VOLUME – IIC

PART-II

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORK

DOCUMENT: INDEX SECTION-E: ELECTRICAL

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[A] General Requirements

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.
The equipment shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

Completeness of Supply

It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering, design and workmanship. The following shall be considered in the scope of work as a minimum.
Any material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble free operation and maintenance of the equipment shall be furnished without any extra charge.
SITC of Electrical Equipment with all necessary erection accessories and materials, all steel members (angle, channel, plate, steel sheet, etc.) for installation of electrical equipment, GI pipes, GI conduits, bends, clamps, nut, bolts, ladder type cable trays, tray installation materials and 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 and termination kits and materials, earthing strips of different sizes, junction boxes, pull boxes, heat resistance paints and all consumable materials for complete laying and termination of cables, earthing system and erection of electrical equipment etc.
Obtaining license / certificates / clearances etc. From appropriate Govt. Statutory authority/body for installation and energizing the complete electrical system and necessary liasoning work for the same (Necessary statutory fees only shall be paid by client).

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

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

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

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

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

a) In Two sets in hard copy along with technical bid for review/evaluation.

b) In five sets by successful bidder in hard copy for review and 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 and Maintenance (O and M) manual including manufacturer's O and M and preventive maintenance schedule, recommended spares list, etc.

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

SITE / AMBIENT CONDITIONS

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

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

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

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

CODES and 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 and Rules
- The Indian Electricity (Supply) Act,1948
- Regulations laid down by local statutory authorities and CEA / Electrical Inspectorate.
- The requirement of Gujarat State Electric Board.

- Fire advisory Committee Insurance Act / Fire Insurance Regulations
- Indian Petroleum rules and any other regulations laid down by the Chief Controller of Explosives The factory act and any other regulations laid down by factory inspectorate Wherever Indian Standards do not exist, the relevant IEC, British or German (VDE) / IEEE / NEMA standards shall apply. Any other Standard which is considered equivalent to or superior than applicable Indian Standards may also be acceptable. The bidder however, shall have to substantiate equivalence or superiority.
- Applicable standards govern the materials and workmanship in the manufacture of all equipments / items of Electrical Equipment's:

Codes	Description
IS:731,BS:137, IEC:383	Pin and Disc Insulator
IS:2544,IS:5350, BS:3297IEC:168	Porcelain post insulators for systems with nominal voltage greater than 1000V
IS 5621	Hollow insulators for use in electrical equipment
IS: 398 (Part- Iand 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 disconnections (isolators) and Earthling 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

Codes	Description
IS 2026 , IEC-60076	Power transformers
IS 11171	Specification for Dry-Type Power Transformers.
IS 335	New insulating oils
IS1180 (Part-1) 2014	Outdoor Type Oil Immersed Distribution Transformers Up to and including 2500kVA, 33kV Specification
IS 8468	On-load tap changers
IS 2099	Bushings for alternating voltages above 1000 Volts
IS 6600	Guide for loading of oil immersed transformers
IS-4237	Switchgear General Requirements
IS 13947 IEC 60947-1 and IEC 60947-2	Low-voltage switchgear and control gear
IS-375	Panel Wiring
IS 3427	A.C. Metal Enclosed Switchgear and Control gear for Rated Voltages Above 1 kV and Up to and Including 52 kV
IS – 2516	Molded Case Circuit Breakers
IS 3842	Application guide for electrical relays for ac systems
IS 13925	Shunt capacitors for ac power systems having a rated voltage above 1000 V
IEC 61921	Power capacitors -Low-voltage power factor correction banks
IS-2959, IEC-158-1	Contactors
IS-1822, IEC-292	Starters
EN 50081-1,50082-2 ar 60204-1	Microprocessor Soft Starter
IEC 61800 and/ or IEEE 519-1992	Harmonics Control and Reactive Compensation Of Static Power Converters
IEC 721-3-3, class 3C1	Max. Corrosion Level of the Cooling Air
IEC 721-3-3 Class 3C2	Max. Corrosion Level of the Chemical Gases
UL 508C	Solid state thermal protection of AC Drive
IS 722	Specification for AC Electricity Meters
IS 12615: 2011	Energy efficient induction motors-three phase squirrel cage.
IS 325	Three phase induction motors
IS 12065	Permissible limits of noise level for rotating electrical machines

Codes	Description
IS 2253	Designation types of construction and mounting arrangement of rotating electrical machines
IS 8789	Values of performance characteristics for three phase induction motors
IS 9283	Motors for submersible pump sets
IS 9334	Electric motor operated actuators.
IS 8130	Conductors for insulated electric cables and flexible cords
IEC : 228	Conductors of Insulated Cables.
IEC : 230	Impulse tests on cables and their accessories
IEC : 502	Extruded solid dielectric-insulated power cables for rated voltage from 1 kV up to 30 kV.
IEC : 540	Test methods for insulations and sheaths of electric cables and chords
IEC : 229	Test on cable over sheaths which have special protective functions and are applied by extrusion.
IEC : 287	Calculations of continuous current rating of cables (100% load factor).
IEC 60751	Industrial platinum resistance thermometers and platinum temperature sensors
IEC 61537	Cable management -Cable tray systems and cable ladder systems
IS: 7098 (Part-II)	Cross-linked polyethylene insulated PVC sheathed cable for voltage from 3.3 kV up to 33 kV.
IS : 5831-1984	PVC insulation and 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 armoring 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 and other accessories.
IEC : 859	Cable termination for gas insulated switchgear.
IS: 7098 Part I	XLPE Insulated electric cables (heavy duty)
IS: 3961	Recommended current ratings for cables.
IS 1554	PVC insulated (heavy duty) electric cables
IS 3043	Code of practice for Earthling
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

Codes	Description
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 Aluminum 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

Codes	Description
IS 5572	Classification of hazardous areas (other than mines) having flammable gases and vapours for electrical installation
IS 9677	Guide for limits of temperature-rise of the windings of electrical equipment when tested by different methods
IS 9678	Methods of measuring temperature rise of electrical equipment
IS 10118	Code of practice for selection, installation and maintenance of switchgear and control gear
IS 15652	Insulating mats for electrical purposes – Specification.
IS 5424	Rubber mat
IS 4770	Rubber Gloves -Electrical Purposes – Specification
IS 2551	Danger notice plates
ISO 3046	Diesel Engine
BS : 2613 / IS : 4722	Alternator

DESIGN BASIS

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

The Basic Design Data to be considered as follows:

Incoming Supply Conditions	11kV ±10%
Frequency	50 Hz ±5%
Voltage and Frequency Combined variation	±10%
Fault Level at 11 kV	500 MVA symmetrical (1 sec)
System Grounding	Effective
Fault Level at 415V (Design)	43.1 kA Symmetrical (1 sec)
Control circuit voltage	230V AC for MCCs tapped from PandN
HV Cabling	3C XLPE,11 kV (UE)
LV Cabling	Alu. Conductor XLPE / PVC
Earthing	Earth Pit: Cu Plate/ G.I. Pipe electrode as per IS:3043 / Specification / Drg.
Induction Motor	Energy Efficient Design of as per IS:12615-2018 IE3 as indicated in BOQ

Soft Starter (S/S)	DOL starting, Soft starter De-rated current for 50º C operating conditions ≥ min.110% of rated motor current, with external bypass contactor, with in- line contactor and semi-conductor (fast acting) fuse protection, required protection parameters, etc.
Variable Frequency Drive (VFD)	VFD De-rated current for 50º C operating conditions ≥ min.110% of rated motor current, with in-line contactor and semi-conductor (fast acting) fuse protection, required protection parameters, etc.

Power is expected from 11kV breaker panel / GOD structure of power supply company and the scope of work shall commence from evacuation of power from this point and transmitting through cables buried underground/laid in cable trench and terminated at incomer of proposed Metering Panel of Power Supply Company / HT breaker panel / Client GOD Structure / respective Transformers, as applicable, located in substation and including necessary step down and onwards distribution up to each load / consumer. In case of power received through GOD structure of power Supply Company, the scope of work shall also include providing client end GOD structure/s and necessary ACSR conductors for evacuation of power and onward transmission as explained above.

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

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

Motors shall be started and stopped by push buttons at Local Control Stations located near respective motors, as per specification / SLD / BOQ. Starters shall be housed in MCCs with STOP / START / RESET Push Button.
In outdoor areas cables shall be mostly buried directly underground with mechanical protection wherever applicable. In indoor areas, cables shall be laid in trenches through G.I. Cable tray / MS fabricated cable trays as indicated in BOQ/SOQ.

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

Notwithstanding anything mentioned in this tender specifications and 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 said Items as per BOQ shall include the following job as a minimum:

- Delivery of the Equipment at site.
- Unloading at site store / proposed area.
- Power and Control cabling work between equipments.
- Assembling various item as per requirement.
- Checking of operation and wiring before commissioning.
- Testing and commissioning of equipments.
- Supply of necessary spares required for commissioning.

DRAWINGS / DOCUMENTS

Successful bidder shall submit documents, data sheets, etc., all manuals, catalogues, characteristic curves, etc. For various electrical equipment/components for review and approval.

Detailed documents to be prepared in line with recommended specifications / details and submitted to client in a timely manner to allow for review and approval.

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

a) List of Drives / Loads with Qty. / Rating / Specifications along with power load statement
b) Transformer, D.G. Set and Capacitor Sizing Calculations
c) SLD and control diagram of complete electrical system
d) Wiring / Schematic Drawings for complete electrical system (HT Panels, LT Panels, Lighting Panels, PDBs, etc.)
e) Overall Cable Layout and 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, clearance requirements, etc. l) filled in Data Sheets
m) Schedule of quantities along with brief specifications
n) Design / sizing calculations for equipment as applicable o) OandM manual for all equipment

VENDOR DATA REQUIREMENT

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

VENDOR DATA REQUIREMENT FOR ELECTRICAL WORK

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

[B] DETAILED TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

1.0 11kV D.P STRUCTURE (Wherever Applicable)

The scope of work included fabrication, supply, erection, painting as per the drawing and IS and getting the double pole structure approved from I.M. & E. department.

The D.P. Structure comprising following items.

All M.S. elements of RS joint, channels, and angles, flat shall be hot dip galvanized and latter painted with two coats of Aluminum paint. All nut and bolts, washers etc. used shall be also hot dip galvanized.

Rolled joints of minimum ISMB 175 (175 mm x 85 mm size) of approximately 9.0 Mtr. length as indicated in the drawing, with 400x400x8 mm size base plate welding to one end of both the joints.

Cross member of minimum ISMC - 100 (100 mm x 50 mm) size channels approximately 3.5mtr. Length.

Cross bracing angle of minimum ISA - 50 (50 mm x 50 mm) size of 4.5 mtr. Length Side clamps, stay clamps, cleats, patties etc. fabricated from minimum 50 mm x 6 mm size M.S. flats as per actual requirement.

All nuts, bolts, washers etc. shall be minimum 15 mm size.

Erection of RSJ poles and fixing of all structural members as per drawing and instruction of site Engineer. The structure shall be erected in plumb, line level, properly facing the incoming and outgoing lines. Cross member shall be firmly tightened.

All member shall be fabricated to suit the mounting / fixing of GOD, L.A., DOF, DISC/PIN/POST insulators, cable end termination kit/box etc. as per the drawing.

All necessary hardware, nut-bolts, extra members, sundry items are included in the scope of work.

All M.S. parts shall be galvanized and applied with aluminum paint.

Earthing terminal shall be provided by welding 12 mm size bolt / clear of 50 x 6 mm size M.S. flat shall be fixed to each joist with a hole of 15 mm size and cadmium coated nuts, bolts, washers shall be provided as earthing terminals. Fixing or joining of any members is allowed by nut and bolt only welding is strictly not allowed.

Suitable M.S. flat support and cleats shall be fixed to R.S.J. poles for supporting / fixing the earthing protection pipes in the approved by the client.

All drawing shall be prepared and submitted to industry, Mines & Energy Dept. for Approval Obtain the approval for I.M. & E. Dept.

