I N D E X

1.0 TECHNICAL SPECIFICATIONS FOR LT XLPE CABLE

1.0 SCOPE OF WORK

This section shall cover supply, laying, testing and commissioning of medium voltage XLPE cables.

This specification gives the general requirement of cables. However, it is the responsibility of the vendor to take the joint measurement and obtain client's approval before the placement of orders to the main supplier / manufacturer.

2.0 CODES & STANDARDS

The following standards and rules shall be applicable :

Sr. No	Item	Relevant IS	Relevant IEC
1	XLPE insulated electric cables (heavy duty).	IS : 7098 Part I	
2	Recommended current ratings for cables.	IS : 3961	
3	Aluminium conductors for insulated cables	IS : 8130	Indian Electricity Act and Rules.

3.0 DESIGN BASIS & SITE CONDITIONS

All equipment and materials will be selected and rated for use at the following site conditions.

Site conditions	
Location NARODA,AHMEDABAD	GUJRAT
Ambient temperature	**Relative humidity**
Maximum 47 0 C	**Maximum** 98 %
Minimum 5 0 C	**Minimum** 40 %
Design 45 0 C	**Design** 98 % at 45 0 C
Seismic factor As per IS:1893	
Environmental Non corrosive, Humid and Dusty	**Location of Equipment** Ground/Air
Wind speed 80 kmph maximum	
Electrical system data :	

	Power supply for Equipment			
	Voltage 415 V ± 5 %		**Frequency** 50 Hz ± 3 %	
	Permissible combined voltage & frequency variation	± 6 %	**System design faults level (Symmetrical)**	35 kA – 60 kA as per specified in SLD for 1-3 sec. max.
	System earthing LV side neutral solidly earthed		**Wiring** 3 phase, 4 wire on 415V system	
	Auxiliary power supply			
	Power supply	240V AC, 1-Ph, 50Hz		
	Control Supply	-----		
	Space heater power supply	240V AC, 1-Ph, 50Hz		
	Illumination power supply	240V AC, 1-Ph, 50Hz		
	Plug-socket power supply	240V AC, 1-Ph, 50Hz		

4.0	**TECHNICAL REQUIREMENTS**
	GENERAL CONSTRUCTIONAL FEATURES
	The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer's instructions. The cables shall be delivered at site in original drums with manufacturer's name, size, and type, clearly written on the drums.
	MATERIAL Medium voltage cable shall be XLPE insulated. PVC sheathed, aluminium or copper conductor, armoured conforming to IS: 7098 Part I.
	Type: The cables shall be circular, multi core, annealed copper or aluminium conductor, XLPE insulated and PVC sheathed, armoured or unarmoured.
	Conductor: Uncoated, annealed copper / aluminium, of high conductivity upto 4 $mm.^2$ size, the conductor shall be solid and above 4 $mm.^2$, conductors shall be concentrically stranded as per IEC: 228.

	Insulation: XLPE rated 70° c. extruded insulation
	Core Identification: Two core : Red and Black Three core : Red, Yellow and Blue Four core : Red, Yellow, Blue and Black Single core : Green, Yellow for earthing Black shall always be used for neutral.
	Assembly: Two, three or four insulated conductors shall be laid up, filled with non-hygroscopic material and covered with an additional layer of thermoplastic material.
	Armour: Galvanised steel flat strip / round wires applied helicaly in single layers complete with covering the assembly of cores. For cable size upto 25 Sq. mm. : Armour of 1.4 mm dia G.I. round wire For cable size above 25 Sq. mm. : Armour of 4 mm wide 0.8 mm thick G.I strip
	Sheath: XLPE 70 deg.c. rated extruded. Inner sheath shall be extruded type and shall be compatible with the insulation provided for the cables. Outer sheath shall be of an extruded type layer of suitable PVC material compatible with the specified ambient temp. 50 deg. C and operating temperature of cables. The sheath shall be resistant to water, ultraviolet radiation, fungus, termite and rodent attacks. The colour of outer sheath shall be black.Sequential length marking required at every 1.0 mtr. interval on outer sheath. Vendor has to furnish resistance / reactance / capacitances of the cable
	Rating: Up to and including 1100 Volts.
	DRAWINGS & INFORMATION
	Contractor shall submit the as built drawing of the cable laying drawing.

	HANDINGOVER DOCUMENTS
	The supplier shall submit following: 1. Data sheet indicating results of tests 2. Test reports
	INSPECTION AND TESTING
	All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of handling during transportation, loading, unloading etc. The cable shall be supplied in single length i.e. without any intermediate joint or cut unless specifically approved by the client. The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practice.
	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.
	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.
	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
	Insulation Resistance test between phases and phase to Neutral and phase to earth.
	Continuity test of all the phases, neutral and earth continuity conductor.
	Sheathing continuity test.
	Earth resistance test of all the phases and neutral.
7.0	**METHOD OF MEASUREMENT**
	The cables will be measured in meters. The unit rate shall include cutting the cable into required lengths, packing, loading, unloading, insurance, transportation, delivery to stores/site as per work order, stocking in stores, testing of cables at stores etc. of medium voltage cable. Total quantity in

	meters shall be measured lug to lug basis.
8.0	**TRANSPORT, DELIVERY AND STORAGE**
	The cable shall be supplied in the actual length as per detailed purchase order
	The cable shall be dispatched at client's stores or at site as per detailed instructions given by client at later stage.
	The cable shall be loaded from the main vendor's store and properly stacked as per instruction of client's local representative. All such labour and transportation charges shall be clearly mentioned in the offer.
9.0	**GUARANTEE OF PERFORMANCE**
	The quotes values of parameters shall be within given tolerance for given period of service life.
10.0	**SPARES**
10.1	As per standard and as per specified by site engineers/contractor/client.

2.0 TECHNICAL SPECIFICATIONS FOR MEDIUM VOLTAGE PANEL

1.0 SCOPE OF WORK

This scope shall cover design, manufacture, check test, and supply of medium and low voltage motor/power control Panel boards, MCB distribution boards etc. as described in this specification, as per drawings and schedule of quantities.

2.0 CODES & STANDARDS

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

Sr.	Item	Relevant IS	Relevant IEC
1.	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237	
2.	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375	
3.	Degree of protection provided by enclosures for Low voltage switches gear and control gear.	IS: 2147	
4.	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197	
5.	Danger notice plates	IS: 2551	
6.	Code of Practice for selection, installation and maintenance of switchgear and control gear.	IS: 10118	
7.	Specification for factory built assemblies of switchgear and control gear for voltage up to and including 1000 V AC and 1200 V D.C.	IS: 8623	
8.	Miniature circuit breakers.	IS: 8828	
9.	Current transformers	IS: 2705	
10.	Voltage transformer	IS: 3155	
11.	Electrical relay for protection	IS: 3231	
12.	Indicating instruments	IS: 1248	

13.	Integrating instruments	IS: 722	
14.	Control switches and push buttons	IS: 6875	
15.	AC motor starters of voltage not exceeding 1000 V	IS: 1822	

The Panels also require approval of the client/consultant at various stage of their manufacture such as design, selection, construction, testing, shipping etc.

3.0 **DESIGN BASIS & SITE CONDITIONS**

Ambient Temperature	: Max. / Min. = 50° C. / 6° C.
Design temperature	: 50 Degree C.
Relative humidity	: 95% max.
Altitude	: 20 M above MSL
Voltage	: 415+/- 10%, TPN
Frequency	: 50 Hz. + 3% to -6%
Neutral	: Solidly / earthed neutral.
Fault level	: 24 MVA, Symmetrical at 415V solidly earthed.

All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.

Site conditions	
Location NARODA,AHMEDABAD	GUJRAT
Ambient temperature	**Relative humidity**
Maximum 47^0 C	Maximum 98 %
Minimum 04^0 C	Minimum 40 %
Design 45^0 C	Design 98 % at 45^0 C
Seismic factor As per IS:1893	Rain fall 1000 mm/year
Environmental Tropical/humid/corrosive conditions	**Location of Equipment** Indoor
Wind speed 80 kmph maximum	

	Electrical system data:				
	Power supply for Equipment				
	Voltage 415 kV ± 5 %		**Frequency** 50 Hz ± 3 %		
	Permissible combined voltage & frequency variation	± 6 %	**System design faultslevel(Symmetrical)**	35 kA – 50 KA – 65 KA for 1 sec. max. as per specified in SLD	
	System earthingLV side neutral solidly earthed		**Wiring** 3 phase, 4 wire on 415V system		
	Auxiliary power supply :				
	Power supply		240V AC, 1-Ph, 50Hz		
	Control Supply		-----		
	Space heater power supply		240V AC, 1-Ph, 50Hz		
	Illumination power supply		240V AC, 1-Ph, 50Hz		
	Plug-socket power supply		240V AC, 1-Ph, 50Hz		
4.0	**TECHNICAL REQUIREMENTS**				
	All the Panels shall be metal clad, totally enclosed, rigid, floor mounting, air insulated, cubicle type suitable for operation on three phase/single phase, 415 V/240 V, 50 Hz., neutral effectively grounded at transformer and short circuit level as mentioned in the drawings.				
	The entire outdoor panel shall be double door type with IP54 protection class construction.				
	The entire indoor panel shall have IP51 protection class construction.				
	The painting of all the metal part shall be as per the painting specification defined in the datasheet.				
	The panel should be CPRI / ERDA approved with 85 KA short circuit withstand strength.				
	The Panels shall be designed to withstand heaviest condition at site, with maximum expected ambient temperature of 45°c, 90% humidity and salty, dusty weather.				
	CUBICAL TYPE PANELS:				
	STRUCTURE				

	The Panels shall be metal clad enclosed and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor mounting type.
	All CRCA sheet steel used in the construction of Panels shall be 2 mm. thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal.
	The Panels shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP: 51. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasketed with foam rubber and/or rubber strips and shall be lockable.
	All panels and covers shall be properly fitted and secured with the frame and holds in the panel correctly positioned. Fixing screws shall enter into holes, taped into an adequate thickness of metal or provided with bolts and nuts. Self-threading screws shall not be used in the construction of Panels.
	A base channel of 100 mm. x 50 mm. shall be provided at the bottom. A clearance of 300 mm. between the floor of the Panels and the bottom of the lower most units shall be provided.
	Panels shall be preferably arranged in multi-tier formation. The Panels shall be of adequate size with a provision of 20% spare space to accommodate possible future additional switchgear. The size of the Panels shall be designed in such a way that the internal space is sufficient for hot air movement and the electrical component does not attain temperature more than 45^0c. The entire electrical component shall be derated for 50^0c. The ratings indicated in the drawing are derated for 50^0c.
	Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the number, and the size of incoming and outgoing conduits/cables.
	Alternately, the Panels shall be provided with removable sheet steel plates at top and bottom to drill holes for cable/conduit entry at site.
	The Panels shall be designed to facilitate easy inspection, maintenance and repair.
	The Panels shall be sufficiently rigid to support the equipment without distortion under normal and under short circuit condition. They shall be suitably braced for short circuit duty.
	PROTECTION CLASS:
	All the indoor Panels shall have protection class of IP 51 for indoor installation and IP 54 for outdoor installation.
	PAINTING:
	The painting shall be with 2 coats of epoxy primer along with two coats of PU paint [Anti-corrosive paint]. Paint shade shall be confirmed with the client.

