separate core in conduit/cable.

On walkway, platforms and other outdoor areas, lighting fixtures shall be nearer to landing of stairs or ladders, gauges, flow meters, panel boards or other equipment requiring good illumination. In outdoor equipment area at ground level, lighting fixtures shall be mounted preferably 4m above floor level. Where this is impracticable, the minimum height of any lighting fixture shall not be less than 2.5m. Socket outlets in process plant areas shall be approximately 1200mm above floor level and 300mm above floor level in office area. Lighting/Power panels shall be mounted such that the top of the panel is 1800mm above finished grade. Control gears of lighting fixtures with separate control gear shall be mounted at suitable height from ground / platform for easy access / maintenance.

All lighting circuits and convenience receptacles shall be fed from lighting / power panels. Main/Lighting Distribution Board (MDB/LDB) shall be dust and vermin proof and shall be provided with SFUs (HRC) / MCCB as incomer and outgoing feeders where fault level is more than 9kA.

Main and Branch Distribution Boards: Each Main DB should be provided with 4 Pole Isolator as Incomer and DP ELCB+MCB as Outgoing circuit in each phase and all sub DBs should be with Isolator+ ELCB as in comer and MCB as Outgoing to control and for protection of lighting circuits. All DBs should be Double Door type – a hinged door to cover the operations knobs shall be provided. MCBs shall not be loaded beyond 80% of rated capacity. A minimum of 20% MCB in each panel shall be kept as spare. Power and lighting panel shall be of 16 gauge sheet steel construction and shall be suitable for surface or flush mounting.

All outdoor lighting shall be automatically controlled by means of synchronous timers with manual override control. Normally about 8-10 fixtures shall be wired in each circuit. Lighting feeders requiring automatic control shall be provided with contactors of suitable rating.

Sufficient number of Three Pin type 5A/15A receptacles as per IS;1293 shall be provided. Flush mounting type receptacle shall be used where concealed wiring has been adopted and surface type shall be used for other areas. For exhaust fans and wall mounted air cirucaltors, socket and switch enclosure shall be separate whereas for rest receptacle and controlling on/off switch shall be mounted in the same enclosure. In building such as Sub-station, D.G. Shed, Workshop, maintenance shop, etc. industrial type metal clad socket outlets and plugs shall be provided. The sockets shall be supplied complete with plugs.

Adequate number of ceiling fans of 1200mm sweep (with double ball bearing and regulator)shall be provided in offices and rooms allocated to operating and maintenance personnel etc. In places where ceiling fans are provided, lighting fixtures shall be suspended below fan level with the help of conduits / chains to avoid shadows on the floor.

Minimum 2 nos. or sufficient exhaust fans as required during detailed engg. / recommended by equipment manufacturer shall be provided at Battery room,

laboratory room, Sub-station/Switchgear/MCC room, DG room, all pump houses, filter house, etc. The exhaust fans shall be provided with louvers / net to prevent insects. For pump house below ground level, suitable GI ducts for exhaust shall be provided as decided during detailed engineering and instructed by Engineer-in-charge.

Lux Levels shall be maintained at various Locations as indicated above and shall be backed up by Calculations from Manufacturer.

Switch Box :

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, upto a size of 20 cm x 30 cm and above this M.S. boxes having minimum sheet thickness of 1.6mm shall be used. Switch boxes shall be galvanized after fabrication. Except where otherwise stated 3 mm thick phenolic laminaged sheets like summica 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 inflush pattern. All fittings shall be flush pattern. It shall be provided with adequate number of knock outs on all sides for ease of wiring either with conduits or without conduits.

Wiring / Conduit System

Surface Conduit Wiring System

PVC conduits pipes of approved minimum 1.6mm wall thickness shall be used. The maximum number of The minimum PVC conduit diameter shall not be less than 25 mm. Maximum number of wires permissible in a conduit shall be seven/nine for wire size of 2.5 sqmm/1.5 sqmm respectively.

In long distance straight run of conduit, inspection type junction box at reasonable intervals shall be provided.

Fixing of Conduit

Conduit pipes shall be fixed by heavy duty G.I. pressure saddle with screws in an approved manner at an interval of nore more than one metre 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 20 gauge for conduits .

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 lips 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. The width and the thickness of the ordinary clips or girders clips and clamps shall not be less than as stated below :

Recessed Conduit Wiring System.

Recessed PVC conduit wiring system shall comply with all the requirements of surface conduit wiring system specified in clauses above and in addition to the requirements specified in the following clauses.

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of buildings under construction, fixed work, specials care shall be taken to fix the conduit and accessories in position along within the building work, to avoid damage to the finished wall etc.

All outlets such as switches, wall sockets etc. shall be flush type

The outlet box shall be same as above and shall be mounted flush with the wall. The metal box shall be efficiently earthed with conduit by an approved means of each attachment.

To facilitate drawings of wire in the conduit. GI mesh wire of 10 SWG shall be provided while laying of recessed conduit.

Drawings

All wiring diagrams shall indicate clearly in plan, the main switch board, the distribution fuse board, the run of various mains and sub-mains and the position of all points with their classification.

Rating of Lamp, Fans, Socket Outlet Points and Exhaust Fans
Lamps installed in pump house & other means shall be LED Type only.

Table fans and ceiling fans shall be rated at 60 watts. Exhaust fans shall be rated according to their capacity.

5 Amps. Socket outlet points and 15 amp. Socket outlet points shall be rated at 100 watts and 1000 watts respectively, unless the actual values of load are known or specified.

Capacity of Circuits
Lights and fans may be wired on a common circuits, such circuit shall not have more than a total of ten points of light, fan and socket outlet or a load or 800 watts whichever is less.

Power circuits on buildings shall be designed with a maximum of two outlets per circuit, based on the loading.

Where, not specified the load shall be taken as 1 kW per outlet. Wherever the load to be fed is more than 1 kW it shall be controlled by an isolator switch or miniature circuit breaker.

Indoor & Outdoor 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 - ≤ 20%
  For Indoor Fittings - ≤ 20%
- Power Factor :- ≥ 0.85
- Colour Rendering Index (CRI) :- ≥ 70
- Colour temperature / apparent : ≥ 5700K (Cool day light)
- Radiation :- No Ultra-Violet (UV) or Infra-Red (IR)
  :- No RF to interfere with radio equipment
- LED Life :- Long Life, generally 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.).

Industrial Luminaire

Indoor LED wall mounting Industrial Luminaire shall be LED Type minimum 10watt to 48Wattage:

Each fitting shall be required LM-79 & LM-80 Certificates.

Tube Light shall be 20Watt or higher wattage with integral / non-integral driver, Surge-4KV,IP-20, 4 feet, with LEDs of wattage 0.2 Watt to 0.5 Watt assembled on single MCPCB, with housing used as a heat sink shall be made of thick sheet Steel conforming to IS: 513/CRCA polyester powder coated and high U.V. & corrosion resistance with diffuser and/or Polycarbonate optics with company mark/name.