Vitreous enameled caution boards of any other requirements shall be provided.

C.T.P.T. mounting channels, clamps, bracing angles, nut bolts, hardwires etc. shall be supplied.

AIR BREAK SWITCH

The air break switch should be constructed as per I.S.: 9920 / 1985 are provided with test certificate.

The A.B. switch should be triple pole with movable center pole. All the poles should be opened / closed simultaneously by a lockable operating mechanism.

The porcelain insulator shall be should free from defects, thoroughly vitrified and smoothly glassed. Insulators shall have compressing type glassed with a good luster and of uniform brown colors.

The air break switch should be provided with 1 year guarantee and the test report.

The A.B. switch should be manually operated and shall be able to:

- Carry the inrush current of transformer.

- Interrupt small inductive / capacitive current

The contact shall be silver faced copper ensuring sufficient contact pressure. The male and female contacts should be of self aligning type to ensure trouble free operation during opening and closing. Mild steel arcing horn capable of breaking the magnetizing current shall be provided.

DROP OUT FUSE:

The D.O. fuse assembly should be suitable for 11 KV supply and in accordance with IS9385/1985 and provided with are Test certificate. The assembly shall be mounted on double pole structure complete with 3 fuse elements of required ampere rating. The fuse link shall consist of iron channel base, stack insulator per phase, fuse carrier Bakelite tube, non ferrous metal parts and souing loaded phosphor bronze contents. The insulator shall comply with impulse voltage test in accordance with IS-3106.

LIGHTNING ARRESTOR:

TYPE AND RATING:

Lightning arrestor shall be station class, heavy duty, non-linear resistance type with rating as 11 KV.The arrestor shall have adequate thermal discharge capacity for severe switching surges, long duration surges and multiple strokes.

CONSTRUCTIONAL FEATURES:

The arrestor shall be single pole and hermetically sealed off. It shall be of robust construction with excellent electrical and mechanical characteristics. Insulators must be non-hygroscopic and shall be wet process porcelain, brown glazed and free from imperfection. All metal parts and hardware shall be hot dip galvanized. Creep age distance shall correspond to heavily polluted atmosphere. Grading ring if required shall be provided to maintain gradient within permissible limit. The arrestor shall be provided with pressure relied device if applicable to prevent shattering of approach in case excessive gas pressure build up.

ACCESSORIES:

Lightning arrestor shall be furnished complete with insulating base, surge counter and anchoring hardware for mounting on steel structure.

A surge counter shall be at a convenient height for reading counter. Terminals shall be such as to permit connections with minimum bends. A leakage current detector shall be furnished with the counter as an integrate part. This is for monitoring the leakage to indicate any possible break down.

A suitable sized bypass shunt along with necessary terminal shall be furnished for by passing the discharge counter if required.

TERMINALS:

All connection terminals shall be of corrosion resistant material and shall be provided with complete connection hardware. High voltage line terminal connector suitable for ACSR conductor.

RELATED CIVIL WORK:

Foundation required for two pole structure in switchyard area will be carried out by vendor as mentioned in out drawing.

PLATFORM

The platform for mounting the transformers shall be constructed as per manufacturer's instructions & drawing. However minimum size of platform shall be 2 m x 2 m and foundation shall be provided minimum at 1 m below GL The contractor shall have to provide foundation at deeper level if required as per instruction of Consultant / Owner. Top of platform shall be kept minimum at 1.5 m above GL. The foundation of platform shall be cast in C.C. of grade M10 (1:3:6) to thickness of 20 cm. Size of this concrete shall be 2.3 m x 2.3 m. The platform shall be constructed in B.B. masonry or rubble masonry in C.M. 1:6. At top of the platform 20 cm thick CC M15 (1:2:4) shall be provided. Outside of the platform from 30 cm below GL shall be rendered with 15 mm thick cement plaster in CM 1:3.Contractor shall have to do necessary curing etc. as per relevant IS. Contractor shall also carry out necessary excavation and refilling.

EARTHING FOR D.P STRUCTURE

SITC of funnel type earthing having earth plate of following size buried in specially prepared earth pit of reqd .mtr below ground with 40.0 Kg charcoal and salt with alternate layers of charcoal and salt 20 mm dia GI Pipe with funnel with wire mesh for watering and brick masonry block and C.I cover complete as per para 7.3 of IS 3043 with necessary length of double G.I/copper earth wire no-6 swg bolted with lug to the paltened covered in 12 mm dia G.I pipe 2.5 mtr long complete connected to the reqd point of DP with end socket as per direction and duly tested by earth tester conforming to ISS as per drawing & specification. comp. with 30 X 30 X 0.35 cm CI earth plate comp. with erection overhead.

Scope

The scope includes collection of data, design of the system as per relevant National/International Standards preparation of layout drawing supply of earthing conductors, earth electrode, installation and approval to the satisfaction of electrical inspector under this tender specification.

Earthing system shall be provided to ensure equipment safety, personnel safety and facilitate designed operation of protective switching during earth fault conditions in the associated system.

Applicable Standards

The earthing and lightning protection system shall conform to the Indian Electricity rules, and the latest applicable standards indicated below :

Code of Practice for Earthing	:	IS:3043
Code of Practice for the Protection of	:	IS:2309
Building and allied structure against lightning		
Hot dip galvanising	:	IS:2629, 2633, 4759
Structural steel	:	IS:2062 & 808
Welding	:	IS:816

Earthing system

The design basis for designing earthing conductor is indicated under design criteria for electrical system. Earthing system shall be provided in plant as per the latest edition including all official amendments and revisions of IS-3043 and Indian Electricity Rules, 1956. All materials and fittings used in the earthing installation shall conform to the relevant Indian Standards or shall be approved by the Engineer's representative.

The material of earthing conductor shall be as follows:

Conductor above ground shall be galvanized steel to prevent atmospheric corrosion.

Conductor buried in ground or embedded in concrete shall be mild steel.

Lightning Protection

Lighting protection shall be provided in plant as per the latest edition including all official amendment and revisions of IS-2309.

Earthing and Lightning Protection Installation

Earthing and lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and code of practices and regulations existing in the locality where the system is installed.

Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections with earthing system.

The scope of installation of earth connection leads to equipment and risers on steel structures/walls shall include laying the conductors welding/ cleating at specified intervals. Welding to the main earth grids, risers, bolting at equipment terminals and coating welded/ brazed joints by bituminous paint. Galvanized conductors shall be touched up with zinc-rich paint where holes are drilled at site for bolting to equipment/structure.

Suitable earth risers approved by the Engineer shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of the main earth conductor. The minimum length of such risers inside the building shall be 200 mm and outdoor shall be 500 mm

above ground level.

Dissimilar metals shall not be used in soil due to the possibility of accelerated corrosion resulting from galvanic coupling between two dissimilar metals.

Contact surface of copper conductors in bolted joints with other metals or in contact with steel should be tinned to prevent electrolytic action.

When material of the main grid conductor buried in soil or concrete differ from the material of the exposed earth lead, the buried conductor shall be brought out for making the joint at a minimum distance of 150 mm above ground level. The joint shall be suitably protected from corrosion by bituminous paint to exclude moisture.

Earthing Connections

All connections in the main earth conductors buried in earth/ concrete shall be welded type connection between earthing conductor and earth leads shall be of the welded type.

Connection between earth leads and equipments shall be of bolted type, unless specified otherwise or shown in the drawings.

Welding operations and fluxes/alloys shall be of approved standards

All connections shall be of low resistance. Contact resistance shall also be minimum.

All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.

Metallic conduits and pipes shall be connected to the earthing system unless specified otherwise.

Galvanizing

Wherever galvanizing has been specified, the hot dip process shall be used. The galvanized coating shall be of uniform thickness. Weight of Zinc coatings for various applications shall not be less than those indicated below.

Fabricated Steel

Thickness less than 2 mm,	340 gms/sq.m
But not less than 1.2 mm	460 gms/sq. M
Thickness less than 5 mm, but not less than 2 mm	610 gm / sq.m
Thickness 5 mm and over	

a) Fasteners

Upto nominal size M10	270 gms/sq.m
Over M10	300 gms/sq.m

Burrs shall be removed before galvanizing. Any site modification of galvanized parts should be covered well by zinc rich primer and aluminum paint.

Contractor shall ensure to use calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards.

Drawings

The tenderer should prepare Layout drawings, after award of contract and before

commencement of work for Purchaser's approval, showing the location of earthing grid, electrodes, interconnection grids and earthing leads to various equipment, down comers, isolating links etc. should be accompanied by design calculation.

2.0 11 kV H. T. SWITCHGEAR PANEL / VCB PANEL (Wherever Applicable)

Design Criteria

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

Specific Requirements

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

Bus and Bus Taps

- Bus bars shall be of uniform cross section throughout the entire length of the switch board and suitable for carrying rated current continuously and short circuit current for specified duration without overheating.
- The main bus bar and connections shall be of high conductivity, electrolytic aluminum (E91-

E).**The current density for sizing purpose of aluminum bus bars shall not exceed 0.8 A/mm2.**

- All Bus bars, Jumpers connection shall be fully insulated for working voltage with adequate phase/ground clearances and shall be sleeved with R,Y,B colour coded heat shrinkable sleeves. Bus bars, links, live parts, etc. Shall have non-flammable Epoxy cast-resin shrouds. All jointing hardware shall have nylon caps.
- No paper/cotton based insulation shall be used anywhere in the switch gear.
  Safety shutter, phase barrier, Bus bar seal-off bushing plate, support insulators etc. Shall be non-flammable high tracking fibre glass/epoxy insulation system.
- All buses and connections shall be supported and braced to withstand dynamic electro-magnetic stresses due to maximum short circuit current and also to take care of any thermal expansion.

CIRCUIT BREAKER

- Circuit breaker shall be triple pole, single throw, Vacuum type / SF6 type as per BOQ, electrically operated (on/off), Draw out type.
- Circuit breaker shall have Service, Test and DISCONNECTED (ISOLATED) positions with positive indication for each position.
- Circuit breakers of identical rating shall be physically and electrically interchangeable.
- Circuit breaker shall have manual spring charge as well as motor wound charging facility with Mechanical and Electrical anti-pumping features and shunt trip. Motor wound mechanism spring charging shall take place automatically after each breaker closing operation. The motor shall be suitable for operation with voltage variation from 85% to 110% of rated voltage.
- Mechanical safety interlock shall be provided to prevent:
- The circuit breaker from being raked in or out of the service position when the breaker is closed.
- Raking in the circuit breaker unless the control plug is fully engaged.
- Closing and opening of the breaker in an intermediate position between ‘service’ and‘test’ and between ‘Test’ and ‘Disconnected’ position. Automatic safety shutters shall be provided to fully cover the female primary contacts when the breaker is withdrawn from service position.
- The manual trip device shall be located on the front door and Indicators with shrouds will be visible from front door even when breaker is closed.
- Each breaker shall be provided with following:
  a) Auxiliary switch with 6 NO + 6 NC contacts, mounted on the draw-out portion of the switchgear.
  b) Position/cell switch with minimum 3 NO + 1 NC contacts, one each for Test and Service Position.
  c) Auxiliary switch, with 4 NO + 4 NC contacts, mounted on the stationary portion of the

switchgear and operated mechanically by a sliding lever from the breaker in SERVICE position.

d) Trip push button, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator.

- Limit/auxiliary switches and shall be convertible type i.e. facility for changing N.O. contact to N.C. and vice-versa. Switch contact shall be rated 10A A.C. and 2A D.C. at operating voltage.
- Each breaker shall be provided with suitable encased rollers.
- The trip coils shall be operated satisfactorily at voltage between 70 % and 110 % of rated control supply voltage.
- Each circuit breaker cubicle shall be provided with an Earthing facility. Earthing facilities shall be fully interlocked to prevent faulty operation e.g. earthing of live parts.

PROTECTION and MEASUREMENT

Protective scheme shall be based on reliability, sensitivity, selectivity.