	CIRCUIT COMPARTMENTS:
	Each circuit breaker and switch fuse unit shall be housed in separate compartments and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker/switch fuse unit in `ON' and `OFF' position. Safety interlocks shall be provided for air circuit breaker to prevent the breaker from being drawn out when the breaker is in `ON' position.
	The door shall not form an integral part of draw out position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.
	INSTRUMENT COMPARTMENTS:
	Separate adequate compartment shall be provided for accommodating instruments, indicating lamps, control contactors/relays and control fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker/switch fuse unit, busbar and connections.
	BUS-BARS:
	The busbar shall be air insulated and made of high quality, high conductivity, high strength Aluminium.
	The busbar shall be of 3 phases and neutral system with separate neutral and earth bar. The bus bar and interconnection between bus bars and various components shall be of high conductivity Aluminum. The busbar shall be of rectangular cross-section designed to withstand full load current for phase bus bars and half rated current for neutral bus bars and shall be extensible on either side. The busbar size shall be as per drawing. The busbar shall have uniform cross-section throughout the length.
	The bus bars and interconnections shall be insulated with heat shrinkable PVC sleeve and be colour coded in red, yellow, blue and black to identify the 3 phases and neutral of the system if specified in datasheet. The busbar shall be supported on unbreakable, non-hydroscopic SMC/DMC insulated supports at sufficiently close intervals to prevent bus bars sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 15 KA RMS symmetrical for 1 sec. and a peak short circuit withstand of 31.5 KA minimum.
	The bus bar shall be housed in a separate compartment. The bus bar shall be isolated with 3 mm. thick Bakelite sheet to avoid any accidental contact. The bus bar shall be arranged such that minimum clearance between the bus bars to be maintained as below:

Between phases	:	25 mm. minimum
Between phases and neutral	:	25 mm.
Between phases and earth	:	25 mm.

		Between neutral and earth	:	20 mm. minimum	
	All bus bar connections shall be done by drilling holes in bus bars and connecting by chromium plated or tinned plated brass bolts and nuts. Additional cross-section of bus bar shall be provided in all Panels to cover up the holes drilled in the bus bar. Spring and flat washers shall be used for tightening the bolts.				
	All connections between bus bars and circuit breakers/switches and cable terminals shall be through aluminium strips of proper size to carry full rated current. These strips shall be insulated with insulating tapes.				
	ELECTRICAL POWER AND CONTROL WIRING CONNECTION:				
	Terminal for both incoming and outgoing cable connections shall be suitable for 1100 V grade, aluminum/copper conductor PVC insulated and sheathed, armoured cable and shall be suitable for connections of solder-less sockets for the cable size as indicated on the appended drawings for the Panels.				
	Power connections for incoming feeders of the main Panels shall be suitable for 1100 V grade aluminum conductor (LT XLPE) cables.				
	Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.				
	Both control and power terminals shall be properly shrouded.				
	10% spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block, so that not more than one outgoing wire is connected per terminal.				
	Terminal strips for power and control shall preferably be separated from each other by suitable barriers of enclosures.				
	Wiring inside the modules for power, control, protection and instruments etc. shall be done with use of 660/1100 V grade, PVC insulated copper conductor cables conforming to IS: 694 and IS: 8130. Power wiring inside the starter module shall be rated for full current raring of respective contactor, but not less than 4.0 sq.mm. Cross-section area. For current transformer circuits, 2.5 sq.mm. copper conductor wire shall be used. Other control wiring shall be done with 1.5 sq.mm. copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solderless sockets at the ends before connections are made to the terminals.				
	Control power for the Motor starter module shall be taken from the respective module switchgear outgoing. Control power wiring shall have control fuses, (HRC fuse type) for circuit protection. All indicating lamps shall be protected by HRC fuses.				
	Particular care shall be taken to ensure that the layout of wiring is neat and orderly. Identification ferrules shall be fitted to all the wire termination for ease of identification and to facilitate checking				

	and testing.
	Spring type washers shall be used for all copper and aluminium connections.
	Final wiring diagram of the Panels power and control circuit with ferrules numbers shall be submitted alongwith the Panels as one of the documents against the contract.
	TERMINALS:
	The outgoing terminals and neutral link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformers for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted; only one conductor may be connected in one terminal.
	WIRE-WAYS:
	A horizontal PVC wire way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.
	CABLE COMPARTMENTS:
	Cable compartments of adequate size shall be provided in the Panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate supports shall be provided in the cable compartments to support cables. All outgoing and incoming feeder terminals shall be brought out to terminal blocks in the cable compartment.
	EARTHING:
	Copper earth bus of 40 X 6 mm shall be provided in the Panels for the entire length of the panel. The frame work of the Panels shall be connected to this earth bar. Provisions shall be made for connection from this earth bar on both sides of the panels to the main earthing bar coming from the earth pit. Door earthing shall be provided for all the compartments.
	The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be made for connection from this earth pit on both sides of the Panels.
	The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be ultimately bonded with the earth bar.
	LABELS:
	Engraved metal labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

	NAME PLATE:
	A name plate with the Panel's designation in bold letters shall be fixed at top of the central panel. A separate name plate giving feeder details shall be provided for each feeder module door.
	Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc. shall suitably be identified by providing stickers.
	Engraved name plates shall preferably be of 3 ply,(Red-White-Red or Black-White-Black) lamicold sheet. However, black engraved Perspex sheet name plates shall also be acceptable. Engraving shall be done with square groove cutters.
	Name plate shall be fastened by counter sunk screws and not by adhesives.
	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.
	The danger notice plates, in general, meet the requirements of local inspecting authorities.
	Overall dimensions of the danger notice plate shall be 200 mm. wide x 150 mm. high.
	The danger notice plate shall be made from minimum 1.6 mm. thick mild steel sheet and after due pre-treatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.
	The letters, the figures, the conventional skull and bones etc. shall be positioned on plate as per recommendation of IS: 2551-1982.
	The said letters, the figures and the sign of skull and bones shall be painted in signal red colour as per IS: 5-1978.
	The danger plate shall have rounded corners. Location of fixing holes for the plate shall be decided to suit design of the Panels.
	The danger notice plate, if possible, is of ISI certification mark. Suitable Voltage rated rubber mates to be provided.
	INTERNAL COMPONENTS:
	The Panels shall be equipped complete with all types of required number of auto transformer starters, switch fuse units, contactors, relays, fuses, meters, instruments, indicating lamps, push buttons, equipment, fittings, bus bars, cable boxes, cable glands etc. and all the necessary internal connections/wiring as required and as indicated on relevant drawings. Components necessary for the

	proper and complete functioning of the Panels but not indicated on the drawings shall be supplied and installed on the Panels.
	All parts of the Panels carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at the part of the Panels.
	All units of the same rating and specifications shall be fully interchangeable.
	COMPONENTS
	GENERAL:
	The type, size and rating of the components shall be as indicated on the relevant drawings. While selection of the capacity of the components resulting from the prevailing conditions like ambient temperature shall be allowed for. The thermal and magnetic trip rating shall be compensated for the ambient temperature. The ratings indicated on the drawing are ratings anticipated at prevailing site conditions.
	MINIATURE CIRCUIT BREAKERS:
	Miniature Circuit breakers shall be current limiting type conformed with British standard BS: 3871 (Part I) 1965 and IS: 8825. The housing of MCBs shall be heat resistant and having high impact strength. The fault current of MCBs shall not be less than 9000 A at 230 V. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical `ON' and `OFF' indications.
	The circuit breaker dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit.
	The MCB contacts shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCBs shall be provided with magnetic fluid plunger release for over current and short circuit protection. The overload or short circuit device shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCBs shall be tested and certified as per Indian Standards, prior to installation.
	FUSE:
	Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with IS: 2000-1962 and having high rupturing capacity of not less than 35 MVA at 415 V. The back-up fuse rating for each motor/equipment shall be so chosen that the fuse does not operate on starting of motors/equipment. HRC fuses shall be of the make as specified in Make of Material.
	AIR CIRCUIT BREAKER:

	Construction: The ACBs shall have following features: 1. Motorised with 230 V A.C. motor. 2. 230 V A.C closing and shunt trip coil 3. Draw out type with "service", "test", "isolated" and "maintenance" position. 4. Safety shutter of Fibre glass/polycarbonate sheet of 2mm thickness shall be provided 5. Mechanically trip free plus anti-pumping feature is to be provided. 6. Electrical trip free plus anti pumping shall be provided with relay ONLY and not by contactors. 7. Electrical/Mechanical operation counter shall be provided. 8. Door interlock with defeat features to be provided. 9. ACB shall be lockable in isolation position.
	Release: 1. Thermal Magnetic release shall be direct acting type, tripping ACB mechanically. 2. Microprocessor based release where ever specified in SLD 3. Short circuit, overload and earth fault protection shall be provided. 4. Vendor to suggest release type for feeders of supply range characteristic and accuracy.
	ACB Performance: 1. ACB performance inside panels at ambient 50 Degree. 2. Ith Symmetrical breaking, 35KA 3. Making capacity peak 87.5 KA 4. Short time rating, 1sec. 35KA 5. Short circuit value 65KA as per specified in SLD.
	CONTACTORS:
	The contractors shall meet with the requirements of IS: 2959 and BS: 775. The contractors shall have minimum making and breaking capacity in accordance with utilisation category AC3 and shall be suitable for minimum Class II intermittent duty. If the contractor forms part of a distribution board then a separate enclosure is not required, but the installation of the contractor shall be such that it is not possible to make an accidental contact with live parts.
	CURRENT TRANSFORMER:
	Where ammeters are called for C.T.s shall be provided for current measuring. Each phase shall be provided with separate current transformer of accuracy Class I and suitable VA burden for operation

	of associated metering and controls. Current transformer shall be in accordance with IS: 2705 - 1964 as amended up to date.
	PUSH BUTTONS:
	The push button unit shall comprise of the contact element, a fixing holder, and a push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps. continuous current rating. The actuator shall of standard type and colour as per its usage for ON, OFF and TRIP.
	INDICATING LAMPS:
	Indicating lamps shall be transformer operated low voltage rated and shall be supplied complete with translucent covers to diffuse the lamp light. Colour shade for the indicating lamps shall be as below – the LED shall be 22.5 mm and self-coloured: ON indicating lamp : Red OFF indicating lamp : Green TRIP indicating lamp : Amber PHASE indicating lamp : Red, Yellow, and Blue
	DIGITAL MULTI FUNCTION METER:
	The load manager shall be digital type with RS485 port. It should measure KW, KVA, KVAR, V, I, PF etc.
5.0	**DRAWING & INFORMATION**
	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, internal wiring size, Panels dimension, colour, mounting details etc.. The contractor shall submit manufacturer's catalogues of the electrical components installed in the Panels.
6.0	**INSPECTION & TESTING**
	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.
	Testing of Panels shall be carried out at factory and at site as specified in Indian standards in the presence of consultant. The test results shall be recorded on a prescribed form. The test certificate for the test carried out at factory and at site shall be submitted in duplicate to the consultant for approvals.