120 to 300 V,Power Factor more than 0.9, THD < 20%

CCT 4000 K to 6500K, Uniformity ratio >0.7,

Luminaire efficacy> 85 lumens/watt ,

LED driver efficiency > 85 %

Fixtures shall be with earthing arrangement facility suitable for ceiling or pendant mounting suitable for 19 mm conduit with stove enameled reflector gray outside and white inside which can be installed without aid of any; tools, complete in all respects and ready for use.

Emergency Light

Emergency light unit working on 230 volts. A.C. supply shall be self containing LED type of minimum with 20 watts 600 mm long type 'SWITCH ON MAIN FAILTURE. It shall be electronic automatic type which incorporates a unit trickle charge circuit, which shall prevent over charging or battery The battery shall be maintenance free. The unit shall provide 4 hours illumination following power failure. The units shall generally conform to IS:9583.

Outdoor Yard / Road Lighting:

Outdoor Luminaire

The luminaire shall be LED Type with minimum 40watt to 240watt LED complete with all accessories and each Street light / Flood light Industrial Luminaire shall be IP-65 & Surge -4KV & shall be required LM-79 & LM-80 certificates.

LED Outdoor Street light / Flood light / well glass Industrial Luminaire shall be with High power White LEDs wattage of 1Watt and above assembled on single MCPCB, efficiency more than 130 lm/w and corrosion free High pressure die cast aluminum housing with smooth finish powder coated and heat sink extruded aluminium with diffuser and Polycarbonate optics/ lenses with company mark/name engraved or embossed

120 to 300 V,Power Factor more than 0.95, THD < 20%, CCT 5000 K to 5700K, Uniformity ratio >0.45, Luminaire efficacy> 85 lumens/watt . LED driver efficiency > 85 %.

LED 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 - ≤ 20%
  For Indoor Fittings - ≤ 20%
- Power Factor :- ≥ 0.85
- Colour Rendering Index (CRI) :- ≥ 70
- Colour temperature / apparent : ≥ 6500K (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
- LEDs shall produce almost no heat, nearly all of the energy used shall be converted to Light.
- 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.
- LED Light/Lamp shall be capable of resisting Mechanical vibration and shock.
- The PCB containing the electronics should be capable of solder free installation and replacement.
- Luminaries must be clearly marked with manufacturer name, model number, electrical rating and agency approval (If applicable - CSA, UL, etc.).
- Lamps shall only be used and installed accordance with manufacturer instructions (If applicable).

SPECIFICATION FOR EARTHING SYSTEM

1 Earthing system design and installation shall generally be as per IS:3043. All metallic non-current carrying parts of electrical apparatus, current and potential transformer secondaries, columns, vessels, towers, stacks, storage tanks, etc. shall be earthedat least by two distinct separate earth conductors from the earth plate connected to main earthing loop.

2 The main grid conductor shall be hot dip galvanized MS flat. The amount of galvanizing shall be minimum 610 gm per sqm. The main earth loop shall be laid at a depth of 500mm below grade level.

3. Earthing conductor shall be laid around the battery limit of the plant. Horizontal conductors shall be laid in both longitudinal and transverse direction to facilitate earthing of various equipment in most economical and reliable manner.

4.Cable Trays in process areas shall be earthed with the help of risers emerging from main earthing conductors laid below/adjacent to structures carrying cable trays. Trays shall be earthed at an interval of approx. 30m and in any case shall be connected to the earthing grid at minimum two points.

5.Joints and tappings in the main loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade shall be welded and suitably protected by giving two coats of bitumen and covered with hessian tape.

6.Adequate number of min. 65mm dia. or higher size as per IS:3043, 3m long GI pipe earth electrodes with earth pit shall be provided. All earth electrodes shall preferably be driven to a sufficient depth to reach permanently moist soil.

7.Multiple earth connection shall be taken from suitably located earth plates connected to earth loop. All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections of equipment. Unless otherwise specified, earthing connections to individual equipment shall be done in accordance with standard equipment earthing schedule.

8.Lightening protection shall be provided for equipment, structures and buildings 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 lightening protection and this shall be bonded with the main earthing network minimum at two points at the buried electrodes.

9.The resistance value of an earthing system to the general mass of earth for the electrical system and equipment shall be as follows:

10.For the electrical system and equipment a value that ensure the operation of the protective device in the electrical circuit but not in excess of 5 ohms. However, for generating stations and sub-stations this value shall not be more than 1 ohm.

11. For lightening protection, the value of 5 ohms as earth resistance shall be desirable, but in no case it shall be more than 10 ohms.

10. **Connection**

The earth system connection shall generally cover the following:

Equipment earthing for personnel safety

System neutral earthing

Static and lightning protection

System neutral

Current and potential transformer secondary neutral

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, etc.

Steel structures/columns, etc.

Cable trays and racks, lighting mast and poles

Storage tanks, vessels, and all other process equipment

Fence and Gate for electrical apparatus (e.g. transformer, yard, etc.)

Cable shields and armour

Shield wire

All main earthing shall be used for earthing of equipment to protect against static electricity.

All medium (LT) and high voltage (HT) equipment (above 250V) shall be earthed by two separate and distinct connections with earth.

Plant instrument system clean earthing, UPS system clean/safety earth shall be separate from the electrical earthing system.

All earthing connections for equipment earthing shall preferably from the earth plate mounted above ground wherever provided. Equipment foundation bolts shall not be used for earthing.

Earth connections shall be made through compression type cable lugs / by welded lugs.

All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections and all connections adequately locked against loosening.

Lighting fixtures and receptacles shall be earthed through the extra core provided in the lighting circuit/cable for this purpose.

The reinforcements of sub-station building and sub-station floor shall be connected to main earth grid.

The earth electrodes shall be situated at a distance not less than 3.0 m from the building fencing structure and equipment foundations. The surrounding the electrodes, soil shall be treated up with salt, coke and charcoal. The distance between two electrodes shall not be less than twice the depth of electrode.

Minimum requirement of earth pits as per I.E. rules are as under.

Two numbers independent for transformer body

Two numbers independent for transformer neutral

Two numbers independent for four pole structure.

One number for lightning arrestors.

Two numbers for L.T. panel at sub-station and at pump house.

The main earth electrodes after being driven into the ground shall be protected at the top by constructing a concrete or block masonry chamber of size 300 mm x 300 mm x height 300 mm shall be provided with CI cover. 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 remaining space in the bore hole shall be filled with bentonite. The bentonite will hold the earth road in position., The neutral conductor shall be insulated throughout and shall not be connected at any point to the consumers earthing system.

It shall not be allowed to use the armour of the incoming feeders cable to the sub-distribution board as the only earthing system.

Sheathed lugs of ample capacities and size shall be used for all underground conductors for sizes above 3 mm^2 whenever they are to be fitted on equipment of flat copper conductor.

The lugs shall be fitted on equipment body to be grounded or flat copper only after the portion on which it is to be fixed is scrubbed, cleaned or paint or any oily substance on a subsequently tinned.

No strands shall be allowed to be cut in case of stranded ground round conductors. GI embedded conduits shall be made electrically continuous by means of good continuity fixing and also rounding copper wires and approved copper clams.

11. Recommended Size of Earthing Conductors

Below are the recommended minimum sizes of earth conductors. However, Earthing Strips/conductors, if required of higher size as per Ground Fault Calculations, should be laid as per BOQ or as per site requirement.