Protective Scheme Requirement

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

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

Sr. No.	**Relay**	**Indication and Monitoring**	**Meter**

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

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

Sr. No.	**Relay**	**Indication and Monitoring**	**Meter**
1	Trip circuit supervision relay	Breaker On	Ammeter
2	IDMT and Instantaneous O/C relay	Breaker Off	MFM (Mini. three line display) with Modbus Port
3	IDMT and Instantaneous E/F	Breaker trip	
4	Anti-pumping relay	Spring charge	
5	Master trip relay with hand reset contact	Service position	
6	Lockout relay	Trip circuit healthy	
7	Aux. relay for Buchholz alarm indication and Trip	12 window Annunciation panel	
8	Aux. relay for winding and oil temp. alarm indication and		
9	Differential relay (For transformer rating 2 MVA and above only)		

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

Sr. No.	**Relay**	**Indication and Monitoring**	**Meter**

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

Relays and Meters

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

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

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

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

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

Current Transformer

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

Voltage Transformer

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

Indication and Monitoring Instruments

- Control cabinet, mounted on top of breaker cabinet, provided with suitable anti-vibration facilities and one number heavy duty spring return type TRIP-NORMAL-CLOSE control switch with pistol grip lockable handle.

- Indicating lights in front of compartments as a minimum:
  Green : Breaker Open
  Red : Breaker Closed
  Amber : Auto Trip
  Blue : Trip Circuit Healthy Yellow
  : Breaker Test Position Blue :
  Breaker Service Position
- Indicating Lamp shall be 20ø LED type with series resistance with metal body. Lamp and lens shall be replaceable from the front.
- All indicating instruments shall conform to IS: 1248-1983 and IS: 2419-1979, Shall be capable of withstanding system fault current taking account CT saturation, back connected and located in the upper part of the panel.

Meters

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

Annunciation

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

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

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

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

Secondary Wiring

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

The colour of wire shall be taken as follows:

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

Terminal Blocks

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

by screw type terminal blocks.

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

Cable Termination

- Switchgear shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection with suitable size gland plates with knock out plates for specified HT Cable connection.
- The design of the cable box shall be such that any type of jointing methods such as heat shrinkable/push on type/cold shrinkable type termination can be adopted.

Ground Bus

- A ground bus copper, aluminum, G.I. (min. 50x6 mm Flat) rated to carry maximum fault current, shall extend full length of the switchgear in all compartments includes cable compartments etc.
- Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and draw-out P.T. unit shall be grounded through heavy multiple contacts.
- C.T. and P.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.
- All hinged doors shall be grounded using silver plated and braided copper flexible of adequate size.

Name Plates

- Nameplates shall be provided as per standard.

Space Heaters and Plug Sockets

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

Auxiliary Power and Control Supply

a) Control Voltage shall be for
   - Closing, Tripping Coil : 110 V DC
   - Indication Circuit : 110 V AC
   - Panel space Heater, 3 pin socket, and Panel illumination : 230 V A.C.

b) Bus-wires of adequate (minimum 4sq.mm copper) capacity shall be provided to distribute the incoming supplies to different cubicles.

c) Isolating MCB shall be provided at the switchgear for the incoming supplies 230 V A.C. supply.

d) Battery backup Power pack unit shall be provided to each VCB panel for 110V AC /110V DC for closing and trip CKT suitable for min. Two Successive open and close operations after failure of power.

Tropical Protection

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

Painting

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

- **Inspection and Tests**

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

- **Routine Test**

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

a) Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme and proper functioning of the equipment.

b) All wiring and current carrying part shall be given appropriate High Voltage test.

c) Primary current and voltage shall be applied to all instrument transformers.

d) Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, meters etc.

e) Power frequency withstands insulation HV test for main circuits, auxiliary and control circuit as per relevant-IS.

f) Milli-volt drop test across main contacts of each phase of VCB and close and open time test for VCB shall be a part of Routine test.

- **Test Witness**

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

- **Test Certificate**

a) Certified reports of all the tests carried out at the works shall be furnished in Four (4) copies for approval of the Owner.
b) The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports.
c) The test report shall furnish complete identification of the equipment such as serial no., rating, equipment designation as per schematic etc. and date of test.

List of Recommended Spares

DOCUMENT: TECHNICAL DATA SHEET FOR H. T. VCB

Sr. No.	Particular	Details	Confirm / Data to be filled by the bidder
1.0	**General :**		
1.1	Make	As per Approved vendor list	
1.2	Model and Type no.	Pl. furnish	
1.3	Design Ambient	50°C	
1.4	Atmosphere	Corrosive, Humid, Dusty	
1.5	Location	Indoor / Outdoor	
1.6	Degree of Protection	IP-5X	
2.0	**Electrical Data :**		
2.1	Type of breaker	Vacuum Circuit Breaker	
2.2	Service	Continuous	
2.3	Voltage	11 kV ± 10%	
2.4	System Earthing	Solidly earthed	
2.5	Frequency	50 Hz. + 5% to - 5 %	

Sr. No.	Particular	Details	Confirm / Data to be filled by the bidder
2.6	No. of phase	3	
2.7	System fault level	500 MVA	
2.8	Rated short time current	26.3 kA (1 sec.)	
2.9	Max. system voltage	12 kV	
2.10	Auxiliary supply : (Battery backup Power Pack required)	110V D.C derived from Power Pack connected on 110V AC P.T. supply.	
2.11	Making capacity	46 KA (peak)	
2.12	Bus bar material and current rating	Aluminum and As per BOQ.	
2.13	Cable entry	Bottom	
2.14	Cable size	Pl. Furnish	
2.15	Breaker particulars :		
	(a) Operating duty	Pl. furnish/ show catalogue / IS	
	(b) Operating mechanism	Motor charged spring / manual trip and close	
	(c) Spring charging motor	230 V AC, 200 W	
	(d) Trip / Closing coil	110 V DC, 180 W	
	(e) Anti pumping feature/relay	Required.	
	(f) Latching requirement	Trip free	
	(g) Emergency trip push button	Required.	
	(h) Space heater and cubicle lamp	Required.	
2.16	**Constructiona l requirements**		
	(a) Thickness of sheet steel for frame, enclosure, doors, covers and partitions	CRCA sheet - 2 mm, hinge type door with neoprene rubber gasket	
	(b) Colour	Epoxy powder coating Light Gray RAL 7035 or Two coats epoxy primer and two coats of epoxy paint Shade 631 as per	
	(c) Earth bus size	50 x 6 mm GI Strip/ Cu	

Sr. No.	Particular	Details	Confirm / Data to be filled by the bidder
	(d) Foundation frame	ISMC-100, Suitable for three breakers or as per BOQ, with necessary bed plate and foundations bolt.	
	(e) Over all dimension	Provide dimensions	
	(f) Over load of equipment	Provide as per tender	
	(g) Minimum clear space required (i) front side as well as (ii) rear side	Provide dimensions	
	Degree of Protection	IP 5 X	
2.17	Annunciation Provided	To be Provided as per tender	
2.18	Relays	As per Specifications	
	(a) Relay no. and detail	Shall be as per tender	
	(b) Type of relay	Shall be as per tender	
	(c) Make of relay	Shall be as per tender	
	(d) Model no of relay	Provide details	
2.19	Current Transformer		
	(a) Type of CT	Cast Resin	
	(b) Accuracy class	Provide details as per tender	
	(c) VA burden	Provide details as per tender	
	(d) CT ratio	Provide details as per tender	
2.20	Potential Transformer		
	(a) Type of PT	Cast Resin	
	(b) Accuracy class	Provide details as per tender	
	(c) VA burden	Provide details as per tender	
	(d) PT ratio	Provide details as per tender	
2.21	**Panel Accessories**		
1	Toggle switch for space heater and socket	230 V A.C , 6 A	
2	(b) Socket	6 pin 5/15 A with DP MCB	
3	(c) MCB for spring charging motor circuit	6 A , DP MCB	
4	(d) MCB for ON / OFF	Double pole, 16 A, 110 V D.C for D.C ckt. Double pole, 16 A, 230 V A.C for A.C ckt.	

Sr. No.	Particular	Details	Confirm / Data to be filled by the bidder
5	Local / Remote selector switch	4 ways, 2 positions, lockable in any position, angular movement, stay put, lever type handle.	
6	Trip – Neutral – Close (TNC) Switch.	6 ways, 3 position, spring return to neutral, angular movement, lockable pistol grip type handle.	
7	Space Heater	230 VA.C , 100 W (LT supply from LT Panel)	
8	Limit switch for test and service position.	Required	

3.0 DISTRIBUTION TRANSFORMER (Wherever Applicable)

Scope:

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

Standards and Compliances:

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

General Constructionand Requirements

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

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

Taps and Tap Change Gear / Device:

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

  ±0.0% ±2.5% ±5.0% -7.5% -10.0%

Off Load Tap Change Gear:

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

Fittings

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

Accommodation for Auxiliary Apparatus:

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

Rating Plates and terminal Plates:

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

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

Gas and Oil Actuated (Buchholz) Relay:

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

Sharp bends in the pipe work shall be avoided.

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

Cable Box / Bus Duct Box

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

Parallel Operation

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

➢ **Test**

1) Test at Works

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

2) Tests at Site

- In addition to tests at manufacturer's premises, all relevant pre-commissioning checks

and tests conforming to IS code of practice No. 10028 (Part II and III) shall be done before energization.

- The following tests are to be particularly done before cable joints or connecting up the bus bar trunking.

  a) Insulation test between HV to earth and HV to MV with 5000 volts Megger. b) Insulation test between MV to earth with 500 volts Megger.

  c) Di-electrical strength Test on oil.

  d) Buchholz relay operation by simulation test when fitted.
- All test result is to be recorded and reports should be submitted to the department.

Installation and Commissioning

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

DOCUMENT: TECHNICAL DATA SHEET FOR TRANSFORMER

SR. NO.	PARTICULAR	DETAILS	Confirm/Data To Be Filled By
1.0	GENERAL FEATURES		
1.1	Make	As per Vendor List	
1.2	Rating in kVA	As per BOQ	
1.3	Installation	Outdoor	
1.4	Service	Continuous	
1.5	Climate	Corrosive	
1.6	Type of cooling	ONAN (Oil natural Air Natural)	
1.7	Ambient temperature	Max. 50° C Avg. 35° C	

SR. NO.	PARTICULAR	DETAILS	Confirm/Data To Be Filled By
1.8	Allowable temperature rise	As per IS:1180(Part-1):2014 (or Latest Applicable IS)	
1.9	Painting	Epoxy, shade no. 631 as per IS : 5	
1.10	Oil type	Mineral oil	
1.11	Position	Plinth mounted	
2.0	ELECTRICAL DATA :		
2.1	Earthing: L.V. side	Solid	
2.2	No. of windings	Two	
2.3	Phase	3	
2.4	Frequency	50 Hz.	
2.5	Voltage ratio	11 / 0.433 kV	
2.6	Phase connection	Delta – Star	
2.7	Vector group	Dyn – 11	
2.8	Winding insulation class	"A"	
2.9 a) b)	Terminations : H.V. side L.V. side	As per BOQ	
3.0	TAP CHANGER :		
3.1	Tapping	H.V.	
3.2	Tap changer	As per BOQ	
3.3	Tapping range	as per IS-1180 (Part 1):2014 (or Latest Applicable IS)	
3.4	No. of steps	as per IS-1180 (Part 1):2014 (or Latest Applicable IS)	
4.0	Limit for transformer operation under over load condition as per IS	Pl. furnish	
5.0	ACCESSORIES AS UNDER :	Required	