7.0	**METHOD OF MEASUREMENT**
	All the items will be measured as mentioned in Bill of quantity.
8.0	**TRANSPORT, DELIVERY & STORAGE**
	The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of site or site store. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.
	All the items will be measured as mentioned in Bill of quantity.
9.0	**GUARANTEE & WARRENTY**
	The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier.
10.0	**SPARES**
	The bidder shall quote for minimum spares required for two years safe operation of transformer along with the offer separately.
11.0	**DATA SHEET**

SR. NO.	PARTICULARS	DESCRIPTION
1.0	Site Condition	
1.1	Type	Indoor
1.2	Mounting	Floor, Indoor
1.3	Ambient Temperature	50° C.
1.4	Atmosphere	Corrosive, Humid & Dusty
2.0	OPERATIVE CONDITION	
2.1	Voltage	415 V ± 10 %
2.2	No. Of Phase	3
2.3	System	3 Ø , 4 WIRE
2.4	Frequency	50 HZ, + 3 % / - 6 %.
2.5	Fault Level	18 MVA
2.6	Fault Current	As per SLD
3.0	CONTROL SYSTEM	

	3.1	Voltage	
		For Indication	230 V A.C.
		For Metering	230 V A.C.
		For Protection	230 V A.C.
	3.2	Control Supply Through Control Transformer	230 V A.C. only
	3.3	Control Wiring	2.5 MM² FRLS Cu. Wire 4.0 MM² FRLS cu. Wise for CT ckt.
	4.0	BUSBAR	
	4.1	Phase Bus bar	
	A.	Material	CUPPER
	B.	Support	SMC/DMC
	C.	Insulation	Epoxy Moulded (Resin)
	D.	Insulating Barriers	Fibre Glass / Poly Carbonate Of Minimum 1.5 Mm Thick And To Be Of Fr4 Class
	E.	Current Density	1.6 Amp. / mm²
	4.2	Neutral Bus bar Material	Aluminium
	4.3	Earth Bus bar Material	GI
	5.0	Source changeover System	Not Required
	6.0	PAINTING	
	6.1	Baked At 310°C. With Powder coating.	
		Type Of primer	EPOXY
		Type Of Paint	PRIMER PU
		Shade	Shall be confirmed with
		Exterior	client
		Interior	
		Degree Of Protection	IP 54
		Max. Temperature Rise Inside The Panel (°C.) Exterior Interior	
		Degree Of Protection	Shall be confirmed with
		Max. Temperature Rise Inside The Panel (°C.)	35 ° C. above ambient
		Control wiring	
		Wire sizing	3c x 4.0 sq mm as per specified. 3 C × 2.5 mm² / 3 C × 1.5 mm²/4 C x 1.5 mm²

			Hardware (Zinc Plated)	YES
			SPACE HEATER	230 V AC with thermostat control
			Pocket For Drawing at door	Yes
			Illumination and switched power plug	YES

3.0 TECHNICAL SPECIFICATIONS FOR INTERNAL WIRING

1.0 SCOPE OF WORK

This section covers, definition of point wiring, system of wiring and supply, installation, connection, testing and commissioning of point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points, bell outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan, bell etc

2.0 CODES & STANDARDS

The following standards and rules shall be applicable:

Sr. No.	Item	Relevant IS	Relevant IEC
1.	Code of practice for electrical wiring installation (System voltage not exceeding 650 V)	IS: 732	
2.	Code of practice for fire safety of buildings (General) Electrical installation.	IS: 1646	
3.	Rigid steel conduits for electrical wiring.	IS: 9537 (Part - 2)	
4.	Fittings for rigid steel conduits for electrical wiring.	IS: 2667	
5.	Flexible steel conduits for Electrical wiring.	IS: 3480	
6.	Accessories for rigid steel conduit for electrical wiring.	IS: 3837	
7.	PVC insulated cables.	IS: 694	
8.	Rigid non-metallic conduits for electrical wiring.	IS: 9537 (Part - 3)	
9.	Flexible (Pliable) non-metallic conduits for electrical installation.	IS: 6946	
10.	3 pin plugs and sockets.	IS: 1293	

11.	Specifications of conduits for electrical installation.	IS: 8130	
12.	Switches for domestic purpose.	IS: 3854	
13.	Fittings for rigid non-metallic conduits.	IS: 3419	
14.	Guide for electrical layout in residential buildings Indian electricity act and rules.	IS: 4648	

3.0 **DESIGN BASIS & SITE CONDITIONS**

All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.

Electrical system data:			
Power supply for Equipment			
Voltage 415 V ± 5 %		**Frequency** 50 Hz ± 3 %	
Permissible combined voltage & frequency variation	± 6 %	**System design faults level (Symmetrical)**	35 kA for 1 sec. max.
System earthing LV side neutral solidly earthed		**Wiring** 3 phase, 4 wire on 415V system	
Auxiliary power supply :			
Power supply		240V AC, 1-Ph, 50Hz	
Control Supply		-----	
Space heater power supply		240V AC, 1-Ph, 50Hz	
Illumination power supply		240V AC, 1-Ph, 50Hz	
Plug-socket power supply		240V AC, 1-Ph, 50Hz	

4.0 **TECHNICAL REQUIREMENTS**

POINT WIRING

A point shall consist of the branch wiring from the distribution board together with a switch as

	required, including the ceiling rose or pendant holder or swan holder, or ceiling fan box or socket or suitable termination. A point shall include, in addition, the earth continuity conductor/wire from the distribution board to the earth pin/stud of the outlet/switch box and to the outlet points
	Supply, installation, fixing of conduits with necessary accessories, junction/pull/inspection/switch boxes and outlet boxes
	Supplying and drawing of wires of required size including earth continuity wire
	Supply, installation and connection of flush type switches, sockets, cover plates, switch plates, and fixing fan regulator etc.
	The point 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, button/swan holder, connector etc.
4.2	**POINT RATE**
	The rate per point shall include supply, installation, connection, testing and commissioning of point as described under “point wiring”. The measurements of the points will be enumerated
4.3	**SYSTEM OF WIRING**
	Unless otherwise mentioned on the drawings, the system of point wiring shall be as follows: The system of wiring shall consist of single core, FRLS insulated, 650/1100 volt grade, copper conductor wires/cables laid through exposed (surface mounted) PVC conduits as directed & wherever required, conduits shall be concealed in walls and slabs
4.4	**GENERAL**
	Prior to laying of conduits, the contractor shall submit for approval, the shop drawing for conduit layout indicating the route of the conduits, number and size of the conduits, location of junction/inspection/pull/outlet boxes, size and location of switch boxes, number and size of wires pulled through each conduit and all other necessary relevant details. Only after the drawings are approved, the contractor shall proceed with the work of laying of conduits.
4.5	**MATERIAL**
	PVC Conduit All non-metallic PVC conduits shall conform to IS: 9537 (Part - 3). The conduit shall be planed and of type as specified in IS: 9537 and shall be used with the corresponding accessories (Refer IS: 3419 specification for fittings for rigid non-metallic conduits). PVC conduits shall be rigid unplasticised, heavy gauge having 2.0 mm. wall thickness upto 20 mm. diameter conduit and 2.5 mm. wall thickness for all sizes above 20 mm. diameter
4.5.2	**M.S. CONDUIT** Conduits shall conform to IS: 9537 (Part - 2), finished with galvanized surface. No steel conduit less than 25 mm. in diameter shall be used. Conduits shall be solid drawn of lap welded type, with minimum wall thickness for conduits having 25 mm. and above diameter The conduits shall be delivered to the site of construction in original bundles and each length of

	conduit shall bear the label of manufacturers The conduit accessories such bends, coupling etc. shall be conforming to the relevant Indian Standard specification
4.5.3	**BOXES** 1. All the boxes for switches, sockets and other receptacles, junction boxes, pull boxes and outlet boxes shall be fabricated from 2.0 mm. thick mild sheet painted with two coats of red-oxide and then two coats of enamel paints as called for. Colour of the paints shall be as approved by the client. The boxes shall have smooth external and internal finished surface 2. Boxes in contact with earth or exposed to the weather shall be of 2 mm. mild steel and hot dip galvanized after fabrication 3. Separate screwed earth terminal shall be provided in the box for earthing purpose 4. All boxes shall have adequate no. of knock out holes of required diameter for conduit entry 5. Switch boxes to receive switches, socket outlets, power outlets, telephone outlets, fan regulators, etc. shall be fabricated to the approved shape and size to accommodate all the devices without overcrowding. 6. Outlet boxes to receive ceiling fan shall be fitted with adequately sized rod 7. Hook to fix ceiling fan. The boxes shall be of minimum depth of 65 mm. 8. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers as required. Boxes for use in masonry block or tiled walls shall be square cornered tile type, or standard boxes having square cornered tile type covers. These boxes shall be installed in the center of the masonry block or tiles **9.** Cast metal boxes installed in wet locations and boxes installed flush with the outside of exterior surface shall be gasketed
4.5.4	**COVER PLATE** The cover of the boxes to receive outlet points shall be of best anodized sheet cut to shape and size or plate of approved manufacturers of switches
4.5.5	**CABLES** 1. The cables shall conform to IS: 694. For all internal wiring FRLS insulated cables of 650/1100 volts grade, single core shall be used 2. The conductors shall be plain annealed copper conductors complying with IS: 1554 3. The conductors shall be circular copper conductor 4. The insulation shall be FRLS compound complying with the requirements of IS: 694. It shall be applied by an extrusion process and shall form a compact homogenous body. 5. The thickness of FRLS insulation shall be as set out in the relevant standards 6. 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

7. Means of identifying the manufacturer shall be provided throughout the length of cable
8. Unless otherwise specified in the drawings the size of the cables used for internal wiring shall be as follows:

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

2.5sq.mm.	From D.B. to switch boards.
1.5sq.mm.	From switch boards to outlet points

- In case of power socket outlet circuit having not more than two 15 A power outlet (P+N+E):

4.0sq.mm.	From D.B. to first power outlet
2.5sq.mm.	From first power outlet to second power outlet

- In case of power socket outlet circuit having single 15 A power outlet (like water heater) (P+N+E):

4.0sq.mm.	From D.B. to power outlet.

- In case of 15 A. power outlet for window Air conditioner or other likewise appliances (P+N+E):

4.0sq.mm.	From D.B. to power outlet.

The earth continuity conductor shall be similar to circuit cables and shall be drawn through conduit along with other circuit cables. The size of the earth continuity conductor shall be as follows:

MINIMUM SIZE OF EARTH CONTINUITY CONDUCTOR NOT FORMING PART OF THE SAME CABLE AS THE ASSOCIATE CIRCUIT CONDUCTOR

Nominal cross-section area of largest associated copper circuit conductor in sq.mm	Nominal cross-sectional area of earth continuity conductor in sq.mm.
1.5	1.5
2.5	2.5
4.0	4.0

Separate circuit shall run for each water heater, kitchen equipment, window air conditioner, and similar outlets at location as shown on drawing

4.5.6	**SWITCHES**

	1. Switches shall conform to IS: 3854, IS: 1293 and IS: 4615. The switches shall be single pole, single or two way as shown on the drawings or as specified. They shall be of moulded type rated for 250 volt, and of full 5/15 A capacity. They shall be provided with insulated dollies and covers 2. The switches shall be rocker operated with a quiet operating mechanism with bounce free snap action mechanism enclosed in an arc resistant chamber. 3. The switches shall have pure silver and silver cadmium contacts. 4. The switches shall be flush modular type. 5. The make of the switches shall be as indicated in the drawings or BOQ or make of material or as suggested and approved by the client. **6.** The switches installed in outdoor area shall be industrial, metal clad type, and shall be provided in weather proof enclosures, complete with weather proof gasketed covers.
	SOCKETS 1. The sockets shall conform to IS: 1293. Each socket shall be provided with control switch of appropriate rating. The sockets shall be moulded type, rated for 250 volts, and either of full 5 A or 15 A capacity, as mentioned on the drawings. 2. Sockets shall be of three pin type, the third in being connected to earth continuity conductor. 3. The socket shall be flush modular type. 4. The sockets installed in machine room, plant room or wet/damp area shall be metal clad weather proof type. 5. The finishing and make of all the sockets shall be same as light switch. 6. The socket shall have fully sprung contacts and solid brass shrouded 7. Terminals to ensure positive electrical connections. 8. The sockets shall be provided with automatic shutters, which open only when earth pin of the plug inserts in the socket. **9.** The socket shall be provided with three pin plug top suitable to the socket and of the same make as socket.
5.0	**DRAWINGS & INFORMATION**
	N.A.
6.0	**INSPECTION AND TESTING**
	INSULATION RESISTANCE TEST
	The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed
	The insulation resistance in megohms of an installation, measured shall not be less than 50 megohms divided by the number of points on the circuit
	The insulation resistance shall be measured between: **1.** EARTH TO PHASE