Type of Equipment	**Earth conductor size (See Note-1)**
Motors upto 3.7KW	8 SWG solid GI wire
Motors from 5.5KW to 30KW and welding receptacles	10mm dia GI wire rope
Motors above 37KW	16mm dia GI wire rope or 40 x 5 mm GI strip
Building columns, fencing	40 x 5 mm GI strip
Storage Tanks (Vert./Hor.) / Vessels	40 x 5 mm GI strip
Small equipment and instrument	8 SWG GI solid wire
Lighting, Power and Instrument Panels	10mm dia GI wire rope
Main Earth Bus / LT & HT Switchgear	75 x 8 mm GI strip

Interconnections / Power Transformer	
HV Sub-stations	50 x 6 mm Cu for Neutral 75 x 8 mm GI strip for rest
Push Button Stations (LCS)	8 SWG GI solid wire
Street Light Poles	8 SWG GI solid wire
Lighting Transformer	16mm dia GI rope
Pipe Rack	40 x 5 mm GI strip
Bonding of pipe flexible	25 sqmm insulated Cu cable

Note:

i. Earth connection to individual equipment from nearest earth plate / grid may also be done alternately using aluminium/copper conductor PVC insulated core of size note less than half the cross section of the respective power cable to equipment (motor, panel, etc.). Connections shall be made using crimpt type lugs.
ii. No. of runs of Cu / GI earthing strips shall be as per ground fault calculations
iii. The size of strip mentioned may be changed as per availability meeting the minimum area requirement of specified size of strip / conductor.

Maintenance Free Safe (Chemical Type) Earthing System:

- Chemical type earthing electrode shall be used for equipment body earthing. It shall be made with steel core and a copper exterior to provide increased conductivity and corrosion resistance. The electrodes shall be minimum 3 meter length, 17 mm diameter with 99.9% pure electrolyte copper coating of minimum 250 microns & ANSI / UL 467 approved. Adherence of copper to steel rod is achieved through a pioneered bright acid copper plating process using 14 stations using proper current densities, temperature and brightener additives to achieve copper plating with finer grain structure and a smoother, harder and more uniform surface. It shall have minimum tensile strength of 80,000PSI and straightness tolerance 0.01" per linear foot and shall meet the requirement of ANSI / UL 467, CSA and ANSI / NEMA.UL logo and control number where applicable shall be stamped on each rod for easy inspection after installation. The rod shall be tested according to IEC-62561-2 and comply to the requirements of IEC-60364-5-54.The rods also should withstand short circuit currents. All fasteners used should confirm to the requirements of the above standards.

- Back filling compound used shall have resistivity less than20 ohm-cm in its set form.Earth resistance shall be remained same over a wide temperature variation of -60 deg to +60 deg.It shall be suitable to absorbs and retains moisture for long time and shall reduced soil resistivity, Dissipate fault current very fast, Eliminate needs of salt and chemical around electrode and maintain compatibility of soil and rod contact. Earth enhancing compound (Soil conductivity improver) used should be tested according to

IEC62561 – 7 from an NABL accredited laboratory. Exothermic welding material used shall be tested as per IEEE 837

Construction Procedure of Chemical Type Earth Pit:

- A hole of 100 to 125 mm dia. shall be augured / dug to a depth of about more than 3 meters or as per instruction of Engineer in-charge.
- Earth electrode of minimum 3 meters length shall be placed into this hole.
- It will be penetrated into the soil by gently driving on the top of the rod. Here natural soil is assumed to be available at the bottom of the electrode so that min 150 mm of the electrode shall be inserted in the natural soil.
- Earth Enhancing material (min. 50 KG) shall be filled in to the augured /dug hole in slurry form and allowed to set. After the material gets set, the diameter of the composite structure (earth electrode + Earth Enhancing material) shall be of minimum 100 mm dia. covering entire length of the hole.
- Remaining portion of the hole is filled with backfill soil which is taken out during auguring / digging
- Construction of masonry earth chamber and cast iron cover with earth resistance result with date or as per instruction of Engineer In-charge.
- For interconnection to the main earthing grid, 40X 5 mm thick copper clamp shall be provided.

A) PIPE-IN-PIPE Technology Safe earthing:

- Two pipes of Co-Axial diameters joined together for enhancing the service life and performance of the overall earthing system.
- The cavity in between the electrodes shall be filled with crystalline conductive compounds for current dissipation and anti-corrosive properties.
- The electrode cross section shall be circular for the uniform distribution of fault current all-around from electrode to earth.
- Inner pipe of length 3 M shall be Hot dip galvanized / zinc coated with minimum galvanizing thickness 80 - 100 micron OR Copper plated (minimum 250mm) as per Drawing/BOQ. Minimum Size of pipe as per Drawing/BOQ.
- Outer pipe of length 3 M shall be Hot dip galvanized / zinc coated (minimum 150 micron) OR Copper plated (minimum 250mm) as per Drawing/BOQ. Minimum Size of pipe as per Drawing/BOQ.
- A hole of 200mm -225 mm dia. shall be augured / dug to a depth of about more than 3 meters or as per instruction of Engineer in-charge.
- Earth enhancing compound of minimum 50 KG shall be filled. **Earth enhancing compound shall be filled till top of Earthing Pipe electrode.**

B) Plate Type Earthing Stations:

- The earthing station shall be as per drawing / IS: 3043. The Equipment neutral earthing shall be with copper plate earthing station.
- The plate electrode shall be 600 x 600 x.3.15 mm copper plate for neutral earthing.
- The earthing conductors shall be of copper strip in plate type earthing.
- G.I. pipe with funnel of good quality shall be used for watering the earthing electrodes / stations.

- The brick masonry chamber with chequered plate shall be provided for housing the above referred funnel and pipe.

Earthing Unit Measurement:

- Earthing station / pit complete with excavation, electrode, watering pipe, soil treatment, masonry chamber with cast iron cover etc. as per tender specification / drg. shall be treated as one unit.
- Different sizes of stripes / wires per unit length covering / including cost of interconnection the earthing station to earthing grid, and to respective equipment with fixing accessories like earthing clamps, saddle, labour, etc. shall be traded as unit length.
- 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 also include followings:

The scope of work shall also cover supply, laying, installation, connecting, testing and commissioning of:

- Plate (600 x 600 x 3.15 mm Copper plate)/ Pipe type (Chemical type) Earthing station with G.I Pipe / Copper plate of size as per tender / IS.
- Earthing Copper strips from Plate earthing station & Hot dipped 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 tender.
- Galvanising thickness shall be 86 micron & 610 g/m2 as a minimum.