SR. NO.	PARTICULAR	DETAILS	Confirm/Data To Be Filled By
_ _ _ _ _ _ _ _ _ _ _	Inspection cover. Buchholz relay with alarm and trip contacts Marshalling box Sampling valve with plug or cover plate. Magnetic oil level gauge and Plain oil level indicator with mini. Mark. Conservator and conservator drain valve Bidirectional rollers. Oil temp. indicator with alarm and trip contacts Bottom drain and Filter valve with plug or cover plate. Double diaphragm Explosion vent Silica-gel breather Air release plug / device. Separate neutral bushing Top oil filter valve Jacking pads Lifting lugs		
_ _ _ _ _ ---	Two Earthing terminals. Thermometer pocket for O.T.I. Winding temp. indicator with alarm and trip contacts Pressure relief valve Rating and diagram plate HV and LV gland Any other required as per IS:2026		
6.0	PERFORMANCE DATA :	Pl. furnish	
6.1. a)	Guaranteed Maximum Total losses without Positive tolerance (no-load + load losses at 75º C) at 100% of rated load.	IS:1180(Part-1):2014 / as per specifications / (or Latest Applicable IS)	
b)	Guaranteed Maximum Total losses without Positive tolerance (no-load + load losses at 75º C) at 50% of rated load.	IS:1180(Part-1):2014 / as per specifications / (or Latest Applicable IS)	

SR. NO.	PARTICULAR	DETAILS	Confirm/Data To Be Filled By
c)	Impedance (Percent) on principal tap	IS:1180(Part-1):2014 / as per specifications / (or Latest Applicable IS)	
6.2 a) b)	Rated current No load current at 100% voltage No load current at 112.5% voltage	As per IS-1180(Part 1):2014 (or Latest Applicable IS)	
6.3	Rated efficiency at 0.8 P.F.	As per IS-1180 (Part 1):2014 (or Latest Applicable IS)	
a) b) c)	At full load At 100% load At 50% load	Pl. furnish.	
6.4 a) b) c)	Rated regulation At 0.9 P.F. lag At 0.8 P.F. lag At unity P.F.	Pl. furnish	
6.5	Load at which max. efficiency occurs	Pl. furnish	
6.6	Maximum efficiency	Pl. furnish	
6.7	Permissible flux density and Over fluxing	Pl. furnish	
6.8	Current density	Pl. furnish	
7.0	**Mechanical Data:**	Pl. furnish	
7.1	Total Quantity of oil.	Pl. furnish	
7.2 a) b) c) d)	Total Trans. Weight (with oil) Trans. Weight without oil Copper weight core weight	Pl.furnish Pl.furnish Pl.furnish Pl.furnish	
7.3	Dimensions (mm.) including all accessories:	Pl. furnish	

4.0 TRANSFORMER YARD WITH FENCING and GATE (Wherever Applicable)

- Fencing around the outdoor transformer.
- The fencing shall be at a distance of not less than 1.525m on all sides of the substation (pole structure and transformer plinths, as applicable) to ensure free movement all round.
- Fencing shall be with Chain links with proper supports (concrete poles / MS Angle) for better look. The posts shall be installed at 2.5m. Centre to center and of 2.75m. Height.

  The RCC posts shall be 100 mm square at top and 150mm square at bottom, 2.15m. Having above ground level and 0.6m. Below FGL, fixed in cement concrete foundation in 1:4:8 with 40 mm size stone jelly. In case of MS angles ISA 6565 angles having 6mm thickness shall be used as a minimum with rest as per RCC poles. The foundation shall be of suitable size to be finalized during detailed engineering.
- To include sand filling of 15 cm height. The fence shall be of chain link 75 mm size, 10 gauge. The height of fence is 2m after leaving 75mm gap from ground level including fixing the fence with the posts using GI binding wire etc. complete. A gate of minimum 2.5 meters or higher suitable width as required shall be provided on one side of the fencing with necessary access (road/pathway) for easy mobility of each transformers / vehicular movement and for ease of OandM of switchyard / transformer yard.
- Fencing and Gates shall be installed as per site condition / requirement.
- Fencing shall be earthed properly covering all rows on all sides. Caution notice should be fixed one on the 2/4 pole structure and at suitable location near transformers and another on the gate. The sub-station shall be uniformly levelled and spread with 35mm blue granite jelly to a depth of 15cm over a layer of sand.

5.0 LT PANEL –PMCC (LT SWITCH BOARDS) (Wherever Applicable)

Construction

- The MV switchboard panels shall be floor mounting, free standing, compartmentalized, Modular type suitable for indoor installation. The panel shall be totally enclosed and dust, damp and vermin proof. Enclosure shall have IP-52 or better degree of protection for indoor unit and IP-55 or better degree of protection for outdoor unit as a minimum. Outdoor unit shall be additionally provided with canopy or weather shed for protection.
- Overall height of Panel shall not exceed 2300mm (For VFD, Soft Starter panel height up to Max.2500mm can be accepted) including 100mm ISMC base frame. Minimum 175 mm height cable alley shall be provided at bottom of each vertical compartment as a part of panel in total height of 2300 mm. However, in case of panel mounted on floor without cable trench shall be mounted at least 500mm above the floor level to provide adequate bending radius for in and out cables and the overall panel height shall not exceed 1600-1800mm.
- VFD, Soft Starter cubical compartment shall be provided with Min. **750mm width and Mini. 800mm depth and 1800/mm Heigh**t.
- Bus bars chamber compartment shall be provided with Min. 300mm or higher as required.
- MFM and Ammeter both shall be provided for all starters rated 30kW and above.
- MV switch boards housing shall be of CRCA mini. 2.0 mm thick. Gland plate shall be CRCA sheet min. 3.0 mm thick. Make of the Panel CRCA / MS / GI Plates and sheet shall be “Essar / Tata / Jindal / Sail / Zenith / Asian” only.
- All the doors and others openings shall be provided with neoprene rubber gaskets or of durable material gaskets.
- All hardware shall be corrosion resistant. Star washers shall be used for effective continuity.
- Suitable lifting hooks and jacking pads shall be provided on each panel or on each shipping section for ease of lifting of switchboard.
- LT Panel shall be of fixed type, single/double front execution. LT Panel shall be single tier for all incomers and bus couplers and multi-tier for all outgoing feeders. Vacant space on incomer and bus coupler panel shall not be used for mounting the starter and switch gear modules.
- All auxiliary devices for control, metering, protection, indication and measurement such as push-buttons, control and selector switches, indicating lamps, ammeters, voltmeters, kWh meters and protective relays shall be mounted on the front side of respective compartment, for easy operation without opening the door.
- Cable alley should be provided as per requirement for all outgoing feeders.
- Circuit Breakers for capacitors shall have a current rating of at least 160% of the capacitor rated current. Circuit breakers capability to interrupt applicable capacitive current shall be specifically verified / supported by manufacturer recommendation.
- The switch board components, Bus bars etc. shall be designed to withstand the maximum designed short circuit level for minimum 1 sec.

- MCCB for power feeders shall have built-in short circuit and thermal overload releases. The rated service short-circuit breaking capacity (Ics) of MCCBs shall be more than or equal to the specified fault level.
- The outgoing Motor Feeders should comply with Type-2 Coordination as per IS: 13947.
- Panel shall have main horizontal and riser bus bars air insulated, housed in a separate compartment, segregated from all other compartments, with sheet steel barriers.
- The MCC shall be provided with a continuous earth bus having sufficient cross section to carry the specified fault current for specified duration without exceeding the safe temperature throughout its entire length.
- All control wiring except C.T. secondary wiring shall be carried out with minimum 1.5 sq.mm copper conductors. C.T. secondary wiring shall be carried out with 2.5 sq.mm copper conductor.
- Adequately rated anti-condensation heater with porcelain connectors shall be provided in each breaker panel and in cable alley to maintain inside temperature 5 deg C above outside ambient temperature. It shall be supplied from 240V AC auxiliary bus for space heater. The space heater shall be provided with a thermostat having variable setting of 30-70 deg C and manually operated switch fuse and link for phase and neutral respectively.
- All starters shall be provided with Auto-Off-Manual and Local-Remote selector switches, to monitor and operate MCC or LCS, ICP / PLC.
- All multifunction meters, VFD and soft starters, where provided shall have RS485 port to communicate with PLC/SCADA.
- Open, Close and Stop Push Button shall be provided for electrical actuator operated delivery valve of each pump at associated starter panel. Also LED type illumination lamp for valves' status indication (OPEN position, CLOSE position, Fault, L/R status) shall be provided at associated starter for each actuator at delivery line of pump.

Bus Bar

- Bus bars shall be of high conductivity, electrolytic aluminum (E91-E) 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 current density only**.
- Bus bars for risers shall be rated to carry 125% of the rated current of all feeders connected to the risers.
- The current rating of neutral shall be min. half that of phase bus bars.
- Both horizontal and vertical TP and N, bus bars, bus joints and supports shall be capable of withstanding dynamic and thermal stresses of the specified short circuit currents for 1 second.
- Only zinc passivated or cadmium plated high tensile steel bolts, nuts and washers shall be used for all bus bars joints and supports.
- The hot spot temperature of bus bars including joints at design temperature shall not

exceed 95 deg C for normal operating conditions.

- All bus bars shall be insulated with heat shrunk PVC sleeves of 1100V grade.

Auxiliary Bus bars

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

Wiring and Terminal Blocks

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

Earthing

- All vertical panels shall be connected to a GI/Alu earth bus bar running throughout the length of the switchboard. The minimum earth bus size shall be 50x6 sq.mm GI or equi. Aluminum for fault level of LT Panel.
- All doors and movable parts shall be earthed using flexible copper connections to the fixed frame of the switch board. Provision shall be made to connect the Earthing bus bar to the plant earthing grid at two ends. All non-current carrying metallic parts of the mounted equipment shall be earthed. Minimum 4 nos., 10mm Dia whole shall be provided on the earth bus for termination of earth strip / wire.

Name Plate

- Nameplates shall be provided as per standard.

Painting

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

Switchgear Modules

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

Air Circuit Breakers

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

ACB Trip Release should have Minimum following

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

ACB shall be fitted with following

- Heavy duty switches having not less than 4 NO + NC contacts
- Built in resin cast current transformer
- Auxiliary contacts
- Shunt and under voltage tripping device
- The ACB shall be suitable for locking the breaker in various positions. Provision for

door locking ACB shall be provided with the requisite end termination lugs/sockets. Terminal bars for connecting more than one terminal.

Switches/ Fuses

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

Contactors

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

Bimetal Relay

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

Moulded Case Circuit Breakers (MCCB)

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

Protective Relays

- Relays shall be rectangular in shape, flush mounting type, having dust tight covers, removable from front, and shall be equipped with externally reset, positive action operations indicators. The relay shall have auxiliary units of either series connected or shunt connected type. All auxiliary relays shall be non-draw out type and protection relays shall be draw-out type with test facilities.
- Test plug shall be supplied loose. All relays shall conform to the requirements of IS-3231 or relevant IEC in general and IS - 3231 in specific.
- Relays shall be provided with adequate number of potential free self-reset / hand

reset output contacts as required. Provision shall be made for easy isolation of trip circuits of each relays for the purpose of testing and maintenance.

Motor Protection Relay (MPR)

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

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

Instrument Transformers (CTs/PTs)

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

Indicating / Measuring Instruments

- The meters shall be generally of square pattern type of 96 x 96 mm suitable for flush mounting. Instrument shall generally conform to IS: 1248 and shall have accuracy class of or better.
- Digital meters shall have 3 ½ Digit, LED / LCD display as a minimum
- All auxiliary equipment such as shunt transducers, CT's, PT's etc., as required shall be included in the supply of switchboard. The current coil of ammeters and potential coils of voltmeters shall continuously withstand 120% of rated current and voltage, respectively, without the loss of accuracy.
- Digital type Multi-function Meter shall be of Accuracy Class: 0.5S (for Active)-IEC-687 / CBIP-88 and Suitable for measuring and digitally mini. Three line displaying the following parameters: kVA, kW, kWh, kVAr, A, V, P.F., frequency and with RS 485 communication port.

Danger Notice Plates:

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

Push Buttons

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

Push button colour shall be as follows:

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

Indicating Lamps

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

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

TRIP circuit healthy lamp : Milky

SHOP DRAWINGS

- Prior to fabrication of the Panels the supplier / contractor shall submit for consultant's approval the shop / vendor drawing consisting of G.A. drawing, sectional elevation, single line diagram, bill of material etc. and design calculations indicating type, size, short circuiting rating of all the electrical components used, busbar size and calculation, internal wiring size, Panels dimension, colour, mounting details etc. in 6 sets..
- The contractor shall also submit manufacturer's catalogues of the electrical components installed in the Panels along with the drawing.