	2. EARTH TO NEUTRAL **3.** PHASE TO NEURAL **4.** PHASE TO PHASE
6.2	**EARTH CONTINUITY PATH**
	The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm
6.3	**POLARITY OF SINGLE POLE SWITCHES**
	A test shall be made to verify that every no-linked, single pole switch is connected to one of the phase of the supply system
6.4	**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.
7.0	**INSTALLATION OF THE SYSTEM**
	CONCEALED INSTALLATION WITH RIGID PVC CONDUIT
	All the rigid PVC conduit used for concealed installation shall be as per IS ; 9537 and its accessories shall be as per IS: 3419 (Small Wire Ropes).
	Whenever necessary bends or diversion may be achieved by bending the conduits with the help of bending spring. No other method of bending is allowed
	Conduit pipes shall be joined with the help of plain coupler fixed at the end with the help of vinyl solvent cement. No other method of joining is permissible
	All other methods, no wires through conduit, bunching, etc. Shall be as specified in the concealed installation
	Prior to fixing the conduits, the complete route shall be marked on site for the approval of consultant
7.2	**CONCEALED WIRING SYSTEM WITH RIGID PVC CONDUIT**
	The rigid PVC conduits shall be used for concealed wiring system. The conduits shall be concealed in the concrete slab, floor, walls, beams, columns etc
	FIXING OF CONDUIT
	1. Conduits embedded in concrete shall be installed in the frame work before pouring concrete. The conduits shall be installed above the bottom reinforcing bars, and shall provide positive wire fastening of the conduit to the reinforcing rods at an interval of not more than one

	meter, but on either side of couplers or bends or putlet/pull/junction boxes or similar fittings, proper hold fast shall be fixed at a distance of 30 cm from the center of such fittings. Conduits embedded in the wall shall be fixed inside the chase . The chase in the wall shall be neatly made and be fixed in the manner desired. In the case of building under construction, chase shall be provided in the wall at the time of their construction and shall be filled up neatly with cement mortar 1:4 after erection of conduit and brought to the original finish of the wall. Cutting of horizontal chases in walls is prohibited. The conduits shall be fixed inside the chase by means of staples or by means of saddles not more than 60 cm apart. 2. Conduits shall be so arranged as to facilitate easy drawing of wires through them. Entire conduit layout shall be done in such a way as to avoid additional junction boxes other than light points. The wiring shall be done in a looping manner. All the looping shall be done in either switch boxes or outlet boxes. Looping in junction or pull boxes are strictly not allowed. Where conduits cross building expansion joints, adequate expansion fittings or other approved devices shall be used to take care of any relative movement 3. All conduits shall be installed so as to avoid steam and hot water pipes 4. Conduits shall be installed in such a way that the junction, derivation and pull boxes shall always be accessible for repairs and maintenance work. The location of junction/pull boxes shall be marked on the shop drawings and approved by the client 5. A separation of 200 mm shall be maintained between electrical conduits and hot water lines in the building 6. No run of conduit shall exceed ten mtr. between adjacent draw in points nor shall it contain more than two right angle bends, or other derivation from the straight line 7. Caution shall be exercised in using the PVC conduits in location where ambient temperature is 50 degree cel. or above. Use of PVC conduits in places where ambient temperature is mote than 60 deg. cel. Is prohibited. The entire conduit system including boxes shall be thoroughly cleaned after completion of installations and before drawing of wires. Conduit system shall be erect and straight as far as possible. Traps where water may accumulate from condensation are to be avoided and if unavoidable, suitable provision for draining the water shall be made 1. All jointing method shall be subject to the approval of the client 2. Separate conduits shall be provided for the following system. • 15 A power outlets. • 5 A outlets and lighting system. • Low voltage system. • Telephone/intercom system. • C.C.T.V. system • Sound system • Computer data cabling system • Equipment wiring
7.3	**CONDUIT JOINT**

	1. Conduits shall be joined by means of plain couplers vinyl and/or solvent cement. Where there are long runs of straight conduit, inspection type couplers shall be provided at intervals , as approved by the client 2. The conduits shall be thoroughly cleaned before making the joints 3. In case of plain coupler joints, proper jointing material like vinyl solvent cement (gray in color) or any material as recommended by the manufacturer shall be used.
7.4	**BENDS IN CONDUIT**
	Wherever necessary, bends or diversions may be achieved by bending the conduits or by employing normal bends. No bends shall have radius less than 2.5 times outside dia. of the conduit
	Heat may be used to soften the PVC conduit for bending, but while applying heat to conduit, the conduit shall be filled with sand to avoid any damage to the conduit
7.3	**OUTLETS**
	All the outlets for fittings, switches etc. shall be boxes of substantial construction
	In order to minimize condensation or sweating inside the conduits, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects , etc.
	Fixing between conduit and boxes, outlet boxes, switch boxes and the like must be provided with entry spouts and smooth PVC bushes.
	Joints between conduit and any type of boxes shall be affected by means of conduit couplers in to each of which shall be coupled smooth PVC bush from inside the box. In any case all the joints shall be fully water tight.
7.4	**BUNCHING OF CABLES**
	Cables of AC supply of different phase shall be bunched in separate conduits
	The number of insulated wires/ cables that may be drawn into the conduits shall be as per the following table. In this table, the space factor does not exceed 40%. However, in any case conduits having lesser than 19 mm dia. shall not be used. MAXIMUM PERMISSIBLE NUMBER OF 650 VOLT GRADE SINGLE CORE CABLES THAT MAY BE DRAWN IN TO RIGID PVC CONDUITS.

CABLE SIZE IN MM SQ.	S I Z E O F C O N D U I T S (MM)
	MAXIMUM NO. OF CABLES

		25	32	38/40	51/50
	1.5	8	15	---	---
	2.5	6	10	---	---
	4.0	4	8	12	---

7.5	**WIRING WITH RIGID STEEL CONDUIT**
	All conduits and it's accessories shall be of threaded type and under no circumstances pin grip type or clamp type accessories be used
7.6	**FIXING OF CONDUIT**
	Conduit pipes shall be fixed by heavy gauge spacer bar saddles. The saddles shall be of 3 mm x 19 mm galvanized mild steel flat, properly treated and securely fixed to support by means of nuts and bolts raw bolts, brass machine screws, as mentioned, at an internal of not more than one meter but on either side of couplers, or bends, or junction/pull/outlet boxes or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings.
	Draw boxes shall be located at convenient location for easy drawing of wires
	Every mains and sub mains shall run in independent conduits with an independent earth wire of specified capacity along the entire length of conduit
	The conduits to be installed shall be of ample cross section area to facilitate the drawing of wires. The diameter of the conduit shall be selected as per table specified in these specifications. But in no case it shall be less than 25 mm diameter
	Entire conduit layout shall be done such as to avoid additional junctions boxes other than for outlet points. Conduits shall be free from sharp edge and burrs. Conduits shall be laid in a neat and organized manner as directed and approved by the client. Conduit runs shall be planned so as not to conflict with any other services pipe, lines/duct
	The entire conduit system shall be electrically and mechanically continuous and shall be bonded, together by means of approved type earthing clamp and earthed through a bare copper conductor of 14 SWG to the earthing terminals on the nearest distribution board
	If required, connection between PVC and steel conduits shall be through a junction box. Direct connection between PVC and steel conduits are not allowed
	Where exposed conduits are suspended from the structure, they shall be clamped firmly and rigidly to hangers of design to be approved by client. Where hangers are to be anchored to reinforced concrete, appropriate inserts and necessary devices for their fixing shall be left in position at the time of concreting, making holes and opening in the concrete will generally not be allowed. In case, it is unavoidable, prior permission of the client shall be obtained
7.7	**CONDUIT JOINTS**

	Conduit pipes shall be joined by means of screwed couplers and screwed accessories, as per IS: 2667
	The threads shall be free from grease or oil
	In long distanced straight runs of conduit, inspection type couplers two way junction boxes at reasonable intervals shall be provided or running threads with couplers and lock nuts shall be provided. The bare threaded portion shall be treated with anti-corrosive paints. Threads on conduit pipes in all cases shall be between 11mm to 27mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any burrs left, to avoid damage to the insulation of conductors while pulling them through such pipes
	Brass female bushes shall be used in each conduit termination in a switch box, outlet box, electrical panel or any other box
	Conduit shall be secured in each outlet box switch box, electrical panel or any other ox by means of one brass hexagonal lock nut and bush, outside and inside the box
	At each building, expansion joints approved oil tight double wire wound flexible steel conduit or any other approved method shall be used. This shall be united on both sides with the rigid conduits by suitable union
	Conduits installed in the plant room for mechanical equipment shall be properly clamped with the mechanical supports, but in no case, it shall be fixed with the body of the equipment
	The connection of conduit to the mechanical equipment shall be through oil tight double wire wound flexible steel conduit. In any case the length of the flexible conduit shall not exceed one meter. The flexible conduit shall be properly clamped with the body of the equipment. They shall not in any case be clamped with any cover or any removable parts of the equipment
7.8	**BENDS IN CONDUIT**
	All necessary bends in the system including diversion shall be done by bending pipes or by inserting suitable solid or circular inspection type normal box or similar fittings. Conduit fittings shall be avoided as far as possible on conduit system exposed to weather, where necessary, solid type fittings shall be used. Radius of such bends in conduit pipes shall be not less than 75 mm. No length of conduit shall have more than the equivalent of four quarter bends from outlet, the bends at the outlets not being counted
7.9	**PROTECTION AGAINST DAMPNESS**
	In order to minimize condensation or sweating inside the conduit, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects, as far as possible
7.10	**PROTECTION OF CONDUIT AGAINST RUST**
	The outer surface of the conduits including bends, junction boxes, etc., forming part of the conduit system shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases, no bare/threaded portion of conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive coating or covered with approved plastic compound
7.11	**BUNCHING OF CABLES**

	Unless otherwise specified, insulated conductors of different phases shall be bunched in separate conduit. Wires carrying current shall be so bunched in the conduit that the out going and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit
	The number of insulated wires/cables that be drawn into the conduits shall be as per the following table. MAXIMUM PERMISSIBLE NUMBER OF 650/1100 VOLTS GRADE SINGLE CORE CABLE THAT CAN BE DRAWN INTO RIGID STEEL CONDUITS.

CABLE SIZE IN MM SQ.	S I Z E O F C O N D U I T S (MM)			
	MAXIMUM NO. OF CABLES			
	25	32	38	51
1.5	10	14	---	---
2.5	8	12	---	---
4.0	6	10	---	---

7.12	**SWITCH AND SOCKET**
	Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings
	The switch controlling the light point or fan shall be connected on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips/plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires
	The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws
	Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators
	The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit
	The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission
7.13	**DRAWING OF CONDUCTORS**

	The drawing and joining of copper conductor or wires shall be executed with due regard to the following precautions. While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends
	Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or ringing
	FRLS insulated copper conductor wire ends before connection shall be properly soldered (at least 15 mm length) with soldering flux/copper solder, for copper conductor. Strands of wires shall not be cut for connecting to the terminals. All strands of wires shall be soldered at the terminals. All strands of wires shall be soldered at the end before connection. The connecting brass-screws shall have flat ends. All looped joints shall be soldered and connected through terminals block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors having nominal cross section exceeding 4 sq. mm shall always be provided with crimping type cable sockets. At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used. Brass nuts and bolts shall be used for all connections
	Only certified wire men and cable jointers shall be employed to do joining work
	For all internal wiring FRLS insulated wires of 650/1100 volts grade shall be used. The sub-circuit wiring for point shall be carried out in looping system and no joint shall be allowed in the length of the conductors. No wire shall be drawn in to any conduit, until all work of any nature that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Before the wires are drawn into the conduits the conduits shall be thoroughly cleaned of moisture, dust, and dirt or any other obstruction by forcing compressed air through the conduits
7.14	**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.
	Contractors shall be continuous from outlet to outlet. For 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.
7.15	**LOAD BALANCING**
	Balancing of circuit in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.
7.16	**EARTHING**
	All earthing systems shall be in accordance with IS: 3043 - 1985 code of practice for earthing

4.0 TECHNICAL SPECIFICATIONS FOR LIGHTING DISTRIBUTION BOARDS

1.0 SCOPE OF WORK

This section relates to specifications for supply of lighting distribution board (LDB) & Power distribution board (PDB) TPN/FP/DP/SP MCB isolator & ELMCB, Earthing terminal, connector strip for phase neutral and earth for each circuit, CRCA sheet steel housing and complete the item supply. Common banking of neutral and earth conductor is not allowed.

2.0 CODES & STANDARDS

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

Sr. No.	Item	Relevant IS	Relevant IEC
1.	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237	
2.	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375	
3.	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197	
4.	Miniature circuit breakers.	IS: 8828	

3.0 DESIGN BASIS & SITE CONDITIONS

All the equipment and components provided in the DB and accessories shall be suitably designed for installation and satisfactory operation as specified below.