SPECIFICATION FOR SAFETY EQUIPMENTS

The contractor shall provide safety equipment for HV panels, Generator panels, LT/Control panels, etc. as per statutory requirement. Generally following shall be provided as a minimum (forming part of scope of this work):

- Supply and spreading Synthetic Rubber mat, 1 mtr wide, 2mm thick, conforming to IS:15652 Class-A for 1.1kV LV voltage in front of LT Panel/ APFC/ MCC Etc
- Supply and spreading 1 mtr wide 2.5mm thick synthetic insulating mat as per IS 15652(Class-B) suitable for operation of 11KV equipment in front of all the HT panel for their entire length. The insulating mat should have ISI mark on every one meter.
- Pairs of electrically tested 22 KV 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 First aid kit for treatment of electrical burns in the main switch room.
- ABC powder type 'Ceasefire' portable type Fire Extinguishers as per IS:13849 or suitable Kg capacity with necessary clamp for erection on wall for the individual substation, panel rooms requirement and fire safety guideline.
- Danger / Caution notices in English shall be fixed permanently on the equipment, LT/HT panel room, Switch yard etc 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 LT panel room, HT sub station and at Transformer yard (Stand shall be with canopy). Stand shall be grouted in RCC.
- 3 Mtr& 6 Mtr. long folding aluminium ladders for safe maintenance of lighting system, etc.
- SLD and Earthing layout of suitable size duly framed/ laminated shall be fixed on the wall near the entranc

INSPECTION & TESTING

- Major electrical equipment, as indicated below shall be tested and inspected at vendor manufacturer's works before dispatch to ensure compliance with the specifications/requirements and applicable codes and standards and agreed quality assurance/testing plan.
- Inspection at Manufacturers Premises: Tests of major items like HT panel, LT panel (rated above 630A), Transformers (rated 500kVA & Above), HT Cable (Length 100Mtr and above) & LT cables (For Cable Size <120 Sq.mm: in case of length 1000m & above for each size; For Cable Size 120 Sq.mm & above: in case of length 500m & above for each size) & for Motors (Except equipment tested with job motors) above 75kW ratings shall be conducted at manufacturer's work in presence of PMC / third party inspection agency (TPIA) and client' representative appointed by purchaser's representative. All the expenses like transportation, lodging & boarding shall be borne by contractor.

  Rest items shall be cleared for dispatch based on review of manufacturer's Test

Certificates / manufacturer's Test Report by TPIA/ Client's Engineer.

- For LT panel to be inspected at manufacturer works by Client/PMC/TPIA bidders to note the following:
  - ✓ Contractor / Vendor shall offer the panel for one day stage inspection and manufacturer's or sub vendor's place for main LT Panel of part thereof under process and for balance panels (PCC/PMCC/MCC) required photographs / video shall be taken and submitted / demonstrated during final inspection.
  - ✓ Prior to final inspection, the panel shall be inspected by contractor's / vendor's engineer to verify & confirm the panel as per approved drawings, BOM, Technical specs, QAP& compliance report of electrical equipment prior to offering the inspection to Client/PMC/TPIA and required inspection report shall be submitted by contractor's / vendor's engineer including all required details (including the breaker model no., serial no., fault current, etc. and other important / major switchgear details and other panel construction and MOC details) for review of client/PMC/TPIA and only after that the client/PMC/TPIA shall witness the panel inspection at manufacturer's works.
- 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.

ELECTRICAL INSTALLATION

This specification covers the technical requirements for equipment, materials, and installation methods, testing and commissioning of electrical system.

The contractor shall possess a valid contractor's license for the state in which site is located and shall ensure it's validity during the duration of the contract.

The contractor shall employ adequate skilled and unskilled labor to complete all work according to programme of work. Skilled workers shall possess the minimum qualifications stipulated by statutory or competent authorities.

The contractor shall employ adequate numbers of supervisor to control the labour force and to carry out the work as per schedule. Supervisory staff shall also possess the minimum qualifications stipulated by statutory and competent authorities.

Various types of equipment shall be installed in accordance with approved drawings and / or manufacturer's instructions and good engineering practice. Particular attention shall be paid to lubrication of moving parts and bearings, alignment, tightness of all connections (mechanical and electrical) and wiring.

The contractor shall place the switchgear correctly on the base of foundation prepared for the same. If the switchgear consists of a switchboard with number of panels bolted together, he will place all the sections of the switchboard correctly, align them and bolt the sections together to form one continuous switchboard. The switchgear shall then be secured to the foundation by means of nuts and bolts or foundation bolts grouted in the base. The contractor shall also make inter-section bus/wiring connections.

In case of wall/structure mounted equipment, boards, the contractor shall fabricate and install the structural steel frame work suitable for mounting the various equipment boards. The contractor may have to prepare drawing showing the proposed general arrangement, of the structural frame which shall be subject to the approval of the Engineer. The fabrication and installation of the framework shall be recommended only after the approval of drawings. Various items of the equipment, board shall be mounted in accordance with the approved drawings.

Motor shall generally be installed by others, along with the driven equipment. The contractor may, however, be asked to install motors in specific instances.

Cable routes and mode of installation shall generally be as shown in the construction drawings.

Identification tags indicating cable designation, shall be affixed to each cable at ends and at an interval not exceeding 15 mtrs or at the location where cables change direction or elevation. Signboards with necessary indication/arrow mark with

necessary structure/foundation shall be also be installed, of adedquate size as approved by Engineer, for the entire cabling system buried underground.

H.V. XLPE / PVC armored cables shall be terminated or jointed by means of cold setting epoxy based cast resin jointing system or heat shrinkable or push on type cold setting kit.

All cable glands should be of nickel plated brass, double compression type. All Alu/Cu cables shall be terminated through crimping type Alu/Cu lugs respectively.

All electrical equipment viz. transformers, switchgear, motor control centers, motors, control stations, switches, lighting, fittings and other electrical apparatus shall be connected to the main earth loop by means of two separate and distinct external earth conductors. The material, type and size of earth conductors will be as shown in the drawings or as specified.

Electrical installation in hazardous areas if applicable as defined in IS:5571 shall be carried out with utmost care and special precautions shall be taken to ensure

operational safety.

All personnel, especially supervisory staff, working on such installations shall be fully conversant with the applicable National Standards and Code of Practice and shall have previous experience of such work.

The contractor shall take all reasonable safety precautions during construction and testing of the works. Particular attention shall be paid to the following:

a) To prevent any conductor or apparatus becoming accidentally or inadvertently charged.

b) Prior to electrical installation (or part there of) being connected to the main supply, the Contractor shall ensure that uncommissioned or incomplete circuits cannot be inadvertently energized and completed circuit cannot be used without the Engineer's consent.

c) No hot work is carried out without work-permit issued by the Engineer in FLP zones (if stipulated by process application).

The tests specified below/elsewhere as part of this tender document shall be carried out on the electrical equipment and installation before commissioning the same. The tests shall be performed by or under the direct supervision of a competent person, qualified to carry out the tests. All tests shall be carried out in the presence of the authorized representative of the Employer/Owner and/or the Engineer, unless this stipulation is waived in writing.

7.0 PAINTING

All surfaces of equipment/structural steel shall be sand blasted, degreased and pickled in acid as required to provide a smooth & clean surface, free of rust / scale / grease.

After cleaning the surface shall be given one coat of high quality red-oxide or yellow chromate and baking in the oven (for equipment only).

All surfaces shall be then finished with 2 (two) coats of finished epoxy based paint of shade 631 of IS:5 or with a paint shade of purchaser's choice unless otherwise specified.