INSPECTION

- At all reasonable times during production and prior to transport of the Panels to site, the supplier / contractor shall arrange and provide all the facilities at their plant for inspection.
- The MV / LT Panels shall be offered for inspection to be witnessed by client / TPI.

TEST CERTIFICATES

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

DOCUMENT: TECHNICAL DATA SHEET FOR MEDIUM VOLTAGE PANEL BOARD (L.T PANEL).

SR. NO.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
1.0	SITE CONDITION		
1.1	Type / Make	Indoor / As per tender	
1.2	Mounting	Floor	
1.3	Ambient Temperature	50° C	
1.4	Atmosphere	Corrosive, Humid and Dusty	
2.0	CONSTRUCTION		

SR. NO.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
2.1	Housing	As per BOQ	
2.2	Protection Class	IP-5X	
2.3	Doors	As per BOQ	
2.4	Base channel	As per BOQ	
3.0	OPERATIVECONDITION		
3.1	Voltage	415 V ± 10%	
3.2	No. of phase	3	
3.3	System	3 phase, 4 wire	
3.4	Frequency	50 Hz, +5% / -5%	
3.5	Fault Current	25 kA/50kA as per SLD	
3.6	Neutral Grounding	Solid	
4.0	CONTROL SYSTEM		
4.1	Voltage		
	For Indication	230 V A.C.	
	For Metering	230 V A.C.	
	For Protection	230 V A.C.	
4.2	Control Supply Through	230 V A.C. for MCC and APFC	
4.3	Control Wiring	Pl. Furnish	
5.0	BUSBAR		
5.1	Neutral Bus bar Material	Same as Phase Bus bar.	
5.2	Earth Bus bar Material	As per SLD	
6.0	PLC Based System	As per SLD / BOQ.	
7.0	Electronic Motor Protection Relay (with RS-485 port)	Microprocessor based	
7.1	Type	As per tender	
7.2	Make	As per tender	
7.3	Protection	Pl. furnish	

SR. NO.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
	1) over current 2) single phasing 3) phase reverse 4) Current unbalance 5) under current (dry run) 6) stall (bearing broken) locked rotor 7) Restart Inhibition 8) Ground/Earth fault (CBCT)	Pl. furnish	
8.0	PAINTING		
8.1	Sheet should be 7 tank processed, Oven Baked at 310 °C with powder coating.	Required	
8.2	Colour	Pl. Furnish	
8.3	Shade : Exterior and Interior	Pl. Furnish	
9.0	PANEL TEMPERATURE		
9.1	Max. temperature rise	35 °C above ambient	
10.0	Control Wiring		
10.1	Wire Size	Pl. Furnish	
11.0	Hardware (Zinc Plated)	YES	
12.0	Space Heater	230 V A.C. with thermostat	
13.0	Pocket For Drg at door	YES	
14.0	Annunciator Window (Free standing to be mounted at convenient location with required cabling, required contacts should have separate terminal block in cable alley)	Indication for each Pump : a. Pump Trip (Red)- Through starter b. High level in sump c. Low and very low level in sump d. High and low discharge pressure e. Valve Motor Trip	

SR. NO.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
15.0	Instrumentation compartment	Separate compartment for energy meter, Hr meter, level controller, etc. with necessary internal wiring	
16.0	Panel Internal Lighting	Auto NO contact/switch with Panel door and CFL 18 W for Panel Internal Lighting	

Note: Other specifications not mentioned in datasheet shall be considered as per tender specifications

6.0 AUTOMATIC PFC PANEL and CAPACITOR BANK (Wherever Applicable)

- Minimum Panel height shall be 1800mm and depth shall be 600mm and length shall be minimum 900mm or higher length as required.
- The control equipment including capacitors shall be mounted in a panel made of 2 mm thick cold rolled sheet steel. The panel shall be of indoor type for internal part of LT panel as a cubical compartment as per SLD / BOQ.
- The housing of the capacitor banks shall be of open construction with free ventilation for capacitor units (IP-5X). The connections from the capacitor units to the control panel shall be carried in totally enclosed, dust-proof, vermin-proof bus-ways or wire-way Except for the specific requirements of PFIC / APFC panel specified here in, rest all specifications shall be as per LT Panel / MV Switchboard specifications specified above

- Capacitors rating shall be at 415V. APFC Panel shall be as per IS: 16636:2017.
- All capacitors shall be with **dielectric losses ≤ 0.2w/kVAr.**

The automatic control panel shall comprise of the following:-

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

Test and Test Reports

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

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

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

- Complete schematic and wiring diagrams for capacitor control panel.

7.0 <u>SOFT STARTER (FORMING PART OF LT PANEL)</u> (Wherever Applicable)

SCOPE

This specification covers the requirement for design, manufacture, installation, testing and commissioning of step-less reduced voltage / solid state torque controlled soft starter for motors in MCC panel to provide linear ramp starting and stopping of A.C induction motors.

Constructional and Performance Features (Microprocessor Soft Starter)

- The PCB power structure shall consist of six SCR's mounted on a heat sink for ratings up to suitable rating of motor. PCB shall be self-tuning to accept control power input as per design.
- All phases should be controlled during start/stop.
- Soft starter shall consist of built-in MODBUS RTU for monitoring control.
- Soft starter should be built for continuous operation without need of by pass for any reason.
- The logic circuitry shall incorporate a latch circuit for two wire / three-wire control.
- Control terminals shall be easily accessible and located on the front bottom of the device.

Following shall be considered while sizing the soft starter and its enclosure:

- Soft Starter (S/S) shall be de-rated as per manufacturer's recommendation for 50°C operating conditions based on site/operating condition and such de-rated current of Soft Starter shall be min. 110% of rated current of motor.
- Soft Starter shall be rated for DOL starting and shall have External Bypass Contactor.
- Soft starter shall be provided with breaker (MCCB/ACB) along with F.A. Semi-conductor fuse protection and with series contactor of rating as recommended by vendor and meeting Type-2 co-ordination requirement (soft starter signal to be interlocked with PLC and in manual mode timer based interlock to be provided to ensure that signal to turn on S/S is fed only if contactor close signal is received) to switch off supply to contactor through PLC when soft starter is not ON.
- Contractor/Vendor shall furnish the heat dissipation load data and shall provide the cooling arrangement accordingly to ensure that the temperature rise within enclosure does not exceed 5°Cover the max. Ambient temperature of 50°C.
- Min. Three or higher nos. as required cooling fans shall be provided for each cubical compartment. The enclosure cooling fans and 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 to protection level 3C3 according to IEC-60721-3-3 to withstand harsh environment.

- Aux. contact of incoming breaker and contactor shall be used in series to provide "Soft Starter Ready" interlock signal for PLC/remote operation

a) Detachable display/key pad with Digital parameter adjustment, preferred with cable suitable for door mounting. The Control keypad and display shall have the option for remote mounting. For safety reasons the controller should have green lights for running and red for start/stop.

CONTROL MODULE DESIGN FEATURES

Mechanical and Electrical

- The PCB module shall consist of a power supply, logic control circuitry, silicon controlled rectifier (SCR) firing circuitry, digital microprocessor control and supervision of all controller operation, including SCR pulse firing control. I/O circuitry a digital programming keypad, dual LED Displays and a serial communication port.
- The PCB power supply shall be self-tuning to accept control power input from 110 to 240 or 380 to 500 V AC, 50/60 Hz. There shall be separate power sections to operate from 200V to 525 V and 200V to 690V, 50/60 Hz.

User Adjustments

- The two acceleration start ramp and stop ramp timers shall have individual adjustments from 1 to 60 seconds and 2 to 60 seconds respectively.
- The initial torque setting shall be adjustable from 0 to 200 % of motor torque.
- The end torque setting shall be adjustable from 50 to 200% of motor torque.
- Current limit starting shall be adjustable from 150% to 500% of the motor's full load current.

Pump Control (Standard Feature)

- The standard feature pump control shall be implemented to provide closed loop control of a motor to match the specific torque requirements of centrifugal pumps for both starting and stopping.
- Pump stop shall be initiated without the need for a dedicated Pump Stop input. A coast-to-rest stop shall still be possible with stop input.

Controller's Features and Modes

a) Starting modes required for controller includes Linear Torque control for Start, Pump Control Current Limit Start (Voltage ramp Start, Voltage ramp with current limit Start, Full Voltage DPL Start, Remote analogue control, Slow Speed time controlled, Slow Speed external controlled, Dual Ramp Start, Soft Start with Selectable Torque Boost), Bypass control and Bypass contactor mode with all the protection parameter working.

b) Stopping modes required for controller includes Linear Torque control for Stop,

Quadratic Torque control for Stop, Pump Control (DOL/Cost to stop, Remote analogue control Stop, Slow Speed time controlled, Slow Speed external controlled, Dual Ramp Stop, Bypass control).

Protection and Diagnostics

- Protections of Controller shall meet applicable standards.

- **Protective Features:**
- Motor Thermal Overload – selectable for starting class 10A, 15A, 25A under load protection (to avoid dry run), Soft Start thermal overload, PTC input, Phase imbalance, Phase reversal, Over voltage, Under voltage, Locked Rotor, Excessive Starts per hour for application, Phase loss input / output etc.
- Shaft Power measurement without the need of external electro-mechanical sensors.
- Electronic thermal memory shall be provided for enhanced motor protection.
- All Protections should be available in bypass mode also.
- When fault conditions are detected, the controller shall inhibit starting or shut down SCR pulse firing.

- **Fault Indications:**

- Controller shall indicate latest fault indications/occurrence for Line failure, Phase imbalance, Over temperature – motor, Over temperature – Soft Starter, Shorted Thyristor, Open Thyristor, Locked Rotor, Motor output loss, Overload and Under load – Shaft Torque, Over voltage, Under voltage, Excessive Starts and Phase reversal etc.

- **Viewing Functions:**
- Motor Current, Three Phase Voltage, Shaft Power in kW / HP (selectable), Motor thermal capacity, Motor Energy consumption (kWh), Power factor and Run time in hours etc.

8.0 H.T. XLPE (Wherever Applicable)

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 and PVC overall sheathed. The cables shall be armored with galvanized steel strip/wire armour.
- Cables shall be capable of operating at a sustained conductor temperature of 90°C and suitable for a maximum conductor short-circuits temperature of 250°C.

Operating Conditions: Electric system

- System Voltage : 11 kV
- Frequency : 50 Hz.

Environment

- Ground temperature : 35°C.
- Ambient air temperature : 50°C.
- Atmospheric conditions : Humid and dusty

Construction

11 kV grade cross-linked polyethylene (XLPE) insulated, PVC outer sheathed GI strip armored, Aluminum conductor UE HT cable as per IS 7098 (part II) with latest amendment.

Cable Marking:

- Embossing on outer sheath:
- The PVC outer sheath shall be legibly embossed / Printed with the legend: “ELECTRIC CABLE 11000 VOLT”, cable size, IS specification No., identification of manufacturer and year of manufacture etc. at each m length. Cable shall be supplied in non-returnable drums as per IS 10418 standard. Cable identification details as above shall be written on Drums also as per IS.

Testing:

Routine tests and acceptance tests shall be carried out in accordance with the relevant IEC standards / IS. The copies of Type test results shall be submitted along with each drum length or part thereof.

9.0 LT POWER and CONTROL CABLES (Wherever Applicable)

- The scope shall cover supply, laying, testing and commissioning of medium voltage PVC / XLPE cables.
- All cables shall carry tag numbers for easy identification. In case of control cables all cores shall be identified at both sides by their terminal numbers using PVC ferrules as per interconnection diagrams.

PVC / XLPE Insulated Cables (Medium Voltage)

1.1 kV grade PVC / XLPE insulated, Aluminum conductor GI strip / wire armored LT Cable as per IS 1554 (part I) / IS 7098 (part I) (for XLPE) with latest amendment.

