

ORIGINS

by **Mahindra** WORLD CITY

Where Business Comes To Life

TECHNICAL SPECIFICATION

PACKAGE NO: P1-E1

ROAD & ALLIED CIVIL WORKS

PROJECT:

**Development of "ORIGINS by Mahindra world City"-
INDUSTRIAL PARK PROJECT**

By Mahindra Industrial Park Pvt. Ltd. (MIPPL)

Location: Village-Jansali, Tal-Limbdi, Dist.-Surendranagar.

(363425) Gujarat.

Partners:

Project Management Consultants



Achieve Ambitions

Infrastructure Consultants



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ELECTRICAL

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GENERAL NOTES

A ABBREVIATIONS:

The following abbreviations have been used in the accompanying specifications, drawings and Bill of quantity:

ISS	: Indian Standard Specifications.
HRC	: High Rupturing Capacity.
GI	: Galvanized Iron.
MS	: Mild Steel.
MV	: Medium Voltage.
LV	: Low Voltage.
PVC	: Polyvinyl Chloride.
AMP	: Amperes.
V	: Volts.
KV	: Kilo Volts.
HV	: High Voltage
KW	: Kilo Watt
KVA	: Kilo Volt Ampere
PF	: Power Factor
Hz	: Frequency
KWH	: Kilo Watt Hour
XLPE	: Cross Linked Polyethylene
ACB	: Air Circuit Breaker
LED	: Light Emitting diode
PLC	: Programmable Logic Controller
UPS	: Uninterrupted Power Supply
DP	: Double Phase
IEE	: Institute of Electrical Engineers, London.
MCB	: Miniature Circuit Breaker.
TPN	: Triple pole and Neutral.
SP	: Single Pole.
MCCB	: Moulded case Circuit breaker.
VCB	: Vacuum circuit breaker.
CT	: Current transformer.
DB	: Distribution board.
DG	: Diesel generator.
BOQ	: Bill of quantity.
SITC	: Supply, installation, testing and commissioning.
L.O.I.	: Letter of intent/Acceptance letter.

B REGULATIONS AND STANDARDS:

The installation shall conform in all respects to Indian standard code of Practice for Electrical

Wiring installation IS: 732-1963 and IS: 2214-1963 (Silver Nitrate Pure and analytical reagent.

It shall also be in conformity with the current Indian Electricity Rules, Indian Electricity Act, National Electrical Code and Regulations of the Local Electrical supply Authority in so far as these become applicable to the installation. Wherever this specification calls for a higher

Standard of material and/or workmanship than those required by any of the above regulations then this specification shall take precedence over the said regulations and standard. In general, the materials equipment and workmanship not covered by the above shall conform to the relevant Indian Standards.

The electrical installation work shall follow Codes, Indian standard specifications and rules
(Within the best meaning of the same) under this contract.

The following list is given for general guidance only in addition to list given in each individual section, however all other latest editions of Codes, Indian standard specifications and Rules shall also be followed when it is required.

- I.S.: 8623 Low voltage switchgear & control gear assemblies.
- I.S.: 10118 Code of practice for selection, installation and maintenance of switchgear and control gear.
- I.S.: 4237 General requirement for switch gear and control gear for voltage not exceeding 1000 Volt a.c. or 1200 volts d.c.
- I.S.: 13947 Low voltage switchgear and control gear.
- I.S.: 9224 Low voltage fuses.
- I.S.: 8828 Circuit breakers for out protection for household and similar installations.
- I.S.: 12640 Earth leakage circuit breaker.
- I.S.: 1248 Direct acting indicating analog electrical measuring instruments
- I.S.: 2705 Current transformers.
- I.S.: 4201 Application guide for voltage transformers.
- I.S.: 6875 Control switches for voltage upto and indicating 1000V a.c. 1200 V d.c.
- I.S.: 5578 Guide for marking of insulated conductors.
- I.S.: 11353 Guide for uniform system of marking and identification of conductors and apparatus transmission.
- I.S.: 8197 Terminal markings for electrical measuring instruments and their accessories.
- I.S.: 694 Specifications for PVC insulated cables for working voltages up to and including 1100 volts.
- I.S.: 2551 Danger notice plates.

I.S.: 3043 Code of practice for earthing.

I.S.: 5216 Guide for safety procedures and practices in electrical work.

I.S.: 1646 Code of practice for fire safety of building: Electrical installation.

Indian Electricity Act as amended up to date.

Rules and Regulations of Regional Council of Fire Insurance & Association of India for Electrical wiring or local equivalent.

C MATERIAL AND EQUIPMENT:

All material and equipment shall conform to the relevant standards and shall be of the approved make and design. The materials and equipment shall conform to relevant Indian Standards. The Contractor shall be responsible for the safe custody of all the materials and shall insure them against theft, damage by fire, earthquake etc. A list of items of materials and equipment, together with sample of each shall be submitted to the OWNER within 10 days of the award of the contract. Any item which is proposed as a substitute, shall be accompanied by all technical detail giving sizes, particulars of materials and the manufacturer's name and shall be submitted along with the tender or bid offer. At the time of the submission of proposed substitute the Contractor shall state the credit, if any due to the owner. In the event the substitution is approved, all changes and substitutions shall be requested in writing and approvals obtained in writing from OWNER. OWNER's decision in the matter shall be final.