Electrical system data:			
Power supply for Equipment			
Voltage 415 V ± 5 %		**Frequency** 50 Hz ± 3 %	
Permissible combined voltage & frequency variation	± 6 %	**System design faults level (Symmetrical)**	10 kA for 1 sec. max.

		System earthing LV side neutral solidly earthed	**Wiring** 3 phase, 4 wire on 415V system
		Auxiliary power supply :	
		Power supply	------
		Control Supply	-----
		Space heater power supply	-----
		Illumination power supply	-----
		Plug-socket power supply	-----
4.0	**TECHNICAL REQUIREMENTS**		
	SYSTEM		
	The lighting distribution boards shall be suitable for operation on 415/240 volt, 50 cycle per second, and A.C supply system. The lighting & power distribution boards MCB shall be capable of withstanding short circuit current of 10 KA.		
4.2	**CONSTRUCTION**		
	The DB's shall be factory made and of those and as per the G.A. layout enclosed. General arrangement lay out of the DB's shall be approved by the consultants in charge before starting the manufacture.		
	The DB shall metal clad duly fabricated from 2mm. thick high quality CRCA sheet metal.		
	The DB shall be wall mounted and dead front operated.		
	The DB shall totally be enclosed and made dust, vermin and weather proof such that it meets to IP42 protection classification for installation.		
	A detachable cover plate of 2 mm thick CRCA sheet to be provided on front of the board such that all live parts of the electrical accessories mounted on the board can be accessible only on removal of the said cover plate. 1) The cover plate shall be fixed to the board with adequate size zinc passivized machine screws. 2) Above the detachable cover plate, one additional hinged door of 2 mm thick CRCA sheet shall be provided with a suitable locking arrangement. The hinged door shall be provided with a suitable gasket capable of withstanding corrosive & humid atmosphere and to maintain degree of enclosure protection to IP 42 as per IS: 13947 for installation.		
	The DB shall have top/Bottom entry arrangement for incoming and outgoing cables/conduits.		

	All hardware to be used in manufacture of the DB shall be S.S 304 to prevent corrosion due to humid atmosphere prevailing at the project site.
	All internal electrical connections shall be carried out using 660/1100 volt grade, FRLS insulated, Copper conductor of ISI approved make, having rated current carrying capacity to carry continuous full current of respective switch Fuse rating at operating conditions prevailing at the project site.
	The DB internals shall be earthed with use of Copper wires/strips running throughout the length. Size of the earthing strip/wire shall be as shown in the respective drawing.
	All non-current carrying metal surface of the DB's shall adequately be treated and painted.
	The surface imperfection shall then be rectified with applications of putty.
	The DB's shall be provided with electric components and accessories as per the details shown in the drawing for the respective electric distribution board. The circuit connection from all the circuit MCB shall be brought to connector provided on top or bottom of the DB with suitable lugs. The connector shall be suitable to receive phase, neutral and earth wire/cable coming from each individual circuit. The connector's shall have circuit identification tag.
	Use of paper/fabric base laminates is not acceptable.
4.3	**PAINTING**
	The painting shall be as per "PAINTING" specification only.
5.0	**DRAWING & INFORMATION**
	The following drawings shall be submitted along with the bid:
	General arrangement drawing showing overall dimensions, weight, internal arrangement and mounting details.
	Terminal chamber, showing bus-bar arrangement with all dimensions.
	Power wiring diagram
6.0	**METHOD OF MEASUREMENT**
6.1	Supply of the Lighting DB including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.
7.0	**TRANSPORT, DELIVERY & STORAGE**
	The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of Lighting DB on site store. The Lighting DB should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted

	prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.
8.0	**GUARANTEE & WARRENTY**
	The quotes values of parameters shall be within given tolerance for given period of service life.
9.0	**SPARES**
	The bidder shall quote for minimum spares required for two years safe operation of Distribution Board along with the offer separately
10.0	**ATTACHMENTS**
	BOQ for LDB

5.0 TECHNICAL SPECIFICATIONS FOR SUPPLY OF LIGHT FIXTURE

1.0 SCOPE OF WORK

The scope of work shall cover the supply, installation and testing of various types of light fixtures.

2.0 CODES & STANDARDS

The following standards and rules shall be applicable :

IS 3646 (1960)	Code of practice for interior illuminator.
IS 1913(1969)	General and Safety requirements for electric lighting fittings.
Indian Electricity Act and Rules issued here under.	

3.0 DESIGN BASIS & SITE CONDITIONS

Electrical system data:			
Power supply for Equipment			
Voltage 415 V ± 5 %		**Frequency** 50 Hz ± 3 %	
Permissible combined voltage & frequency variation	± 6 %	**System design faults level (Symmetrical)**	35 kA for 1 sec. max.
System earthing LV side neutral solidly earthed		**Wiring** 3 phase, 4 wire on 415V system	

4.0 TECHNICAL REQUIREMENTS

4.1 GENERAL REQUIREMENTS

All fixtures shall be complete with accessories and fixings necessary for installation whether so detailed under fixture description or not

Fixture housing, frame or canopy shall provide a suitable cover for the fixture outlet box of fixture

	opening
	Fixture shall be installed at mounting heights as detailed on the drawings or instructed on site by the client's representative
	Fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the fixture. Design of hangers and method of fastening other than shown on the drawings or herein specified shall be submitted to the client's representative for approval
	Fixture shall be completely wired and constructed to comply with the regulations and standards for Electric Lighting Fixtures, unless otherwise specified. Fixtures shall bear manufacturer's name and the factory inspection label unless otherwise approved
	Wiring within the fixture and for connection to the branch circuit wiring shall be not less than 1.5 sq.mm. copper for 250 Volt application. Wire insulation shall suit the temperature conditions inside the fixture and wires bypassing the choke shall be heat protected with a heat resistant sleeve
	Metal used in lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specifications or standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burrs and tool marks. Solder shall not be used as mechanical fastening device on any parts of the fixture
	Ferrous metal shall be bonderized and given a corrosion resistant phosphate treatment or other approved rust inhibiting prim coat to provide a rust-proof base before application of finish
	Non-reflecting surfaces such as fixture frames and trim shall be Alluminium die cast
	All the fixtures are as per the IP - 54 insulation class
	Vendor shall be responsible for measuring the level of illumination after installation
	Lighting fixtures shall be designed for minimum glare and for continuous operation under specified atmospheric condition
	All fixtures shall be complete with accessories like power factor improvement capacitors, ballast, ignitor etc
	Fluorescent fixture shall be of sheet steel casing with corrosion resistance finish. It shall be provided with separate wiring channel with cover plate and an earth terminal. All screw shall be chromium brass only. Lamp and starter holders shall be of tough molded plastic with spring loaded rotor type connector. Condensers shall be low loss paper impregnated hermetically sealed. Internal wiring shall be neatly clipped and where by passing the ballast, a suitable heat resistance barrier or sleeve shall be provided.
4.2	**REFLACTOR**
	Light reflecting surface shall be mirror finished having the reflection factor of not less than 80%. All parts of reflector shall be completely covered by finish and free from irregularities. It shall be capable of withstanding a 6 mm. radius bend without showing sign of cracking, peeling or loosening from the base metal. Finish shall be capable of withstanding 72 hours exposure to ultra violet sun lamp placed 10 cm. from the surface without discoloration, hardening or warping and retain the same reflection factor after exposure. Test result shall be furnished for each lot of fixtures

	Lighting fixture reflectors shall generally be manufactured from sheet steel of aluminium of not less than 20 SWG. They shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be security mounted to the housing by means of positive fastening devices of a capative type.
	Polystyrene egg-box type louvers shall be provided whenever specified. Appropriate captive type fixing devices shall be incorporated for securing these.
4.3	**BALLAST**
	Lighting fixtures ballasts shall be designed manufactured and supplied in accordance with the relevant standard IS 6616 and shall function satisfactorily under site conditions specified. The ballasts shall have a long service life and low power loss
	Ballasts shall be mounted using self-licking, anti-vibration fixings and shall be easy to remove without removing the fittings
	Ballast shall contain a thermosetting type compound not subject to softening or liquefying under any operating conditions or upon ballast failure. The ballasts shall be of the inductive and heavy duty type Filled with polyester of equivalent. They shall be free from hum and protected from the atmospheres. Ballsts which produce a humming sound shall be replaced free of cost by the supplier. HPMV lamp ballasts shall be provided with suitable tappings
4.4	**STARTERS**
	Lighting fixtures starters shall be of the safety type (i.e. if the lamps fails to ignite at the first start, no further starting must be possible without attending to the tube light. Starters shall have bimetal electrodes and high mechanical strength
	Starters shall be replaceable without disturbing the reflector or lamps and without the use of any tool. Starters shall have brass contacts and radio interference capacitor
4.5	**CAPACITORS**
	Lighting fixture capacitors shall have a constant value of capacitors and shall be connected across the supply of individual lamp circuits
	Each capacitor shall be suitable for operation at 240 volts ± 5% single phase 50 Hz with a suitable value of capacitance so as to correct the power factor of lists corresponding lamp circuit to the extent of 0.98 lag
	The capacitors shall be hermetically sealed preferably in metal container to prevent seepage of impregnating material and ingress of moisture
4.6	**LAMP HOLDER**
	Lamp holders for fluorescent tubes shall be of the spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature, without deterioration in insulation valve, contact resistance of lamp holding quality. The shall hold the lamp in position under normal condition of shock and vibration
	Lamp-holders for incandescent and HPSV lamps shall be of G.L.S. type manufactured in accordance

	with relevant standards and designed to give long and satisfactory service
4.7	**LUMINAIRES**
	HPSV fixture shall be of single die cast aluminium made out of LM6 canopy , anodized high purity aluminium reflector, toughened glass at the front and die cast aluminium control gear box complete with all accessories mention in 3.22 with pre-wired up to connector block and loop in and loop out facilities
	Street light fixture shall be of single die cast aluminium housing with provision for the easy removal of gear box during maintenance. Acrylic bowl shall be linked to one end and toggle shall be provided. Neoprene rubber and felt gasket shall be provided between acrylic bowl and fixture to prevent entry of insects and moisture
	Industrial low bay fitting shall be of die cast aluminium housing, high purity Al. Reflector, acrylic cover and wire guard
4.8	**LAMPS**
	Lamps shall be supplied and installed in all lighting fixtures furnished under this contract
	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 shown on the drawings and schedules. Where not shown, 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
5.0	**DRAWINGS & INFORMATION**
	As per of the proposal the bidder furnish relevant descriptive and illustrative literature on lighting fixtures and accessories and following drawings/ data for the respective lighting fixtures:- 1. Dimensional Drawings. 2. Mounting details cable entry facilities and weights. 3. Light distribution diagrams (Zonal & Isokandora) 4. Light absorption and utilization factors. 5. Lamp output V/S temp. curves.
6.0	**INSPECTION AND TESTING**
	Each fixture shall be tested at 1500 volts rms. 50 Hz for one minute and no flashover of breakdown shall occur between current carrying parts and ground
	Insulation resistance of each fixture shall be tested at 500 V.D.C. and the insulation resistances so measured shall not be less than 2 mega ohms between all current carrying parts and ground.
	Each fixture complete with its proper lamp/lamps shall be shown to operate satisfactorily at its normal voltage and frequency

	Each fixture shall be examined visually to ensure that it is complete in all respects and satisfactorily finished
	Type and routine test certificates shall be submitted for tests conducted as per relevant IS/BS for the fixture and accessories
7.0	**METHOD OF MEASUREMENT**
	Supply of the fixture including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.
8.0	**TRANSPORT, DELIVERY AND STORAGE**
	The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of fixture or site store. The fixture should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.
9.0	**GUARANTEE AND WARRENTY**
	The Bidder shall stand guarantee for the performance of entire fixtures and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.
10.0	**SPARES**
	The bidder shall quote for minimum spares required for two years safe operation of light fixtures along with the offer separately.
11.0	**LED LIGHT FIXTURES**
	GENERAL REQUIREMENT
	General Purpose Led Luminaires suitable for Office /Industry / Street Light applications. The Fixtures should be Operational for 220-240 V Single Phase 50 HZ AC , and operational from 170-280 V without significant drop in output .
	LED ORIGIN
	The LED modules should be from Cree/Nichia/Philips Lumi Leds Only with efficiency of a min 110-130 lm/watt and efficacy of fixtures should be greater than 80 lm/w for both indoor and outdoor fixtures, built with Integral driver. The class and LED shall be procured from a single bin of class 1 to 2 only.
	IP Protection

	The Min degree of Protection for Indoor Fixtures should be IP20 and IP65 for Outdoor/ Semi Indoor Fixtures. The THD of Fixtures should be strictly <10 % and drivers should be compulsarily provided with miswiring/ overload and short circuit protections
	Housing
	For Indoor applications the housing should be made of die cast/ Metal Housing and diffusers should be polycarbonate only, out door fixtures should be with die cast aluminium / extruded aluminium housing only.
	Fixtures
	The Fixtures should be prewired upto the terminal block and easy to mount and Install and maintain if necessary. The fixture should comply LM79-08 certification criteria and also module should be backed with LM80-08 Certificate from the OEM.
	Guarantee, Warranty & Reports
	The fixtures should be warranted for a period of 3yrs from the date of Installation. The fixtures should have some kind of embossing/ engraving to identify the brand name
	The manufactures should provide all kind of test report , technical details as and when called for . The fixture may be tested from govt approved Lab for Claimed parameters by the manufacturer.