RTD / BTD / Signal Cables:

Vendor is fully responsible for the sizing of all cables in their scope of supply considering factors like maximum distance between Panel/Control Room and the Units/Motors. Specifications for cables for RTD / BTD / Analog signals shall be as follows:
Cables shall be of 660V/1100V grade, single / multi-pair / Triad / Core cables as per BOQ/Price bid. Triad / Multi Core Signal cables shall be annealed, tinned, high conductivity 0.5/1.0/1.5 sq.mm stranded copper conductor, Polyester tapped PVC insulated nos. of cores twisted into pair, laid up collectively, individual pair / triad shielded and overall shielded with aluminum Mylar tape, armored with galvanized steel wire/strip, overall sheathed with PVC, conforming to IS:1554 and IEC:189 Part II.

Splicing and Termination

- Branch circuit wiring shall be spliced only in switch boxes, panel switch socket outlet boxes light fixtures outlets and circular junction boxes. They shall be made only with approved porcelain connectors. No joints shall be allowed within the conduit pipes, cable entry pipes or ducts for cable laying and wire pulling.

Testing:

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

Finished Cable Tests at Manufacturer's Works:

The finished cables shall be tested at manufacturer's works. Following routine tests for each and every length of cable and copy of test results shall be furnished for each length of cable along with supply. If specified, the cables shall be tested in presence of client's representative.

1. Voltage Test:

Each core of cable shall be tested at room temperature at 3 kV A.C. R.M.S. for duration

of 5 minutes.

2. Conductor Resistance Test:

The D.C. Resistance of each conductor shall be measured at room temperature and the results shall be corrected to 20° c. to check the compliance with the values specified in IS 8130 - 1976.

Cable Test before and after laying of cables at site:-

1. Insulation Resistance test between phases, phase to Neutral and phase to earth.
2. Continuity test of all the phases, neutral and earth continuity conductor.
3. Sheathing continuity test.
4. Earth resistance test of all the phases and neutral.

Sealing and Drumming:

- Cable shall be supplied in non-returnable drums as per IS 10418 standard. Cable identification details like Voltage, size, name, etc. shall be written on Drums also as per IS.

10.0 LOCAL PUSH BUTTON STATION (Wherever Applicable)

Each motor shall be provided with a local control station in the field near the motor.

Construction Features:

- Push Button and related control switches shall be as per IS-6875 and as per BOQ.
- The local push button station / local control station (LCS) shall have die-cast aluminum enclosure with minimum IP-5X protection and canopy made of at least 14 SWG (2mm) galvanized sheet steel or FRP suitable for outdoor application. The enclosures painted with two coats of epoxy paint with final colour shade (both internal and external) of Light grey shade 631 of IS: 5
- All control stations shall be suitable for 10 A continuous current rating 240V AC as well as 110V/220V DC control supply.
- All push buttons shall be fitted with 2NO + 2NC rated to carry and break 6 Amps at 415 Volts (10 A at 240 V AC)
- The open/close/start push buttons shall be of the momentary contact push to actuate type and shall be green in colour.
- The stop push buttons shall be stay put type with mushroom knob and lockable in pressed position and shall be red in colour.
- All ammeters shall be of moving iron type having an accuracy class of 1.5 and suitable for 1 ampere CT secondary. The size of ammeter shall be 72mm x 72mm or minimum 65mm dia. The ammeter front glass shall be toughened.

Type of Push Button Stations

- Push button station Type-A - Each P.B. station suitable for outdoor installation and shall comprise two push buttons viz. 'START' and 'STOP' for control of Non-Reversible Motors, with or without ammeter.
- Push button station Type-B - Each P.B. station for indoor installation and shall be comprise of three push buttons viz. 'OPEN', 'CLOSE' and 'STOP' with on/off indicating lamps for control of **Reversible Motor,** , with or without ammeter.

11.0 JUNCTION BOX: (Wherever Applicable)

- Junction Box (JB) material shall be Cast Aluminum (LM-6)/ as per BOQ, and shall be weather proof to IP-55/65. Outdoor JBs shall be provided with canopy made of at least 14 SWG (2mm) galvanized sheet steel or FRP suitable for providing protection against rain from top and two sides for IP-5X protection JBs. JB shall be as per electricity regulations and BS 7671.
- The boxes shall have terminals suitable for Power cables and/or control cables termination as per BOQ, mounted on ISMC / Steel structure. The size of terminal and bus bar connections shall be suitable for terminations of Submersible pump motor flat cable / PVC / XLPE cables as per SLD and BOQ. Minimum 20% or minimum 2 Nos. (Whichever is higher) of spare terminals shall be supplied in junction boxes for each size of terminals.
- Each junction box shall be provided with 10% or minimum 1 No. of spare entry for each power and control cable with plugs.
- Fault level of Junction box shall be 20 MVA or as per BOQ.
- JB shall be with Wall / Stand mounting with Zinc passivated Bolts and nuts and earth terminals as per IS and name plate as required.
- JB shall be as per approved drawings and test certificates shall be submitted.

12.0 EARTHING SYSTEM (Wherever Applicable)

Standards

The following standards and rules shall be applicable:

1. IS: 3043 - 1987 Code of practice for Earthing.
2. IS: 2309 -1989 Code of practice for the protection of buildings and allied structures against lightning.
3. Indian Electricity Act and Rules / Electrical inspector / statutory norms

All codes and standards mean the latest. The installation shall generally follow the Indian Standard Code of Practice or the British Standard Code of Practice in absence of Indian standard.

General

- The resistance of any point in the earth continuity system of the installation to the main earth electrode shall preferably not exceed 1.0 ohm.
- The earth resistance shall be maintained with suitable soil treatment, (If required).
- The main earth loop shall be laid at a depth of 500mm below ground level.
- All medium (LT) and high voltage (HT) equipment (above 230V) shall be earthed by two separate and distinct connections with earth.
- Lightening protection shall be provided as per IS: 2309. Self-conducting structures may not be provided with aerial rod and down conductors but shall be connected to the Earthing grid at minimum two points of the base. An independent Earthing network shall
- Be provided for lightening protection and this shall be bonded with the main Earthing network minimum at two points at the buried electrodes.
- Plant instrument system clean Earthing, UPS system clean/safety earth shall be separate from the electrical Earthing system.
- The main earth electrodes after being driven into the ground shall be protected at the top by constructing brick masonry chamber of size 400 mm x 400 mm x height 300 mm shall be provided with 6mm thick Chequered plate cover / CI cover hinged with CI frame for housing of funnel and pipe.
- The earth electrodes shall be situated at a distance not less than 3.0 m from the building fencing structure and equipment foundations.
- The distance between two electrodes shall not be less than 3 meter.
- The surrounding the electrodes, soil shall be treated up with salt, coke and charcoal.
- The earth system connection shall generally cover the following:

1. Equipment Earthing for personnel safety
2. Transformer, DG and System neutral Earthing
3. Static and lightning protection

4. Current and potential transformer secondary neutral
5. Metallic non-current carrying parts of all electrical apparatus such as transformers, switchboards, bus ducts, motors, neutral Earthing resistors, capacitors, UPS, battery charger panels, welding receptacles, power sockets, lighting/power panels, control stations, lighting fixtures ceiling fan and exhaust fan, Street light, flood light pole circuit / cable.
6. Fence and Gate for electrical apparatus (e.g. transformer yard, etc.)
7. Cable shields armourand Shield wire.

Scope of work

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

- Plate (600 x 600 x 3mm Copper plate) / Pipe (40 mm Dia B class G.I pipe) type Earthing station with G.I Pipe / Copper plate of size as per BOQ / IS.
- Earthing Copper strips from Plate Earthing station and 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 and construction of Earth Pit, chamber etc. Shall be as per IS 3043 and BOQ.

13.0 INTERNAL AND EXTERNAL LIGHTING SYSTEM: (Wherever Applicable)

- Section covers supply, installation, connection, testing and commissioning of internal and external lighting system, definition of point wiring, system of wiring, point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan etc.
- Lighting system shall confirm to the latest Indian Standards.

Point Wiring

- The point wiring shall be complete with the branch wiring from the distribution board to the outlet point, through switch board, conduit with accessories, junction, pull, inspection boxes, control switch, socket, outlet boxes, ceiling roses, batten / swan holder, earth wire DB to SB and point etc.

System of Wiring

- The system of wiring shall consist of ISI marked, single core, stranded copper conductor PVC insulated, 650/1100 volt grade, FRLS wires laid through exposed (surface mounted) PVC conduits as directed.
- In places where ceiling fans are provided, lighting fixtures shall be installed suspended / wall mounted below fan level with the help of conduits / chains to avoid shadows on the floor.

Conduit Wiring - PVC Conduit

- All non-metallic PVC conduits shall conform to IS: 9537 and shall be used with the corresponding accessories.
- PVC conduits pipes of approved minimum 1.6mm wall thickness shall be used. The minimum PVC conduit diameter shall not be less than 20 mm.
- In long distance straight run of conduit, inspection type junction box at reasonable intervals shall be provided
- To facilitate drawings of wire in the conduit. GI mesh wire of 16 SWG shall be provided while laying of recessed conduit.
- Conduit pipes shall be fixed by heavy gauge clamps, secured to suitable wood plugs or other approved plugs with screws in an approved manner at an interval of not more than 60 cm but on either side of the couplers bends, or similar fittings, saddles shall be fixed at a distance of 30 cm from the center of such fittings.
- The saddle should not be less than 24 gauge for conduits up to 25 mm Dia and not less than 20 gauge for larger diameter.
- Where conduit pipes are to be laid along the trusses, steel joints etc. the same shall be secured by means of ordinary clips or girder clips as required by the Engineer-in-Charge. Where it is not possible to drill holes in the truss members, suitable clamps with

bolts and nuts shall be used.

Boxes:

- Switch box shall be made of metal on all sides, except on the front.
- In the case of cast boxes, wall thickness shall be at least 3 mm and in case of welded mild steel sheet boxes the wall thickness shall not be less than 18 gauge for boxes, up to a size of 20 cm x 30 cm and above this M.S. boxes having minimum sheet thickness of 1.6mm shall be used.
- Inside each switch box, one bolt shall be welded to receive Earthing wire.
- Switch boxes shall be galvanized after fabrication. Except where otherwise stated 3 mm thick phenolic laminated sheets like Bakelite hylam/sun mica shall be fixed on the front with brass screws. Clear depth of the box shall not be less than 60 mm and this shall be increased suitably to accommodate mounting of fan regulators in flush pattern.

Cables:

- The size of the cables used for internal wiring shall be as per BOQ / IS :
- The cores of all cables shall be identified by colours in accordance with the following sequence.

Single phase	-	Red
Three phase	-	Red, Yellow, Blue
Neutral	-	Black
Earth	-	Green or Green/Yellow

- Unless otherwise specified in the Specification/drawings the size of the cables used for internal wiring shall be as follows :

  In case of circuit wiring for lights, exhaust fans, convenience socket outlet points (P+N+E):

  a) 1.5 mm.² - From MCB at Panel to switch boards.
  b) 1.5 mm.² - From switch boards to outlet points
  c) 2.5 mm.² - From MCB at Panel to 15 Amp socket.
  d) 4.0 mm.² - From MCB at Panel to 20 Amp socket.

Switches and Sockets:

- Switches and Sockets shall conform to IS: 3854, IS: 1293 and IS: 4615.

Joints

- The wiring shall be by looping back system, and hence all joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only.
- No joints shall be made inside conduits and junction boxes.
- Joints where unavoidable, due to any specified reasons, prior permission in writing shall be obtained from the client before making such connections. Joints by twisting conductors are prohibited.

Testing of Installation

Before a completed installation is put into service, the following tests shall be complied with

Insulation Resistance

1. The insulation resistance shall be measured by 500 volt Megger with all fuses in places, circuit breaker and all switches closed
2. The insulation resistance of an installation, measured shall not be less than 50 mega-ohms Divided by the number of points on the circuit.
3. The insulation resistance shall be measured between Earth to phase, Earth to neutral, Phase to neutral and Phase to phase.