8.0 DETAILS OF TESTS

- **I HV & MV SWITCH GEAR**

i) Check proper mechanical operation of circuit breakers including alignment of trolleys in case of draw–out type circuits breakers, smooth operation of all mechanical parts, lubrication, mechanical interlocks etc.

ii) Check contact alignment and wipe, proper sequence of closing and opening of main

and arcing contacts.

iii) Check electrical relays, instruments & controls for correct wiring.

iv) Insulating test on bus bars – phase to phase and phase to ground. This test will be carried out with circuit breakers in service position, but contacts remaining open.

v) Insulation test on relays & control wiring including current and potential transformers and wiring of CT & PT secondary's.

vi) Insulation test on circuit breakers in withdrawn position – phase to phase and phase to ground with contacts closed.

vii) Adjust correct settings of relays and/or direct acting trips - as specified.

viii) Operation test

Energies only control circuits and carry out closing and tripping operations (where AC supply derived from main supply is used for operation, the switch–gear bus may be energised). Check operations of electrical interlocks. Check tripping of circuit breakers by manual operations of protective relays contacts. Check operations of mechanical closing and tripping devices. Check lockout conditions for closing of circuit breakers by simulating the required conditions. Check control, indications, sequence interlocks and alarms.

ix) Polarity and connections of instrument transformers – Check for correctness of CT & PT connections provided. Check electrical continuity of secondary with ELV tester.

x) Check operation of instruments, meters, relays and tripping of circuit breakers by primary / secondary injections as specified.

xi) Check continuity of power circuits and earth continuity of all non current metallic parts with a low voltage a (6 volts or less) continuity tester.

III MOTOR CONTROL CENTRES, SWITCHGEARS

i) Check equipment, internal wiring, smooth mechanical operation, interlocks, etc.

ii) Check continuity of power circuits and earth continuity of all non-current carrying metallic parts with a low voltage continuity tester.

iii) Insulation test for power & control circuits between phases, between phases and neutral and between phase / neutral and ground.

iv) Check operation by energizing control circuits (without energizing power circuits) for correct functioning. Simulate eternal controls and interlocks for the same. Note chatter or humming of contactor and rectify, in necessary.

v) Check fuse ratings and adjust relay setting (overhead, single phasing preventers etc)

in accordance with load ratings.

vi) Polarity and connections of instrument transformers – Check for correctness of CT & PT connections provided. Check electrical continuity of secondary circuits with ELV tester.

- **IV MOTORS & ROTATING EQUIPMENT**

i) Check equipment for free movement of rotor, and play, lubrication and for any other visual checks.

ii) Insulation test of motors – between winding and ground. Use 500 volts megger for M.V. motors and 1000 volts megger for HV motors.

iii) Check electrical continuity with ELV tester.

iv) No load running of motor noting down no load current and voltages in all three phases.

- **V CABLES**

i) Insulation Test between each phase and neutral and between each phase / neutral and ground.

ii) D.C. High Voltage Test on HV cables in accordance with the relevant Indian Standards and Code of Practice. This test shall be carried out on cables installed in final positions, and all joints and terminations have been made. The cables, however, may not be connected to the equipment, so that the equipment may not be subject to the test voltage.

iii) In case of lighting wiring, insulating test shall be carried out on lighting feeders with branch circuits open. Branch circuits shall be tested separately with lamp holders, plug receptacles and lighting fittings in position, but without lamps. In case of lighting circuits will lamp ballasts and glow starters, insulation resistance may be measured between phase and ground only.

iv) In case of directly buried cables, insulate resistance of cables shall be measured before and after the back-fillings.

v) Test all receptacles for correct phase sequence.

- **VI EARTHING SYSTEM**

i) 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.

ii) 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.

iii) Continuity test for earth continuity conductors with ELV tester.

9.0 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 including DG Set carried out by him unless otherwise specified and agreed. Necessary test reports 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.**

- **10.0 ACCEPTANCE OF INSTALLATION**

On completion of the work the Engineer, together with the Contractor, will carry out an inspection of the Installation. The Engineer will issue a completed copy of the Purchaser's Acceptance of Electrical Installation to the Contractor as confirmation that the work has been accepted, subject to any matters noted on the form being attended to.

- The minimum numbers of skilled / unskilled labors for each shift for operation of the pumping station will be as under:

Name of work:- Comprehensive & Preventive Maintenance of Vinodnagar Pumping Station For Two Years.

Sr No.	Qty.	Description	Education Qualification	Experience
1	3	Operator- Semi skilled	12th Std. Passed	Min 1 Year Experience of O&M of pumping machinery & operation of DG set and HT-LT work.
2	3	Helper - Unskilled (Male)	10th Std. Passed	Min 1 Year Experience in valve operation & other Ele./Mech. work

- The presence of staff as per schedule & instruction in tender or by Engineer in Charge, at pumping station is compulsory. If while checking, any staff is found absent, the prevailing wages will be deducted from the bill of contractor and also deduct penalty per person as per the penalty mentioned in this tender & Also, in case of breach of any other condition of contract or work is not found satisfactory, penalty will be imposed as deemed fit by the Exe Engineer / Add. City Engineer, Dy. Commissioner or commissioner, which will be binding to the contractor.
- Contractor must be submit all necessary documents as per below list of their employees engage under this contract.
  - Aadhar card
  - Education Qualification Certificate
  - P.F.U.A.N number
  - Bank Account Number

  All above document should submit within 10 days after issue work order.

Signature of Contractor with stamp

:: GENERAL SCOPE OF WORK ::

Name of work:-Comprehensive Operation Maintenance of Vinodnagar Pumping Station For Two Years.

Providing skilled/semiskilled/unskilled/conservancy workers as per tender for running of Pumping Station and all works like; daily regular operation of all electrical and mechanical machineries, cleaning of site, regular cleaning of machineries, operation of all control valve - by pass and gate valve, daily regular Operation of other pumps, valves within the premises as and when instructed by Operator/Engineer In-Charge etc. all the necessary cleaning liquid/detergent/agent, tool-tackles, scaffolding, Safety ladder, safety equipment/PPE for staff etc. shall have to provided by the contractor and make use of them as and when instructed by Engineer In-Charge, Loading, un-loading of chlorine cylinders & its charging as well as maintenance work in three shifts should be done. Report regarding scheduled maintenance work should be generated & submit to In charge Engineer periodically.

Preventive Operation & Maintenance Schedule

- **Electro-Mechanical Preventive Maintenance**:

DAILY:

1) Checking of Vibration in the Motors and Pumps.
2) Visual inspection of all Electrical items.
3) Checking of Temperature rise in Motor.
4) Checking all measuring devices.
5) Checking and Take reading of voltage and current of Motors as well as starter penal.
6) Checking and rectifying pump and valve gland packing leakage.
7) Bearing temperatures, Pressure, noise & Vibration in all moving parts.
8) Check all level for bearing lubricant and topping up if necessary.
9) Clean and remove dust from pump sets, piping and valves.
10) Tightness of all loose nut-bolts and other fasteners.
11) Working of gauges and other measuring devices.
12) Checking and take reading of chlorine dose.
13) Checking any leakage in chlorine system like copper pipe, header line etc.
14) Cleaning of pumping station as per instruction of engineer in-charge.