6.0 TECHNICAL SPECIFICATIONS FOR SUPPLY OF EARTHING SYSTEM

1.0 SCOPE OF WORK

Design, assembling, testing, painting, supply, delivery at site with all related accessories as per the specifications as specified below. Compliance with the provisions of this specification shall not relieve the Bidder of the responsibility of furnishing apparatus and accessories of proper design, electrically and mechanically suited to meet the operating requirements under the specified service conditions and be suitable for the purpose of which they are intended.

2.0 CODES & STANDARDS

The design, material, assembling, inspection and testing shall comply with all currently applicable statutes, regulations and safety codes in the locality where the system will be installed. The equipment shall also conform to the latest applicable standards and codes of practice as mentioned below.

Sr.	Item	Relevant IS
1	Code of Practice for Earthing	IS 3043
2	Insulation Co-ordination Application Guide	IS 3716
3	Code of Practice for Protection of Buildings and Allied Structures against Lightning	IS 2309
4	Indian Electricity Rules, 1956	
5	Indian Electricity Act, 1910	
6	National Electrical Code	

3.0 DESIGN BASIS & SITE CONDITIONS

All the equipment and components provided in the system and accessories shall be suitably designed for installation and satisfactory operation as specified below.

Electrical system data:			
Power supply for Equipment			
Voltage 415V ± 5 %		Frequency 50 Hz ± 3 %	
Permissible combined voltage & frequency variation	± 6 %	System design faults level (Symmetrical)	35kA for 1 sec. max.

	Wiring 3 phase, 4 wire on 415V system
4.0	**TECHNICAL REQUIREMENTS**
	The earth gird shall consist of main grounding grid conductors forming a closed ring network with required number of pipe/plate type earthing stations connected to it to provide a common earth for electrical equipments and metallic structures. Two distinct connections shall be made from each earthing station to the main grounding/earthing mat through GI/Cu. flat.
	The earth bus in required numbers shall be installed in various plant open areas and rooms. Each earth bus shall be provided two distinct connections by GI flats from the main grounding grid conductors available nearby. The plant equipment, metallic structures, tanks, etc. shall be brought to earth by providing two distinct connections between earth bus installed nearby and that equipments, tank, apparatus, etc.
4.3	**GENERAL CONSTRUCTIONAL DETAILS**
	Plate Earthing Stations The plate electrode shall be 600 x 600 x 3.25 mm copper plate or 600 x 600 x 6.15 mm hot dip GI. 1. The earth resistance shall be maintained with suitable soil treatment 2. The earth lead shall be connected to the earth plate through Hot Dip G.I. bolts 3. The earthing conductors shall be of copper strip in case of copper earthing 4. G.I. pipe with funnel of approved quality shall be used for watering the earthing electrodes / stations. 5. This brick chamber with cement plaster of dimensions in accordance with the drawing shall be constructed so as to protect the earthing station and to facilitate to locate the earthing station easily. The chamber shall also facilitate pouring of water and would provide easy access for testing, which would require disconnection of the earth electrode and connection to the earthing grid. 6. IS marked cast iron cover of appropriate dimensions shall be supplied as specified in IS: 3043 along with fabricated MS angle frame. The cover shall be hinged to the frame. The frame shall be grouted in brick masonry work of earthing station. The cove rand frame shall be painted with bitumen paint after applying primer. Earthing station Tag No. shall be painted on top of cover as per designation given on the layout drawing. 7. The hardware and other consumables for earthing installation shall be of copper/bras in case of copper earth plate and shall be hot dip galvanised iron material in case of G.I. earth plate 8. The depth of an earth electrode pipe shall be in approximately in accordance with the drawing as well as on nature of soil. However as per general guidelines, the pipe electrode shall have to be placed at depth where soft earth is available. This is to reduce the effect of earth resistance.
	Pipe Electrode Earth Station 1. The earth station shall be as shown on the drawing and shall be used for equipment earth

	grid and/or street light pole earthing 2. The earth electrode shall be 3 M long 38/50 mm diameter class "A", Galvanized steel pipe 3. The earth resistance shall be maintained with a suitable soil treatment. 4. The earth lead shall be fixed to the pipe with a nut and safety set screws. The clamp shall be permanently accessible 5. The earthing grid and the earthing conductor shall be hot dip Galvanized iron strips of the size as shown in the drawing 6. G.I. pipe with funnel of approved quality shall be used for watering the earth electrode \ station 7. This brick chamber with cement plaster of dimensions in accordance with the drawing shall be constructed so as to protect the earthing station and to facilitate to locate the earthing station easily. The chamber shall also facilitate pouring of water and would provide easy access for testing, which would require disconnection of the earth electrode and connection to the earthing grid. 8. The hardware and other consumables for earthing installation shall be of copper/bras in case of copper earth plate and shall be hot dip galvanised iron material in case of G.I. earth plate 9. The depth of an earth electrode pipe shall be in approximately in accordance with the drawing as well as on nature of soil. However as per general guidelines, the pipe electrode shall have to be placed at depth where soft earth is available. This is to reduce the effect of earth resistance.
4.4	**EQUIPMENT EARTHING** All apparatus and equipment transmitting or utilizing power shall be earthed in the following manner. Copper /G.I. Earth strips/wires shall be used unless other-wise indicated.
4.5	**ELECTRICAL AND PERFORMANCE REQUIREMENTS**
	Power Transmission Apparatus 1. Metallic conduit shall not be accepted as an earth continuity conductor. A separate insulated continuity conductor of size 100% of the phase conductor subject to the minimum shall be provided. 2. Non metallic conduit shall have an insulated earth continuity conductor of the same size for metallic conduit. All metal junction and switch boxes shall have an inside earth stud to which the earth conductor shall be connected. The earth conductor shall be distinctly coloured (Green or Green / Yellow) for easy identification 3. Armoured cable shall be earthed by two distinct earth connections to the armouring at both the ends and the size of connection being as for the metallic conduit. 4. In the case of unarmoured cable, an earth continuity conductor shall either be run outside along with the cable or should form a separate insulated core of the cable 5. Three phase power panel and distribution boards shall have two distinct earth connections of the size correlated to the incoming cable size. In case of single phase DB's a single earth connection is adequate
5.0	**DRAWINGS & INFORMATION**

	Drawing for Plate Type Earthing Station – Annexure-1
	Drawing for Pipe Type Earthing Station – Annexure 2
6.0	**INSPECTION AND TESTING**
	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
	Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 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 consultant / client
7.0	**METHOD OF MEASUREMENT**
	Provision of earthing station complete with excavation, electrode, watering pipe, soil treatment, masonry chamber with cast iron cover etc. shall be treated as one unit of measurement
	The following items of work shall be measured and paid per unit length covering the cost of the earth wires / strips, clamps, labour etc. 1. Main equipment earthing grid and connection to the earthing station. 2. Connection to the switch board, power panels, DB etc
	The cost of earthing the following items shall become part of the cost of the item itself and no separate payment for earthing shall be made. 1. Motors - earthing forming part of the cabling / writing for the motors. 2. Isolating switches and starters should form part of mounting frame, switch starter etc. 3. Light fittings - form part of installation of the light fittings. 4. Conduit wiring, cabling - should form part of the wiring or cabling. 5. Street lighting - should form part of the street light poles
8.0	**TRANSPORT, DELIVERY AND STORAGE**
	The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of earthing system

	or site store. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.
9.0	**GUARANTEE & WARRENTY**
	The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply.
10.0	**SPARES**
	Not applicable
11.0	**MATERIALS REQUIRED**
	All required hardware such as bolts, nuts, washers (round and spring type), anchor fasteners, screws, etc. of sizes and type as required shall be conforming to relevant IS. All hardware shall be hot-dip galvanized or zinc passivated /cadmium plated as per requirement of work either mechanical fabrication or electrical jointing.
11.2	All other items required for installation shall be as approved by site in-charge.
12.0	**INSTALLATION OF SYSTEM**
	The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case less than 3 M below finished ground level
	The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column
	The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture
	20 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid level of block masonry chamber
	Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe
	The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing
	The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry
	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, Hot dip G.I. / copper) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Hot Dip GI screws / bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level/
	The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished
	Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long and bitumen coated.
	The earth conductors shall be in one length between the earthing grid and the equipment to be earthed
	Minimum distance of 2 mtr shall be maintained between other electric conductor, earthing conductor and the conductor laid for the lightning protection system. Earthing and lightning protection system conductors shall be bonded to each other to prevent side flashover in case of non-availability of adequate clearance.
	The earthing met conductors, risers, earthing cables, etc. passing through walls shall be covered with galvanized iron sleeves for the passage through wall. Water stop sleeves shall also be provided wherever the earthing conductor enters the building from outside.

7.0	**ERECTION, TESTING & COMMISSIONING OF ELECTRICAL INSTALLATIONS**
1.0	**SCOPE OF WORK**
1.1	The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical system like H.T VCB panel, transformer, L.T. panels, Cables, earthing network, 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.
2.0	**STANDARDS**
2.1	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 authorised 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 2.1, all works shall also conform to the requirement of the following : **1.** Indian Electricity Act and Rules framed thereunder. **2.** Fire Insurance Regulations. **3.** Regulations laid down by the Chief Electrical Inspector of the State / State Electricity Board / Union Territory. **4.** Regulations laid down by the Factory Inspector of the State / Union Territory. **5.** Any other regulations laid down by the local authorities. **6.** Installation & operation manuals of original manufacturers of equipment.
3.0	**ERECTION**
3.1	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 authorised representative. The empty packing cases shall be returned to the stores and any document if found with the equipment shall be handed over to the client's representative. Any damage or shortage noticed shall be reported to the client / consultant in writing immediately after opening of packing cases.
3.2	**DRY TYPE TRANSFORMER** **1) Erection** Transformer complete miscellaneous accessories shall be thoroughly inspected and any damage noticed

	shall be reported to the client / consultant. Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out. After the completion of erection, necessary stoppers shall be provided at the wheels. All loosely supplied fittings / accessories shall be cleaned and mounted on the transformer and connections made. After completely assembling & installation, the transformer shall be cleaned and touched up with a paint supplied by the manufacturer applied wherever necessary. All cover bolts shall be checked for proper tightness. (The foundation of transformer and rail fixing will be made by some other agency). **2) Testing** • Winding insulation resistance shall be measured from primary and secondary to ground and between primary and secondary. • Test the operation of thermister type sensor relay in accordance with the manufacturer's instructions. • Check the polarity of terminals and the phase sequence. **Proforma for transformer tests :** **1) Proforma for transformer tests :** • Transformer name plate. • Insulation resistance test with 1000 V meagre. a) between primary to earth b) between secondary to earth c) between primary and secondary • Operation of the tap changer (off load tap changer) to be checked • Polarity marking and phase sequence. • Earth resistance:Body & Neutral tank. [This proforma shall be jointly signed by the CLIENT/ CONSULTANT and the contractor in duplicate]
3.3	**POWER CONTROL CENTER / MOTOR CONTROL CENTER, DISTRIBUTION BOARDS** **1.0 Erection** • Electrical panels and bus duct shall be delivered in convenient shipping section by the manufacturer. 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. The contractor shall be responsible for final assembly and interconnection of busbars / wiring. Foundation channel shall be grouted in the flooring by the contractor. 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 drawout circuit breaker shall be checked for proper alignment and interchange ability. • 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.
- The busduct shall be suitably supported between switchgear and transformer. The opening in the wall where the duct enters, the switchgear room shall be sealed to avoid rain water entry. The foundation of the switchgear shall be raised suitably for minor adjustment to ensure proper alignment and connection of the busduct at no extra cost. Expansion joints, flexible connection, etc. supplied by the manufacturer / contractor of the busduct shall be properly connected.