Polarity of Single Pole Switches:

- A test shall be made to verify that every single pole switch is connected to one of the phase of the supply system.

Completion Certificates:

- All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms.
- Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result from shall be submitted to the client for approval.
- On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

Light Fixtures

Scope:

- The scope of work shall cover the supply, assembling, installation, testing and commissioning of various types of light fixtures as per specification and latest standards.
- All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the relevant British Standard Code of Practice in the absence of Indian Standard.
- The light fixtures shall be of standard make from list of vender as per tender.

General Requirements:

- All fixtures shall be complete with ballast, igniters, starter, capacitor, lamp, accessories and pre wired at manufacture work.
- Fixture shall be completely wired with FRLS wires and constructed to comply with the

regulations and and shall confirm to relevant IS standards for Electric Lighting Fixtures, unless otherwise specified.

- All the fixtures are as per the IP – 2X / 4X protection for indoor application whereas IP -6X protection for outdoor application.
- The lighting fixtures shall comply with the following requirements.

a) Luminaries shall have high efficiency Lumen Output/Watts
b) Enclosures shall be with corrosion resistance paints.
c) For all the fluorescent fittings the ballast shall be High Frequency Electronic Ballast only (less than 10% Total Harmonic Distortion). Fittings shall preferably have integral ballasts and shall confirm to relevant IS.
d) Fluorescent/LED fittings shall be provided for indoor areas as specified in SOQ. HPSV/LED or other fittings as specified in SOQ shall be provided for outdoor and yard areas...

Lamps:

- Lamps used for temporary lighting service shall not be used in the final lamping of fixture units.
- Lamps shall be of wattage and type as given in the drawings and schedules. Where not given, the details shall be ascertained from the client before procurement.
- Lamps for permanent installation shall not be placed in the fixtures until so directed by the Client's representative, and this shall be accomplished directly before the respective portions are ready for occupation.

LED Light Fixtures / Lightings:

LED fixtures shall be generally having

LED luminous Efficacy lumens/watt: - 100% min.

Efficiency of Electronics system - 80% - 85% min.

	LED Lamp/Light efficiency	:-	85% - 90% min.
	Total Harmonic Distortion	:-	For Outdoor Fittings - ≤ 20%
			For Indoor Fittings - ≤ 10%
	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
- Outdoor LED fixtures must be fully enclosed with minimum IP Rating of IP66/65 (Weatherproof). LED optical system must be gasketed (enclosed) to minimize light dirt depreciation.

- Electrical safety for outdoor LED Lights shall be of Class-I.
- Luminaries must be clearly marked with manufacturer name, model number, electrical rating and agency approval (If applicable - CSA, UL, etc.).

Lighting Poles

Lighting poles shall be steel tubular swaged type made from GI pipe conforming to IS: 1239 medium class and made as per IS: 2713.

Street light pole, steel tubular swaged type, 9 / 7.5 / 6 meter long (6 / 4.5 / 3.0m x 1.5m x1.5m) 139.7mm, 114.3mm, 88.9mm Dia respectively, 4.85mm, 3.65mm, 3.25mm thick respectively, with M.S. base plate, pipe cap, single/double arm of 1/0.5m height and and over hung 1/1.5m long GI pipe having dia. to suit the socket of 250/150/70W etc., 240V, HPSV/LED/MH/HPMV lighting fixture as applicable. Street light pole shall be conforming to IS 2713: 1980.and with

1. PVC junction boxes on pole with 8 way connector and 1 no. 4 A SP MCB.
2. Street light pole shall be as per approved Drg.

TEST:

The routine tests shall be conducted as per the relevant Indian Standards

14.0 PRESSURE GAUGE (Wherever Applicable)

Industrial Model Heavy Duty Pressure gauges shall be provided on discharge of each pump and on common discharge header of each pump. Pressure gauge shall be bourdon type with a dial size of 150 mm in diameter and calibrated for the required range of duty heads of pumping machinery to be installed as per range available in the market unless specified otherwise in the price bid. The gauge shall be supplied complete with impulse tubing, two valve manifold with drain cock / calibration valve, fittings etc. The pressure gauges shall have an accuracy of ± 1% full scale and weather protection class IP 65. All wetted parts material shall be SS 316.

Pressure gauge shall comply with IS 3624 / BS 1780. Pressure gauge shall have siphon & cock arrangement. Glycerin filled dial shall be provided as the gauge is subjected to pressure pulsation and / or vibrations. The internal parts of pressure gauge shall be stainless steel.

The minimum diameter for round pressure gauge shall be 150 mm unless specified otherwise in data sheet.

The zero and span of pressure gauge shall not change by more than ±0.1 % of the span per 0C changes in ambient temperature.

The pressure gauge shall have to be fitted on individual delivery of pump as well as on the common discharge header.

DATA SHEET (PRESSURE GAUGE)			
SR.No	Particulars	Dept.Requirement	Bidder's Data
1.0	GENERAL		
1.1	Make	As per vendor list	
1.2	Service	Individual Pump desch. and Common header	
1.3	Fluid	Raw water	
1.4	Area of Classification	Non-hazardous	
2.0	MATERIAL OF CONSTRUCTION		
2.1	Type	Bourden Type	
2.2	Sensor & other wet parts	SS 316	
2.3	Process connection	½" NPT (M)	
2.4	Dial size	150 MM	
2.5	Material of dial	Aluminum with white background & black numerals	
2.6	Glass	Shatter proof	
2.7	Housing material	Die cast aluminum with epoxy	
2.8	Accuracy	+ or – 1 %of full scale or better	
2.9	Over range protection	125 %of maximum pressure	
2.10	Gauge protection	IP 65	
2.11	Temperature	50 Degree Celsius Ambient	
2.12	Range	As per BOQ	
2.13	Accessories	Snubber ,3 way isolation valve, all other installation hardware	
2.14	Diaphram seal M.O.C	SS 316	
2.15	3 way isolation Valve	SS 316	
2.16	Impulse Tube Fitting M.O.C	SS 316	

15.0 SAFETY EQUIPMENTS (Wherever Applicable)

The contractor shall provide safety equipment as per IE rules / as specified in BOQ, on the HV panels, Generator panels, Control panels and main MV panel rooms. Generally following shall be provided:

- Rubber mat conforming to IS 5424 in front of all the HT and MV panel for their entire length – 1000 m. wide.
- Pairs of electrically tested rubber gloves. These are to be kept in a suitable wooden box.
- A shock treatment instruction chart in English and local language duly framed as detailed in IS: 1355. Detail of the nearest medical facility available with phone number shall also be kept.
- First aid box containing of medicines for treatment of electrical burns in the main switch room.
- Portable fire extinguishers of dry powder (Store type) as per IS: 935 to suit the individual substation, panel rooms requirement.
- Caution notices in English shall be fixed permanently on the equipment to comply the requirement of IE rules.
- Safety posters for vigilance against electrical accidents as detailed in IS: 1255.
- Fire buckets with MS angle stand and with 4 Nos. round bottom fire buckets marked fire shall be provided in the HT substation.
- 3 Mtrsand 6 Mtrs. long folding aluminum ladders for safe maintenance of lighting system, etc.

16.0 OTHER EQUIPMENT AND ACCESSORIES SPECIFICATIONS: (Wherever Applicable)

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 galvanized, 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.

Cable Glands:

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

Cable Connectors:

- Cable connectors, lugs/sockets, shall be of copper/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. pipes shall be used.
- Pipe shall be laid at an angle of max. 45 deg. to trench wall. Both ends of pipe shall

be sealed with approved W.P. Sealing plastic compound after cabling work.

- Size of pipe shall depend upon the overall outer diameter of cable to be drawn through pipe.
- To determine the size of pipe, assume that 40% area of pipe shall be free after drawing of cable.

[C] INSPECTION AND TESTING

- All the equipment shall be tested and inspected at vendor manufacturer's works before dispatch to ensure compliance with the specifications/requirements mentioned in the tender / BOQ and applicable codes and standards and agreed quality assurance/testing plan.
- The owner / Client or his authorized representative may visit the works during manufacture of various electrical equipment/materials to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given full assistance to carry out inspection. Owner/ client's representative shall be given minimum two weeks advance notice for witnessing of final testing.
- Field tests as per approved procedures / procedures available with engineer-in-charge or his authorized representative shall be performed on the electrical system / equipment before it is being put into service. All test equipment shall be arranged by the vendor. Test reports shall be approved by the engineer-in-charge before acceptance of the complete plant and equipment.
- All the cost pertaining to inspection including to and from travel, local conveyance, lodging and boarding expenses shall be borne by contractor for minimum 2 representatives of client / client's consultants / Third Party Inspection Agency.

[D] ERECTION, TESTING and COMMISSIONING OF ELECTRICAL INSTALLATIONS

Scope

- The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical system like HT Equipment, HT Panel, transformer, M.V panels, Cables, Earthing system, Internal and External lighting, Light fixtures etc. Requirement of this project shall be as specified in bill of quantities / approved drawings / general specifications or as per the battery limits fixed by the owner / consultant.
- Inspection at manufacturers premises: All tests of all major items like HT panel, LT panel, Transformers, Power cable (in case of more than a drum) shall be conducted at manufacturer's work in presence of third party inspection agency and client' representative appointed by purchaser's representative. However, all the expenses like transportation, loading and boarding shall be borne by contractor.

Standards

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specification / codes of practice of the Indian Standards Institution, approved drawings and the instructions issued by the authorized representative, from time to time.

Some of the relevant Indian Standards are listed elsewhere in this tender document.

In addition to the standards mentioned in the tender, all works shall also conform to the requirement of the following:

1. Indian Electricity Act and Rules framed there under
2. Fire Insurance Regulations.
3. Regulations laid down by the Chief Electrical Inspector of the State / State Electricity Board / Union Territory.
4. Regulations laid down by the Factory Inspector of the State / Union Territory.
5. Any other regulations laid down by the local authorities.
6. Installation and operation manuals of original manufacturers of equipment.

ERECTION and TESTING:

The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. Equipment shall not be removed from packing cases unless the floor has been made ready for installing them. The cases shall be opened in presence of the client / consultant or his authorized representative. Any document if found with the equipment shall be handed over to the client's representative.

ONAN Type Transformer Erection

- Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out.
- After the completion of erection, necessary stoppers shall be provided at the wheels.
- All loosely supplied fittings / accessories shall be cleaned and mounted on the transformer and connections made.
- After completely assembling and installation, the transformer shall be cleaned and touched up with a paint supplied by the manufacturer applied wherever necessary.
- All cover bolts shall be checked for proper tightness. All the civil foundation work required shall be in the scope of contractor.

Testing

- Winding insulation resistance shall be measured from primary and secondary to ground and between primary and secondary.
- Check the polarity of terminals and the phase sequence.
- Insulation resistance test with 1000 V megger.

Between primary to earth between secondary to earth between primary and secondary

- Polarity marking and phase sequence.
- Earth resistance: Body as well as Neutral link.

MOTOR CONTROL CENTER, DISTRIBUTION BOARDS: Erection

- Electrical panels his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation.
- The contractor shall be responsible for final assembly and interconnection of bus bars / wiring. Foundation channel shall be delivered in convenient shipping section by the manufacturer.
- Switchgear shall be aligned and levelled on their base channels and bolted to them as per the instructions of the client / consultant.
- The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. The contacts of the draw out circuit breaker shall be checked for proper alignment and inter changeability.
- After erection, the switchboard shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost. If the instrument transformers are supplied separately, they shall be erected as per the direction of the client / consultant.
- The contractor shall fix the cable glands after drilling the bottom / top plates of all switchboards with suitable holes at no extra cost.
- Range of overload relays / timers etc. shall be checked with requirement of motor actually to be connected at site and if the same is undersized / oversized, it shall be brought to the notice of the client / consultant, who shall arrange procurement of corrected components.
- However, the contractor shall not charge anything extra for labour for such replacements.