WEEKLY:

1) Tightening of all cable connections & Electrical panel connections.
2) Cleaning of all the electrical panel, motor, pump, valve, chlorine system etc.
3) Checking of pump-motor alignment and tightening of foundation bolt.
4) Greasing in all pump-motor set.
5) Checking operation of all valves.

MONTHLY:

1) Checking of all electrical ear-thing and ear-thing pit.
2) Checking of all pump-motor couple bush.
3) Checking of graphite cord in valve and pumps If it's necessary insert new graphite cord in valve and pumps.
4) Checking and tightening of all nut-bolt.
5) Checking of all electrical connection and cleaning the same with blower.

QUARTERLY:

1) Insert new graphite cord in all the pumps and valves.
2) Cleaning of gland cover nut-bolt with oil and tightening the same.
3) Checking alignment of pump-motor.
4) Greasing in all bearings of pumps and motors.
5) Checking of chlorine system.

Signature of Contractor with Stamp

A.A.E. (MECH.)	**A.E.(ELE.)**	**D.E.E. (MECH.)**	**A.C.E.**
(W.M.U. E/Z)	(W.M.U. E/Z)	(W.M.U. E/Z)	(W.M.U)

SPECIAL TERMS AND CONDITIONS

1) The operation and maintenance of all the works included in this tender as per details given should be carried out by contractor at his own cost.

2) All the storage structures situated at H.W. sites should be kept in fill-up condition as per requirement during the full day period. (24 Hours)

3) A weekly report for quantity of water received & supply of water with qty. should be submitted to the office of the additional City Engineer.

4) Electric bill for running the plant at head works site will be paid by department, i.e RMC but bill should be submitted to office for payment as soon as received by him from PGVCL Penalty if any for delay will have to be paid by contractor.

5) All the required electrical goods like bulb, tube light, chock, starter, fuse, wire etc. required for operation and maintenance shall be procured by contractor at his own cost and lighting arrangement should be kept in good condition.

6) Roofing of the sump should be checked regularly so that water should not be polluted. Every care should be taken to prevent falling of birds and insecticides . water storage structure like, sump located at head work site shall be regularly cleaned and mud should be removed at every **three month** by contractor and record for it should be maintained. Planning for this work should be so done that it should not effect the supply of water.

7) During the period of contract a person other than responsible representative of contractor or persons employed by him should not enter into the premises of the head work site. Every care should be taken by contractor to prevent such type of un authorised entry or interruption in the premises or surrounding the property of RMC .

8) Persons required for security of materials in the stores at sub head works sites will be deployed by contractor.

9) At any time during the visit of Engineer in charge or his representative if it is observed that the operation and maintenance is not carried out properly, water supply is stopped and contractor is responsible for it recovery will be made at double rate of contract for that particular day or contract will be terminated.

10) During the period of contract for any type of dispute, decision of additional city Engineer/DyExecutive Engineer will be final and binding to both the parties.

11) Deleted

12) Prescribed registers as maintained by agency during the period of operation and maintenance period shall be submitted to the department. All repairing work should be carried by contractor at his own cost during the period of contract contractor should be fully responsible for injury to any public person or men engaged by

contractor for work and contractor shall be fully responsible for compensation for it.

13) Proper care is to be taken by contractor to keep neat and clean. Every component of head work sites and maintenance of all the components shall be done by contractor.

14) Servicing of all the valves cleaning of all civil works and maintenance shall be carried out regularly by contractor and entered into the concerned registers.

15) History sheet shall be maintained by contractor for replacement of material in pipeline, or valves, space parts of Electro -mechanical equipments.

16) **DELETED**

17) All the gardens and plants situated at head works sites shall be supplied water and maintained properly by contractor. No any extra payment will be made on account of this work.

18) Telephone/wireless message shall be received and entered in the register and message should be conveyed to concern party head works for action. One person shift wise for 24 hours shall be on duty for this work.

19) The contractor has to make all the arrangements required for the proper operation, maintenance and safety of all the works included in this contract at his own cost during the whole contract period.

20) All the storage structure located at H/W site should be kept in fill up condition as per the requirement during the full day period.

21) Separate log book for arrival & releasing of water from Each storage structure will be maintained day to day by the contractor and shall be submitted to department at the end of month.

22) **DELETED**

23) Expect in unavoidable circumstances all the storage structures should be filled with water as per requirement & availability of electricity & pressure during the period of day or night. If electric supply is not available for during continues 24 hours, contractor shall contact to PGVCL to start the electric supply & intimate to Department with reasons for non availability of electric supply. When power generating set will be installed by RMC, It will be operated during PGVCL power cut or power failure and maintained by the contract agency.

24) List of all the assets, piping, appearances plants & machineries, all types of valves, chambers, pump houses, security cabin, office building, hydraulic civil structure, spare parts, store malts, wireless sets, telephone, air-conditioner, electric panels etc. will be handed over to contractor for M&R purpose & same has to return to Department with good conditions as soon as the project is taken over by department for further M&R period to any other party.

25) Any damage / breakage found from mischievous element found in the system, the contractor should lodge policy case immediately under intimation to concern engineer in charge.

26) DELETED

27) DELETED

28) Material consumption register in prescribed format should be maintained by the contractor. During the visit of Engineer - in - charge if required it should be produced.

29) Vehicle as and when required shall have to be arranged by the contractor at fault time for providing such facilities for betterness of operation period. No extra payment shall be made.

30) "The Contractor" shall operate Water Pumping Station and associated services, on a continuous 24 hours basis to supply all the flow conveyed from filter plant and transfer it to ESR by Pumping with assured quantity.

31) "The Contractor" shall operate and utilize all the control and monitoring systems, provided and if found to be necessary and if approved by the engineer, shall make adjustments within the operating range of the control system and equipment so that the plant operation matches the requirement.

32) "RMC" shall directly pay all the power bill to PGVCL but the Contractor will be required to furnish Electricity Consumption in the Schedules provided.

a) Telephone bills will have to be paid by the successful bidder. No reimbursement shall be made.

b) Electric/Battery operated wireless sets will be provided by RMC. The hand sets will be periodically got checked and repaired through other agency but the operating of wireless sets and it's battery etc will be in the scope of the contractor. The wireless sets shall be kept in running condition for round the clock.

c) Electric/Battery operated flow meter has to maintain by successful bidder. In case failure of batteries, same has to be replaced by successful bidder at his own cost.

33) All miscellaneous items, for example, vehicles, tools, testing equipment, cleaning or green keeping equipment, security and safety equipment, electrical fixtures, etc shall be provided by the Contractor at his expense.