2.0 Testing

- Before electrical panel is energised, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.
- Before switchgear is energised, the insulation resistance of all control circuits shall be measured from line to ground.
- The following tests shall be performed on all circuit breakers during erection.
- Contact alignment and wipe shall be checked and adjustment where necessary in accordance with the breaker manufacturer's instructions.
- 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 consultant/ manufacturer.
- The dielectric strength of insulating oil wherever applicable, shall be checked.
- Before switchgear is energised, the following tests shall be performed one each circuit breaker in its test position.
- Close and trip the circuit breaker from its local control switch push button or operating handle. Switchgear control bus may be energised to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.
- Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
- 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.
- Trip breaker either manually or by applying current or voltage to each of its associated protective release.

- Before switchgear is energised, 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. In addition, test for output and/or capacitance, insulation resistance test and test for efficiency of discharge device shall be carried out.
- All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

Performa For PCC, MCC, DB, Control Panel Test

- Circuit breaker or contactor module designation / bus no.
- Insulation resistance test (contacts open, breaker racked in position)

a) between each phase of bus	:	Mega ohm
b) between each phase and earth	:	Mega ohm
c) DC and AC control and auxiliary circuits	:	Mega ohm
d) between each phase of CT / PT and between CT & PT circuit if any	:	Mega ohm

- CT checks
  - a) CT ratio
  - b) CT secondary resistance
  - c) CT polarity check

1. Check for contact alignment and wipe.
2. Check / test all releases / relays.
3. Check mechanical interlocks.
4. Check electrical interlocks.
5. Check switchgear / control panel wiring.
6. Check breaker / contactor circuit for :
   - a) Closing - local & remote (wherever applicable)
   - b) Tripping - local & remote (wherever applicable)

1. Opening time of breaker / contactor.
2. Closing time of breaker / contactor.

[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

3.4 INSTALLATION OF CABLE NETWORK

Cable network shall include power, control and lighting cables which shall be laid in underground trenches, hume pipe open trenches, cable trays, G.I. pipes, or on building structures as detailed in the relevant drawings, cable schedules or as per the client / consultant's instructions. Supply & installation of cable trays, G.I. pipes / conduits, cable glands and sockets of both end isolators, junction boxes, remote

push button stations, etc. shall be under the scope of the contractor.

1.0 General requirements for handling cables:

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.

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. Where the carriage is not available, the drum shall be mounted on a properly supported axle, and the cable laid out from the top of the drum. In no case the cable will be rolled on as it produces kinks which may damage the conductor.

Sharp bending of cable shall be avoided. The bending radius for PVC insulated and sheathed, armoured cable shall not be less than 10 D, where "D" is overall diameter of the cable.

- 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 cotton / bituminous compound.
- High voltage (11 KV and above), medium voltage (240 V and above) and other control cables shall be separated from each other by adequate spacing or running through independent pipes / trays.
- Armoured cables shall never be concealed in walls / floors / roads without G.I. pipes, conduits or RCC pipes.
- Joints in the cable throughout its length of laying shall be avoided as far as possible and if unavoidable, prior approval of site engineer shall be taken. If allowed, proper straight through epoxy resin tight joint shall be made, without any additional cost.
- A minimum loop of 3 mtr. shall be provided on both ends of the cable, and on both ends of straight through cable joint. This additional length shall be used for fresh termination in future. Cable for this loop shall be paid for supply and laying.
- Cable shall be neatly arranged in the trenches / trays in such manner so that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cable within the trenches / trays shall be the responsibility of the contractor.
- All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided. The routes indicated in the drawings are indicative only and the same may be rechecked with the client / consultant before cutting of cables. While selecting cable routes interference with structures, foundations, pipelines, future expansion of buildings etc. should be avoided.
- 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. Lead sheathed cables shall be plumbed with lead alloy.
- 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 upto 300 mm. distance of concerned cable gland or as instructed by the client / consultant.
- 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.

2.0 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.

- Cable shall be laid at minimum depth of 750 mm. in case of L.T. and 1200 mm. in case of H.T. from ground level. Excavation will be generally in ordinary alluvial soil. The width of trench shall be sufficient for laying of required no. of cables.
- Sand bedding 75 mm. thick shall be made below and above the cables. Layer of bricks (full size) shall be laid above sand bedding on the sides and above the of cables to cover cable completely. More than one cable can be laid in the same trench by providing a brick on edge between two cables. However, the relative location of cables in trench shall be maintained till termination. 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 used :

Separate route markers should be used for LT, HT and telephone cables.

- Route markers should be grounded in ground with 1:2:4 cement concrete pedestal size 230 x 230 x 300 mm.
- Cable markers should be installed at an interval not exceeding 30 mtr. along the straight routes of cables at a distance of 0.5 mtr. away from centre of cable with the arrow marked on the cable markers plate indicating the location of cable. Cable markers should also be used to identify change in direction of cable route and for location of every joint in underground cable.
- 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 at the ends shall be sealed by bituminous compound after laying and testing of cables by electrical contractor without any extra charge.

1.0 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 is more.

Entry of cables in trenches shall be sealed with bituminous MASTIC compound to stop entry of water in trenches.

2.0 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 erector.
- Cable shall be fixed in cable trays in single tier formation and cables shall be clamped with aluminium flat clamps and galvanised bolts / nuts.
- Earthing flat / wire can also be laid in cable tray along with cables.
- After laying of cables, minimum 20% area shall be spare.

3.0 TERMINATION AND JOINTING OF CABLES

a) For HT cables suitable size of Reychem termination kit shall be used.

b) Use of glands:

All PVC cables upto 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. Armour of cable shall be connected to earth point. The contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded opening of different size, suitable galvanised threaded reducing bushing shall be used of approved type.

In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, close fit holes should be drilled in the bottom plate for all the cables in one line, 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.

- USE OF LUGS / SOCKETS

All cable leads shall be terminated at the equipment terminals, by means of crimped type solderless connectors unless the terminals at the equipment ends are suitable for direct jointing without lugs / sockets.

The following is the recommended procedure for crimped joints and the same shall be followed :

1. Strip off the insulation of the cable and with every precaution, not in severe or damage any strand. All insulation's to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.
2. The cable should be kept clean as far as possible before assembling it with the terminal / socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the aluminium conductors, the socket should be filled with corrosion inhibiting compound. This compound should also be applied over the stripped potion of the conductor and the palm surface of socket.
3. Correct size and type of socket / ferrule / lug should be selected depending on size of conductor, and type of connection to be made.
4. Make the crimped joint by suitable crimping tool.
5. If after crimping the conductor in socket / lug, some portion of the conductor remains without insulation the same should be covered sufficiently with PVC tape.
6. For HT cable upto 11 KV the manufacturer's recommendation should be followed.

- DRESSING OF CABLE INSIDE THE EQUIPMENT

1. 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.

2. For motors of 20 HP and above, terminal box if found not suitable for proper dressing of aluminium cables, the erector shall modify the same without any additional cost.

Cables inside the equipment shall be measured and paid for.

- IDENTIFICATION OF CABLES / WIRES / CORES

1. Power cables shall be identified with red, yellow and blue PVC tapes. For trip circuits identification, additional red ferrules shall be used only in the particular cores of control cable at the termination points in the switchgear / control panels and control switches.
2. In case of control cables all cores shall be identified at both ends by their wire numbers by mean of PVC ferrules or self-sticking cable markers, wire numbers shall be as per schematic / connection drawing. For power circuit also, wire numbers shall be provided if required as per the drawings of switchgear manufacturer / supplier.

- TESTING OF CABLES

1. Before energising, the insulation resistance of every circuit shall be measured from phase to ground. This requires 3 measurements if one side is grounded and 6 measurements for 3 phase circuits.
2. Where splices or terminations are required in circuits rated above 650 volts, measure insulation resistance of each length of cable before splicing and/or terminating. Repeat measurements after splices and/or terminations are complete.
3. DC high voltage test shall be made after installation on the following :
    a) All 1100 volts grade cables in which straight through joints have been made.
    b) All cables above 1100 V grade.

For record purpose test data shall include the measured values of leakage current versus time.

- The DC high voltage test shall be performed as detailed below :
- Cables shall be installed in final position with the entire straight through joints complete. Terminations shall be kept unfinished so that motors, switchgear, transformer etc. are not subjected to test voltage.
- The test voltage and duration shall be as per relevant codes and practices of Indian Standards Institution.

PROFORMA FOR TESTING CABLES

DATE OF TEST

a) Drum No. from which cable taken.

	b) Cable from to c) Length of run of this cable meter d) Insulation resistance test i) between core-1 to earth mega-ohm ii) between core-2 to earth mega-ohm iii) between core-3 to earth mega-ohm iv) between core-1 to core-2 mega-ohm v) between core-2 to core-3 mega-ohm vi) between core-3 to core-1 mega-ohm vii) duration used : 1 KV e) High voltage test Voltage Duration i) between core an earth. ii) between individual cores [This proforma shall be jointly signed by the CLIENT / CONSULTANTand the contractor in duplicate].
4.0	**EARTHING NETWORK**
4.1	**INSTALLATION AND CONNECTION** • The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 3 M below finished ground level. • The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column. • The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture. • 19 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid-level of block masonry chamber. • Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe. • The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber. • The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry. • Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation. • The earth conductors (Strips / Wires copper / Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanised Iron clamps and Mild Steel Zinc Passivated screws / bolts. The conductors outside the building shall be laid atleast 600 mm. below the finished ground

	level. • The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished. • Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long. • The earth conductors shall be in one length between the earthing grid and the equipment to be earthed
4.2	**EARTH LEADS AND CONNECTIONS** • Earth lead shall be bare copper or Galvanised steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. G.I. strip buried in the ground shall be protected with bitumen and hessian wrap or polythene faced hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is atleast 8 mm away from the wall surface. • The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.
4.3	**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. • Each earthing station • Earthing system as a whole • Earth continuity conductors • Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 ohm in each case. • Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed. • All tests shall be carried out in presence of the Pmc
5.0	**CONCEALED / SURFACE CONDUIT WORKS**
5.1	**LAYING OF CONDUITS** Conduits shall be laid before casting in the upper portion of a slab / in PCC if below flooring or otherwise, as may be instructed in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Conduits shall be so laid that they are interconnected. This is required to facilitate pulling of wires from different openings in case of any of the outlet is outlet is blocked during slab casting. Vertical drops shall be cut by the contractor to sufficient depth to allow full thickness of plaster over conduits. The width of the chases will be made to accommodate the required number of conduits. The chases will be filled with cement, coarse **1.** When the conduit is to be embedded in a concrete member it shall be adequately tied to the