Testing

- Before electrical panel is energized, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.
- Before switchgear is energized, the insulation resistance of all control circuits shall be measured from line to ground.
- Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulation resistance measured from phase to phase and phase to ground.
- All adjustable direct acting trip devices shall be set using values given by the manufacturer.
- The dielectric strength of insulating oil wherever applicable shall be checked. Before switchgear is energized,
- The following tests shall be performed on each circuit breaker in its test position.

1. Close and trip the circuit breaker from its local control switch push button or

operating handle. Switchgear control bus may be energized to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.

2. Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
3. Test proper operation of circuit breakers latch, check carriage limit switch if provided. Test proper operation of lockout device in the closing circuit. Wherever provided by simulating conditions which would cause a lockout to occur.
4. Trip breaker either manually or by applying current or voltage to each of its associated protective release.

Before switchgear is energized, the tests covered above shall be repeated with each breaker in its normal operating position.

- Capacitor banks shall be tested as per manufacturer's instructions.
- All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.
- Insulation resistance test (contacts open, breaker racked in position)

Between each phase of bus : Mega ohm
Between each phase and earth : Mega ohm
DC and AC control and auxiliary circuits : Mega ohm
Between each phase of CT / PT
Between CT and PT circuit if any : Mega ohm

Installation of Cable Network:

- Cable network shall include power, control and lighting cables which shall be laid in underground trenches, cable trays, G.I. pipes, or on building structures as per drawings / site condition as per cable schedules or as per the client / consultant's instructions.
- Supply and installation of cable trays, G.I. pipes / conduits, cable glands and sockets of end isolators, junction boxes, remote push button stations, etc. shall be in the scope of the contractor.

General Requirements for Handling Cables:

a) Before laying cables, this shall be tested for physical damage, continuity, absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500 / 1000 V megger.

b) The cables shall be supplied at site, wound on wooden drums as far as possible. For Smaller length and sizes, cables in properly coiled form can be accepted. The cables shall be laid by mounting the drum of the cable on drum carriage. Cables shall be handled and laid as per IS 1255.

c) While drawing cables through G.I. pipes, conduits, RCC pipes, ensure that size of pipe is such that, after drawing cables, 40% area is free. After drawing cables, the end of pipe shall be sealed with approved WP sealing plastic compound.

d) Armoured cables shall never be concealed in walls / floors / roads without G.I. pipes, conduits or RCC pipes.

e) A minimum loop of 3 m shall be provided on both ends of the cable, and on both ends of straight through cable joint if any.

f) Cable shall be neatly arranged in the trenches / trays in such manner so that crises crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cable within the trenches / trays shall be the responsibility of the contractor.

g) All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided. The cable routes indicated is indicative only and the same may be rechecked with the client / consultant before cutting of cables.

h) All temporary ends of cables must be protected against dirt and moisture to prevent Damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tapes. Use of friction type or other fabric type tape is not permitted.

i) Wherever cable rises from underground / concrete / masonry trenches to motors /switchgears / push buttons, these shall be taken in G.I. Pipes of suitable size, for mechanical protection up to 300 mm. distance of concerned cable gland or as instructed by the client / consultant.

j) The cable pass through foundation / walls of other underground structures, the necessary ducts for opening will be provided in advance for the same. However, should it become necessary to cut holes in existing foundation of structures the electrical contractor shall determine the location and obtain approval of the client / consultant before cutting is done?

k) Cable trays, racks and trenches shall be installed to allow for 20% future cables. Cable Installation shall provide minimum cable bending radius recommended by cable manufacturer.

Laying of Cables (Underground System)

- Cables shall be so laid in trench that this will not interfere with other underground structure. All water pipes, sewage lines or other structures which become exposed by excavation shall be properly supported and protected from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded / diverted as directed by the owner / consultant.
- The cables shall be laid and protected by filling trench bottom with a layer of sand. This
- Sand shall be levelled and cables laid over it. These cables shall be covered with 150mm of sand on top of the largest diameter cable and sand shall be lightly compacted. This laying work shall comply with IS 1255 with latest amendments and enclosed tender drawings
- Cable shall be laid at minimum depth of 750 mm. in case of L.T. and 1000 mm. in case of H.T. from ground level. Excavation will be generally in ordinary soil. The width of trench shall be sufficient for laying of required no. of cables.

- The surface of the ground after back filling the earth shall be made good so as to conform in all respects to the surrounded ground and to the entire satisfaction of the client / consultant.
- For all underground cables, route markers should be installed at 30 Mt. Interval along the cable route. Separate route markers should be used for LT, HT and Instrumentation cables.
- Route markers should be grounded in ground with 1:2:4 cement concrete.
- RCC Hume pipe for crossing road in cable laying shall be provided by employer. No deduction shall be made for cable laying in Hume pipe for not providing bricks, sand and excavation.
- RCC hump pipe and pipe sleeves shall be sealed at both ends by bituminous compound / WP sealing after laying and testing of cables by electrical contractor without any extra charge.

Laying of Cable in Masonry Trenches

- Masonry / concrete trenches for laying of cables shall be provided by employer. However, steel members such as M.S. angles / flats etc. shall be provided and grouted by electrical contractor to support the cables without any extra charge.
- Cables shall be clamped to these supports with minimum saddles / clamps. More than one tier of cables can be provided in the same trench if the no. of cables are more.
- Entry of cables in trenches shall be sealed with approved WP sealing plastic compound to stop entry of water in trenches.

Laying of Cables in Cable Trays

- Cable trays and steel members such as M.S. angle / channel / flats etc. shall be provided and fixed by the contractor.
- Cable shall be fixed in cable trays. Cables shall be clamped with flat clamps and galvanized bolts / nuts in cable trays.
- Earthing flat / wire can also be laid in cable tray along with cables.
- After laying of cables, minimum 20% area shall be spare.

Termination and Jointing of Cables:

- For HT cables suitable size of heat shrinkable type termination kit shall be used as per BOQ/ SLD. For HT cable manufacturer's recommendation should be followed.
- For LT cables:

1. All PVC cables up to 1.1 KV grade, armoured or Unarmoured shall be terminated at the equipment / junction box / isolators / push buttons / control accessories, etc. by means of suitable size double compression type cable glands, crimped type solder less lugs / connectors for termination of cable.
2. Armour of cable shall be connected to earth point.
3. In case of termination of cables at the bottom of the panel over a cable trench having no

access from the bottom, a close fit hole should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

Dressing of Cable inside the Equipment:

- After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.
- For motors of 20 HP and above, terminal box if found not suitable for proper dressing of aluminum cables, the erector shall modify the same without any additional cost.

Cable Test before and after laying of cables at site:-

1. Insulation Resistance test between phases, phase to Neutral and phase to earth.
2. Continuity test of all the phases, neutral and earth continuity conductor.
3. Sheathing continuity test.
4. Earth resistance test of all the phases and neutral.

- All tests shall be carried out in accordance with relevant Indian Standard Code of practice and Indian Electricity Rules. The Vendor shall provide necessary instruments, equipment and labour for conducting the above test and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the client and results shall be recorded in the prescribed forms.

EARTHING SYSTEM:

- The plate/pipe electrode shall be installed as per IS: 3043 / tender specification / BOQ.
- Construction of the Earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS: 3043, Code of Practice for Earthing Installation.
- The earth conductors (Strips / Wires copper / hot dip G.I.) Inside the building shall properly be clamped / supported on the wall with galvanized Iron clamps and Mild Steel Zinc Passivated screws / bolts. The conductors outside the building shall be laid at least 600 mm below the finished ground level.
- Measure earth resistance of each electrode separately. If a number of earth electrodes are interconnected with one another, combined earth resistance shall also be measured. The earth resistance of each electrode and/or a group of electrodes shall not exceed the values specified.
- Carry out line earth loop impedance test. The loop comprises the line conductor from the point of fault, back to the supply transformer, the path through transformer winding, the

earthed neutral point of the transformer and path for that point to the point of fault through the Earthing system.

- Continuity test for earth continuity conductors with ELV tester.
- The complete Earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

Test:

- The entire Earthing installation shall be tested as per requirements of Indian Standard Specification IS: 3043.
- The following earth resistance values shall be measured with an approved earth Megger and recorded.
    1. Each Earthing station
    2. Earthing system as a whole
    3. Earth continuity conductors
    4. Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 ohm in each case.
- Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.
- All tests shall be carried out in presence of the client's or PMC.

Erection:

Ceiling / Wall Outlet Boxes for Lights / Fans:

- Outlet boxes shall be of steel with cover and so installed as to maintain continuity throughout.
- In beams conduit socket shall be provided in place of outlet boxes. The same shall be used for installation of luminaries.
- For fixing light fixtures / brackets, outlet boxes complete with knock out for holding conduits shall be used. For lighting fixture suitable for 40/20 watts fluorescent tubes / incandescent lamps / mercury vapour lamps, only one outlet box is required.
- For fixing ceiling fans, circular outlet boxes, 100 mm. diameter, complete with 12 mm. dia. Mild Steel rod 300 mm. long, for holding 12 mm. dia. Mild Steel cover 125 mm. dia. at bottom shall be used.

Switch and Socket:

- Switches shall be installed at 1200 mm above finished floor level unless otherwise indicated on the drawings.

Installation of Lighting Fixtures:

- Scope of work under this item shall start from light point, with 3 nos. 1.5 mm.² PVC insulated wires from connector to the connector inside the lighting fixture, connections,

fixing of lighting fixture complete with all accessories, lamps on wall / roof / steel truss etc. testing the lighting fixture and commissioning.

Installation of Exhaust Fans:

- Scope of work under this system shall start from exhaust fan point, with a ceiling rose, 2 core 2.5 mm.² PVC insulated wire from ceiling rose to connector of exhaust fan, connections, making fan opening in walls including repair / finishing fixing of exhaust fan complete with accessories and louvers on walls with hold-fasts, testing the exhaust fans and commissioning.

COMPLETION TESTS of INSTALLATION:

After supply and installation of complete project or a particular building / area, following tests shall be carried out by the contractor before switching on the power to installation and the results shall be recorded and submitted to the Site-Engineer.

If results are not satisfactory / as per standards set herewith, the contractor shall identify the defects / short coming and shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.

Insulation Resistance

- The insulation resistance shall be measured by 500 volt Megger with all fuses in places, circuit breaker and all switches closed
- The insulation resistance of an installation, measured shall not be less than 50 mega-ohms divided by the number of points on the circuit.
- The insulation resistance shall be measured between
  Earth to phase Earth to neutral Phase to neural Phase to phase
- Earth continuity test for all points, fixtures, fans etc.
- Polarity test all single phase switches.

Completion Certificates:

- All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms.
- Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result from shall be submitted to the client for approval.

  On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

STATUTORY APPROVAL

The Contractor shall be totally responsible for obtaining statutory approval from the electrical inspector or any other statutory authority for the entire installation carried out by him unless otherwise specified and agreed. Necessary test reports, drawings and documents shall be submitted by him to electrical inspector. This will be an integral part of the contract and shall not be paid for separately. **The contractor shall liaison with local electric supply company for getting power supply and only necessary fees, if any, payable to supply company shall be borne by the Owner.**

Note No. - 1:

Any LT Panel Manufacturer meeting / possessing the following requirements as a minimum shall also be qualified as an approved vendor for supply of LT Panels:

1. Should have obtained approval from CPRI / ERDA and obtained type test certificate for LT Panel with rated voltage of 415V (3-Ph. + N), 50Hz rated frequency and min. 3200A rated current and having short circuit withstanding strength of min. 65kA for one sec.
2. Should have obtained approval from CPRI / ERDA and obtained type test certificate for Degree of Protection Class IP-55 or above for LT Panel with rated voltage of 415V (3-Ph. + N), 50Hz rated frequency and certificates must have validation for current year..
3. Shall have In-house panel fabrication facility.
4. The company should be in existence for mini. 5years and shall have Excise Registration Certificate.
5. Shall be ISO 9001:2008 certified

[E] Vendor List

Latest Gujarat Water Supply and Sewerage Board (GWSSB) Approved Vendor List Shall Be Made Applicable. Can Be Downloaded From official Website Of GWSSB.