34) a) The Contractor shall provide experienced technical, supervisory, and non-technical personnel and labour necessary to operate and maintain the distribution Water Pumping Station properly, safely and efficiently on a continuous 24 hours basis for the term of the O & M Contractor Period.

b) 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 the Water Pumping Station before being given responsibility for operating any part of the plant. If in the opinion of the Engineer, any member of the Contractors staff is considered to be insufficiently skilled or otherwise inappropriate for the task he is required to perform, he shall be replaced by the Contract with a person with the appropriate skills and experience for the task, to the approval of the Engineer. The Contractor will be required to submit to the Employer the Schedule of 'Manpower' and 'Organization Chart'.

c) The Curriculum Vite(CV) /Resumes ofthe Contractors personnel shall be submitted to the Engineer for acceptance at least 7 days before the anticipated commencement of the 0 & M , period. 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 agreed by the Engineer. A rotating shift schedule shall be established by the Contractor and agreed by the Engineer which will ensure that an adequate number of the Contractor's staff, fluent in Hindi as well as Gujarati is on duty at Plants 24 hours per day, 7 days per Week, including all holidays.

d) DELETED

35) a) The Contractor shall be responsible for safety on Site during the 0 & M of the Works by the Contractor.

b) The Contractor's duties with respect to Safety shall include the following:

i) Utilize safety awareness procedures in every element of operation and maintenance.

ii) Give emphasis to site including:

* Safe working and safety procedures as per rules and regulations of Governments regarding use ofprotective clothing, gloves, boots and helmet etc.
* Cleanliness of the plants as a whole.
* Awareness of hazardous conditions and accident reporting and Necessary compliance.
* Safe practice in Pumping Stations.

36) **a)** The maintenance service provided by the Contractor for the period specified in the Contract shall ensure the continuous operation of the water Pumping Station and 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.

b) The Contractor shall adhere to the manufacturers' recommendations with respect to equipment maintenance, the type and grades of lubricants to be used. Frequency of lubrication, adjustments to be made regularly and recommended spares to be held in store.

37 The Contractor shall be responsible for:

a) The maintenance of electrical, ventilation and air circulation, plumbing and drainage installations.

b) General Building Maintenance and housekeeping of pump house

c) Full maintenance of the site services, cabling and earthling systems, together with the site road lighting system. Painting of all mechanical structures which are open to sky once in 2 Years.

The building services and house keeping maintenance shall be undertaken on all building and services

installation.

The Contractor shall ensure that all unwanted or redundant items are removed from the building and sites. Depending on their condition such items shall either be placed into storage or disposed off site.

38) **a**) The store's inventory, the issuing and recording of spare parts will be the responsibility of the Contractor.

b) The Contractor is also responsible for providing spare parts and material required for the operation and maintenance during the operation period, including the cost of storing and safeguarding.

c) The Contractor will make all necessary arrangements to ensure the continuous supply of spare parts and material for the works and the rate of supply of these materials shall be in such quantities and amounts as would ensure uninterrupted operation.

d) Spare parts shall be supplied by the Contractor and the same will be used during Operation and Maintenance Contract period.

e) The contractor shall have to procure the required spares from original manufacture or authorized dealer at his cost.

39) **a)** The Employer reserves the right to arrange the visits of VIP's dignitaries, public representatives and other persons of Social or Political repute, any organization as and when necessary, to the Water Pumping Stations. The Contractor shall offer full cooperation to the RMC on the occasions of such visits.

b) Inspection register will have to be maintained, wherein inspection officers will note their instructions duly dated signature. Successful bidder has to follow the instructions strictly.

40) On the date of Contract Completion or if the Contract is terminated, all the installations, works and equipment placed under the Contractor's responsibility shall be handed over to the Employer, at no cost, in good working order. The Employer may perform any inspections, tests 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.

41) No accommodation *I* guest house/ transportation facility will be provided by the RMC to Contractor.

42) For smooth & efficient 0 & M of the plant, and in case of emergency just like fire, fault, accidents, or other rescues operation, the contractor shall arrange for suitable vehicle, No extra payment shall be made.

43) While handing over the spares to the contractor, Contractor should maintain the record of spares of inventory of utilize the spares.

44) In the event of any dispute or difference arising, decision of municipal commissioner shall be final and binding to the Contractor. However contractor is not satisfied with the decision of municipal commissioner, he may get the justice through court and the Jurisdiction of the court shall be Rajkot (Gujarat) only.

45) It is mandatory for the contractor to operate the pumping machinery not less than limit efficiency of pump. If deviation is noted in respective energy bill for succeeding month the difference in amount considering based on KWH will be invoked through O&M bills.

47) The contractor shall provide a Notice board /Display board at appropriate locations detailing precautions to be taken by operation and maintenance personnel in work conformity with industries and labour Regulations and Department of Explosives.

Signature of Contractor

A.A.E. (MECH.)	**A.E.(ELE.)**	**D.E.E. (MECH.)**	**A.C.E.**
(W.M.U. E/Z)	(W.M.U. E/Z)	(W.M.U. E/Z)	(W.M.U)

TERMS AND CONDITIONS FOR PAYMENT O&M

1) Amount shown in Price scheduled is for the period **of 24 months** the payment shall be made on **quarterly installment basis as per the payment schedule** subject to terms & conditions mentioned in Price bid.

2) If supply of water disturb for want of electricity, breakage of line or machinery being out of order or due to some other reasons, contractor shall be paid for as many days water is supplied.

3) In case of non availability of water from filter plant or no demand on section, the system will not run for small duration. During such period contractor will carry out major overhauling of the plant and system. No reduction in the payment will be made during such period.

4) Payment to person engaged (at fixed rate by the contractor) for work shall be made according to grade of work. If any court case is filed or administrative problem arises for short payment, the contractor shall be entirely responsible for it.

5) Contractor has to maintain PF as per the Standard practice otherwise penalty levied by PGVCL due to poor PF shall be deducted from RA Bills.

6) Contractor shall be vigilant as under for constant operation of pumps during supply and distribution;

a. In order to maintain continuous water level in the sump, operator shall have to throttle the valve as per requirement and other implements and keep vigilance for constant operation.

This work involves operation of valve, repairing, servicing etc.

b. Operator shall prepare shift duty register and shall obtain permission from in-charge Engineer before implementing the same contractor shall prepare three copies of it, one of which shall be published on site of head work as can be read. If any change is required in any kind of shift duty it may be done with permission of engineer-in-charge. Operation shall be shifted to other place as per written instructions of Engineer-in-charge. There shall be no dispute about it.

c .Details of daily work load entrusted to operators and his assistants engaged shall be kept ready at the site of head works for scrutiny of engineer-in-charge.

7) Instructions for operation :

Contractor shall ensure that valve operator engaged by him holds know how about operating valve.

a) Before starting water: Before starting valve by valve operator scrutiny on following matter shall be made.i) Checking leakage of gland.

ii) Valve should open or closed slowly so that tank is not felt.

iii) Valve should be opened as per requirement of water in villages on line.

iv) Before opening of main valve instruction should be given to branch line valve operator in advance.

b) Valve operator shall take care during supply in progress as shown below;

i) To open valve slowly.

ii) To check the delivery head pressure gauge and valve should be made throttle to regular constant flow of water and keep constant supervision on the pressure.

c) Valve operator shall take care at the time of closing the valve.

i) Valve should be closed not at-once but slowly and slowly.

Signature of Contractor with stamp

Name of work: Comprehensive Operation & Maintenance of Vinodnagar Pumping Station For Two Years.