	reinforcement to prevent displacement during casting. Tie wire to be supplied by the contractor. **2.** Cutting of chases in any RCC member / finished floor / already finished surface is not allowed unless prior approval of Site Engineer is taken in site instruction book. If a chases is cut in an already finished surface, the contractor shall fill the chases and finish it to match the existing finish including painting at his cost to Site Engineer's satisfaction. **3.** Contractor shall not cut any iron bars to fix the conduits. Puncher of wooden / steel shuttering for RCC slab / beams / column etc. for conduit work is also not allowed, unless Site Engineer permits in site instruction book under special conditions. **4.** Run of conduit pipe through expansion joints in RCC members should be avoided as far as possible and if unavoidable, flexible conduit pipe should be used with ceiling outlet box on both sides of expansion joints. **5.** Conduit on surface of RCC walls / RCC members shall be avoided as far as possible and if unavoidable prior approval of Site Engineer on sample saddles, clamps screws and a minimum 5 mtr. conduit laid on surface shall be taken, to achieve best possible workmanship. Distance between 2 consecutive clamps for fixing conduit on surface shall not exceed 900 mm. wooden patties for fixing saddles / clamps shall be used. Use of roll plug / steel fastener with hard setting / sealing compound is recommended. **6.** In case of stone masonry, necessary conduits with M.S. boxes should be placed as the masonry is in progress, since after completing masonry, it is very difficult to cut chases in wells. Special location of cement concrete shaft is also recommended to conceal conduit in stone masonry and the same shall be provided by client / consultant. **7.** In ground floor conduiting below the flooring should be avoided. Wherever it is unavoidable G.I. pipe should be used with prior approval of Site Engineer.
5.2	**CEILING / WALL OUTLET BOXES FOR LIGHTS / FANS** **1.** Outlet boxes shall be of steel with aluminium cover and so installed as to maintain continuity throughout. These shall be protected at the time of laying by filling with jute / earth / cotton etc. so that no cement mortar finds its way inside during concreting or plastering etc. Typical sketches for such outlet boxes shall be supplied alongwtih other working drags. In beams conduit socket shall be provided in place of outlet boxes. The same shall be used for installation of luminaire. **2.** For fixing light fixtures / brackets, outlet boxes complete with check nut for holding conduits shall be used. For lighting fixture suitable for 20 watts fluorescent tubes / incandescent lamps / mercury vapour lamps, only one outlet box is required. For fixing lighting suitable for 40 watts fluorescent lamps, two numbers outlet boxes should be provided at a distance of 300 mm. away from the centre in the longitudinal direction of the fixture, so that the use of patties / roll plug etc. may be avoided, as well as wiring from outlet box to the light fitting is to be installed in RCC beam and due to heavy reinforcement at the bottom of beam it is not possible to provide outlet boxes simple conduit should be provided. However alternative fixing arrangement shall be made in consultation with client / consultant. **3.** 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.
5.3	**1.** DRAW OUT JUNCTION BOXES **2.** Steel drawout boxes at angle dimensions shall be provided at a convenient points on walls / ceilings to facilitate pullling of long runs of cables / wires. These shall be completely concealed with Anodised Aluminium, flush with plaster works. These draw boxes should be five sided. The

	location of these boxes is to be decided prior to fixing, as per site requirement and following should be treated as general guidance for deciding the location of these : **3.** These should be provided at a place where these are not in direct view. Recommended place is 400 / 450 mm. below ceiling, if conduits are running vertically. **4.** Junction box in the offset of bottom of RCC beam and vertical wall should not be provided. **5.** If junction boxes are coming side by side for two or more conduits, one common M.S. box of proper size can be used to act as junction box. **6.** If junction box is to be provided in ceiling, its position should be so located that it is in line with other light / fan points. **7.** Junction boxes should never be used for splitting one conduit into two or more. Junction box for such functions is avoidable and for this, number of conduits to be connected to one switch board should be calculated correctly as per drawing before laying conduits in ceiling. **8.** Locating junction boxes on outer surface of exterior walls of building should be avoided as these are in direct view and are also exposed to weather. **9.** Junction boxes should never be closed permanently by plaster. Removable covering of aluminium should be provided for conduit junction boxes for M.S. junction boxes removable hylem plate should be provided. This cover may be painted with wall colour. **10.** Junction boxes in important areas should be avoided and can be located in toilets / corridors / service shafts and stores etc.
5.4	**SWITCH BOXES** Steel boxes of required sizes, shall be provided to house speed regulators of fans, switches for lights, fans, plug sockets etc. as per requirement of drawings. These should be so designed that accessories on Anodised aluminium sheet could be mounted with tapped holes and brass machine screws, leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on all walls of the boxes through which the conduits are entering. These shall be completely connected leaving edges flush with finished wall surfaces. Anodised aluminium cover should be fixed to these switch boxes by means of brass chrome plated machine screws and cup washers. Utmost care shall be taken by contractor to ensure that all switch boxes are in line and level. Inside each switch box, one bolt shall be welded to receive earthing wire.
5.5	**SWITCH AND SOCKET** Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings. • The switch controlling the light point or fan shall be connect on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips / plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires. • The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws. • Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and

	regulators. • The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit • The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission.
5.6	**CLEANING AND PROTECTION OF CONDUIT SYSTEM** The entire conduit system including outlet boxes, junction boxes and switch boxes shall be thoroughly cleaned after completion of erection and tested for not blockage by air / sound or steel wire prior to finishing of building by air / sound or steel wire prior to finishing of building and before drawing in of cables / wires to safeguard conduit system against filling up with the plaster / cement slurry / water etc. all the outlet and switch boxes will have to be provided with temporary jute / cotton filling, covers and plugs etc.. Within tendered cost which shall be replaced later on by hylem / sheet cover after wiring as required.
5.7	**TESTING OF INSTALLATION** Before a completed installation is put into service, the following tests shall be complied with: **INSULATION RESISTANCE** The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed. The insulation resistance in gegohms of an installation, measured shall not be less than 50 megohms 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 PATH** The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm. **POLARITY OF SINGLE POLE SWITCHES** A test shall be made to verify that every no-linked, 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.
6.0	**INSTALLATION OF LIGHTING FIXTURES / FANS**
6.1	**INSTALLATION OF LIGHTING FIXTURES** Scope of work under this item shall start from light point, with a 5 A bakelite connector, 2 core 1.5 mm.^{2} PVC insulated wires from this 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. If wire length of light point is enough to reach connector of light fitting, connector in light point can be deleted.
6.2	**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.
7.0	**INSTALLATION OF EXTERNAL LIGHT FIXTURES**
7.1	**BRACKET FOR STREET LIGHT FITTINGS** The brackets shall be made of 38 mm. NB MS class "B" pipe approx. 1.8 mtr. long bent at the centre at an angle 120° C. with necessary holding brackets, hold fasts etc. with special reducer at the end to accommodate type of street light fitting to be fixed. Bracket shall have 1 coat of anti-corrosion paint before despatch to site and 2 coats of approved make and shade of aluminium paint. This bracket shall also be provided with one M.S. water tight box complete with the connector, neutral link, rewireable fuse etc.. See enclosed drawings of street light poles.
7.2	**INSTALLATION OF POLES** Installation of poles shall be done as per enclosed drawings of street light poles. The depth of pole to be burried in ground shall be 1/5th of the total pole length or as specified in drawing, whichever is more. Special care shall be taken in erecting poles so that these are not strained or damaged during erection and are firmly stayed till the foundation are secured. The pole shall be grouted inside ground pit (cross-section 600 x 600 mm.) with cement concrete 1:2:4. Before the placement of concrete around pole in the pit, necessary conduit pipes (not less than 25 mm. dia.) shall be placed for facilitating drawing of cables. Separate conduit shall be provided for incoming and outgoing cables. The cement concrete shall be protected from prematured drying by curing for atleast 7 days after pouring. All concrete surface from 150 mm. below ground level to top shall be finished smooth with cement mortar 1:4.
7.3	**INSTALLATION OF STREET LIGHT FIXTURES** This includes fixing of street light fittings complete with accessories and lamps at the end of the pole / bracket, connecting it with 3 x 2.5 mm.^{2} aluminium conductor, PVC insulated cable from water tight M.S.

	box, testing, commissioning. Third core shall be connected with earthing point of light fitting at one end and earthing point of marshalling box at the other end.
7.4	**GENERAL NOTES FOR STREET LIGHTING** **1.** For supplying and laying of cables, technical specification (wiring) shall be applicable reference shall be made under heading Cable Work elsewhere in the tender. **2.** For street light poles along roads, nearest finished road level shall be taken as ground level and for poles along compound wall / away from roads, existing ground / finished ground shall be taken as ground level. **3.** Distance of 1 mtr. shall be maintained between centre of pole and centre of curb of road. For compound wall poles, distance between compound wall and poles shall be 3 mtrs. **4.** A loop of 1.5 mtr. of cable shall be provided near each street light pole for all incoming and outgoing cable.
8.0	**COMPLETION TESTS**
8.1	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.
8.2	**INSULATION RESISTANCE TO EARTH** This is to be measured with all fuse links in place, all switches ON, all lamps and appliances in position by applying a voltage not less than twice the working voltage (subject to a limit of 500 V). Insulation resistance of the whole or any part of the installation to earth must not be less than 50 mega-ohms divided by the number of outlets (points and switch positions) except that it need not exceed one mega-ohm for the whole installation.
8.3	**INSULATION RESISTANCE BETWEEN CONDUCTORS** Tests to be made between all the conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or neutral or the other pole or phase conductors of the supply. For this test, all lamps shall be removed and all switches put ON. The result of the test must be 50 mega-ohms divided by the number of outlets (points and switch positions) but need not exceed 1 mega-ohm for the whole installation.
8.4	**POLARITY OF SINGLE POLE SWITCHES** Tests shall be made to verify that all non-linked single pole switches are on phase conductor (live) and not on neutral or earth conductor. This can be done by connecting test lamps between two terminals of switch and earth. If the lamp lights up when switch is ON and either terminal is touched, the switch is correctly installed.
	RESISTANCE OF METAL CONDUITS / SHEETS (EARTH CONTINUITY TEST) In case of cables encased in metal whether conduit of metallic sheathing, the total resistance of the

	conduit or sheathing from the earthing point any other position in the completed installation shall not exceed 2 ohms. This can be carried out by following circuit : One end of the load is connected to the ECC and its connection with the electrode and the other to the farthest point of the ECC. First, current through the circuit is measured with the resistance of 2 ohms short circuited by the link. Next, current is measured through the two ohms resistance by disconnecting the two leads from the ECC and joining them together. If current is more in the first case, the resistance of ECC is less than 2 ohms.
9.0	**HANDING OVER / TAKING OVER**
9.1	After completion of works and tests specified above, the various building of the project can be taken over by the employer as and when these are ready in all respects. However, the defect liability period of 12 months would start from the date, when all the buildings of the project have been completed and handed over, unless employer agrees for defect liability period in phased due to non-completion of civil work of few buildings for which electrical contractor is not responsible.
1.10	**HANDING OVER / TAKING OVER**
	The Tenderer shall indicate the makes of tools, test equipment and other item listed below: 1. TOOLS **A.** Set of spanners of sizes 6 mm to 32 mm width across flat • Adjustable wrench of 36 mm jaw width • Adjustable wrench of 23 mm jaw width **B.** Heavy duty screw driver with full size insulated handle and blade length of • 100 mm • 50 mm • 200 mm 2. TEST EQUIPMENT A. 2500 V megger motor operated B. 500 V megger hand operated C. Multimeter (Battery operated) satisfying the following • With 0-1 mA, 0-100 mA, 0-1A and 0-5A, AC & DC current ranges • With 0-100 mV, 0-3V, 0-30 V, 0-300 V and 0-1000V AC & DC voltage ranges • The resistance ranges shall be atleast five (0-100) m ohm, (0-1) Ohm, (0-10) Ohm, (0-100) Ohm, (0-100) mega ohm • The Input impedance shall not be less than one mega Ohms for voltage ranges 3. LADDERS

	Ladder shall be made out of light aluminium alloy of good strength. They shall be of step ladder, foldable, self supporting type with spreader of metallic angles or high strength nylon straps. The ladder shall be provided with shoes on bottom of legs. Rugs shall be flat type having thickness of 30 mm in case of 3 meters long ladders and 60 mm for 6 metres long ladder. • 3 metres long • 6 metres long 4. Tong tester - ammeter range 0 to 30, 150 & 300 Amps AC and voltmeter (0-600) V, class 1.0 with leads and leather case.