Details of tools required on site

Details of Tools and Plants with Name (To be kept by the Agency during the period of contract)	Qty.
6 mm to 24 mm size Fix Spanner Set	01 Set
6 mm to 24 mm size Ring Spanner Set	01 Set
Pipe wrench of 24" and 36" size	01+01 No.
Screw Driver of size 6", 9" and 12"	2 Nos. each size
Insulated Pliers of 12" size	01 Nos.
Adjustable screw spanner size	01 No.
Hammer	01 No.
Testers	02 Nos.
Hacksaw frame with Hacksaw blade	02 Nos.
Hand gloves for 11 KV, D.O. Rod and Tin coated D.O. Wire	01 Set
Torch / Battery (Chargeable)	01 Nos.
Grease (Approved Make) AP3 Grade	5 kg

Note: -

1. Other than above, Mention Tools if required For the Comprehensive Operation & Maintenance of Pumping Machinery should be arranged by the agency.
2. All the tools must be in good condition should be kept at head works.
3. The responsibility to look after the all-necessary tools for maintenance of pumping machineries at site rests with the successful Bidder.

Signature of Contractor with stamp

(E) APPROVED VENDOR LIST FOR ELECTRICAL EQUIPMENT / COMPONENT:

1	11 KV FOURPOLE / TWO POLE STRUCTURE ACCESSORIES	NATIONAL / PSG / HI-TECH
2	11 KV SWITCHGEAR	BHEL / ABB / C.G. / SIEMENS / SCHNEIDER
3	L.V. (415 V) SWITCHGEAR	ABB / L & T / C & S / SIEMENS

4	PMCC PANEL MANUFACTURERS	ALPHA NIPPON / ELEMBICA / INDUSTRIAL CONTROL / SWATI SWITCH GEAR / SAMUDRA
5	SOFT STARTER	ABB / DANFOSS / L & T / SIEMENS / SCHNEIDER
6	CAPACITOR	L & T / EPCOS / SIEMENS/ABB/SUBODH
7	A.P.F.C. PANEL	ABB /L&T/SIEMENS/ALPHA NIPPON / ELEMBICA / INDUSTRIAL CONTROL/ SWATI SWITCH GEAR /SAMUDRA
8	MICROPROCESSOR RELAY	BCH / ABB / L & T / SIEMENS
9	THERMISTER RELAY	ALSTOM / MINILEC / INSTA CONTROLS
10	S.P.P. & O.V. / U.V.	ABB / L & T / MINILEC / SIEMENS
11	LIGHT FITTINGS	BAJAJ /CROMPTON / HAVELLS / PHILIPS
12	H.T. CABLE	HAVELLS / KEI / POLYCAB / TORRENT/GLOSTAR
13	L.T. CABLE & CONTROL CABLE	HAVELLS / KEI / POLYCAB / TORRENT / FINOLEX / RR KABEL
14	DECORATIVE / MODULAR SWITCH & SOCKET	ABB / ANCHOR / CRABTREE / L & T / LEGRAND / INDOASIAN
15	CEILING / WALL MOUNTING / EXHAUST FANS	BAJAJ / CGL / HAVELLS / ORIENT / USHA
16	CABLE TERMINATION / JOINT KIT	3M / M-SEAL / RAYCHEM / CCI
17	CONTROL /SELECTOR SWITCH	ABB / BCH / GE / HAVELLS / KAYCEE / L & T / SALZER / RECOM / SIEMENS
18	INDICATION LAMP	BCH / L & T / SIEMENS / TEKNIC CONTROLS / VAISHNO
19	TERMINAL BLOCK / CONNECTORS	CONNECTWELL / ELMEX / PHEONIX / TELEMECHANIQUE / WAGO/GRIPON
20	CONSTANT VOLTAGE TRANSFORMER/ CONTROL TRANSFORMER	AE / ASHMORE / G&M / INDCOIL / NEC / PRAGATI / PRECISE / SILKAANS
21	SEMICONDUCTOR FUSE	BUSSMANN / FERRAZ / GE / SIEMENS
22	PUSH BUTTON STATIONS / JUNCTION BOX (CAST ALUMINIUM)	BALIGA / BCH / CEAG / EXPROTECTA / FCG / FLEXPRO / HANSU / HENSEL / PUSTRON / SCHNEIDER / SIEMENS / SUDHIR/EXCEL
23	NON METALLIC ENCLOSURES (INCLUDING INDUSTRIAL RECEPTACLES)	BCH / HENSEL / LEGRAND / PUSTRON / RITTAL / SCHNEIDER / SIEMENS / SINTEX
24	DIGITAL AMMETER / VOLTMETER / POWER FACTOR METER / KWH METER	NIPPEN / L & T / MASIBUS / RISHABH / SCHNEIDER / SIEMENS/IMP/MECO/ CONZERV/ABB

25	8/10 CHANNEL TEMPERATURE SCANNER WITH RS 485 MODBUS COMMUNICATION	MASIBUS/NIVAM/NISHKO/ELECTRONET/REDIX/ MULTISPAN
26	CABLE LUGS & GLANDS	HEX / COMET / CONNECTWELL / DOWELLS / JAINSON / 3M / BRACO
27	CABLE GLANDS – POLYAMIDE	FIBOX / GEWISS / HENSEL / LAPP
28	HOT DIP GALVANIZED CABLE TRAYS	GLOBE / INDIANA / JACINTH / LEGRAND / M.M. ENGINEERING / SHARDA / SILVERLINE POWER / VATCO/SUPER ELECTRO/POLYCAB
29	UPVC CONDUIT & ACCESSORIES(CABLE RACE WAY/ CABLE DUCT)	AKG / CLIPSAL / L&T / POLYCAB / PRECISION / SALZER/ GRIPON
30	MS / GI CONDUIT & PIPES	BEC INDUSTRIES / JINDAL / JK TUBE / SAIL / TATA STEEL / ZENITH
31	MS / GI LIGHTING POLES & BRACKETS (OCTOGONAL POLE)	BAJAJ / VALMONT / CROMPTON / TRANSRAIL / UTKARSH
32	HANDHELD DIGITAL MULTIMETER / CLIP-ON METER / MEGGER	FLUKE / IMP / MECO / MOTWANE / RISHABH
33	ALUMINIUM BUSBAR MATERIAL	BANCO / HINDALCO / JINDAL
34	PANEL CRCA/MS/GI PLATES & SHEET	ESSAR / TATA /JINDAL / SAIL
35	CHEMICAL TYPE EARTHING INCLUDING COPPER BONDED ELECTRODE & BACK FILL COMPOUND	ASHLOK / CURSP / ECO TECHNOLOGY & PROJECTS/ENNOV INFRA / ERICO/ISG GLOBAL / PRAGATI ELECTROCOM/SAARA EARTHING/ EQUI. REPUTED MAKE SUBJECT TO CLIENT APPROVAL
36	PVC Conduits & Accessories	Precision / Clipsal / L&T
37	Module Type Plug Socket	Anchor / Havells / Clipsal / Toyama / MDS

A.A.E. (MECH.) (W.M.U. E/Z) **A.E.(ELE.)** (W.M.U. E/Z) **D.E.E. (MECH.)** (W.M.U. E/Z) **A.C.E.** (W.M.U)