All materials of the same kind of service shall be identical and made by the same manufacturers. Any deviation to this rule shall be approved by the Consultant. Top priority shall be given to the products that have a permanent agent providing spare parts and maintenance facilities in the same city where the project is situated.

The make of electrical equipments, components, accessories, etc. has been mentioned in order of priorities. The tenderer has to quote for the first priority as mentioned above after ascertaining that the first preference materials are available. If at a later stage during executing the work, material of the first preference make are not available, the contractor has to get approval from the OWNER to use other make of material prior to procurement. Any rate difference for the first preference make and the one approved will be passed on to the owner.

D MANUFACTURERS :

Where manufacturers have furnished specific instructions relating to the materials used in this job, covering points not specifically mentioned in these documents, these instructions shall be followed in all cases.

Where manufacturer's names and/or catalogue numbers are given, this is an indication of the quality, standards and performance required.

When interfacing occurs, equipment shall be mutually compatible in all respects.

E RATING:

Rating of all items shall be appropriate for the conditions on the particular site on which the items will be used. All the equipment shall be fit for continuous work under the worst conditions of site and shall be rated for the following ambient condition.

- ◆ Outdoor temperature 45 deg. cel.
- ◆ Temperature under shed 40 deg. cel.
- ◆ Salty, dusty and humid

F INSPECTION AND TESTING:

OWNER'S representative reserves the right to request inspection and testing at manufacturer's works at all reasonable times during manufacture of items for this contract. Tests on site of completed works shall demonstrate, among other things:

- a. That the equipment installed complies with specification in all particulars and is of the correct rating for the duty and site conditions.
- b. That all items operate efficiently and quietly to meet the specified requirements.
- c. That all the features performed at its best and loading _unloading of the system.
- d. That all the accessories used in low side work are of specified make only. And any deviation in the same needs written approval from our technical consultant.

The contractor shall provide all necessary instruments and labor for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the OWNER and shall provide test certificates signed by a properly authorized person. Such test certificates shall cover all works.

If tests fail to demonstrate the satisfactory nature of the installation or any part thereof then no claims for the extra cost of modifications, replacements or re testing will be considered. OWNER's decision as to what constitutes a satisfactory test shall be final.

The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere.

G TEST CERTIFICATES:

The contractor shall submit test certificates for all the electrical material/system installed. These shall be issued by a government recognized inspection office certifying that all equipment, materials, construction and functions are in

agreement with the requirements of these specifications, ISI and when ISI is not applicable other approved certifying agencies.

H INSTRUCTION MANUAL:

The contractor shall prepare and produce instruction, operation and maintenance manuals in English for the use, operation and maintenance of the supplied equipment and installations, and submit 3 sets to OWNER, at the time of handing over

I SAMPLES AND CATALOGUES:

Before ordering the material necessary for these installations, the contractor shall submit to OWNER for approval, a sample of every kind of material such as cables, conductors, conduits, switches, socket outlets, circuit breakers, lighting fixtures, boxes etc., along with the catalogues.

For big items such as switchboards, the submission of catalogues shall be enough. Prior to ordering any electrical equipment/material/system, the contractor shall submit to OWNER, the catalogues, along with the samples, at least from three different manufacturers. After the selection of manufacturer by OWNER, the contractor shall arrange inspection and testing at the manufacturer's factory or assembly shop for final approval. No material shall be procured prior to the approval of the OWNER.

J VENDOR AND SHOP DRAWINGS:

The contractor shall prepare and submit to PMC/Consultant/OWNER, for his approval, two sets of vendor detailed drawings of all distribution boards, switch boards, outlet boxes, special pull boxes, and other likewise material, equipment to be fabricated by the contractor, or other vendor within 15 days of signing of the contract.

Before starting the work, the contractor shall submit to PMC/Consultant/OWNER for his approval in the prescribed manner, the shop/execution drawings for the entire installation, specially the main connections and junctions, the route of conduits and cables, no. and size of wires drawn through the conduits, location of all the outlet points, and switch boards and distribution boards and any other information required by OWNER. OWNER reserves the right to alter or modify these drawings if they are found to be insufficient or not complying with the established technical standards or if they do not offer the most satisfactory performance or accessibility for maintenance.

K AS BUILT DRAWINGS:

At the completion of work and before issuance of certificate of virtual completion the contractor shall submit to OWNER, three sets of layout drawing drawn at appropriate scale indicating the complete wiring system "as installed" duly approved by Consultant/PMC. These drawings must provide (in plan, folded elevation and section)

- a. Location and details of distribution boards, main switches, switchgear and other particulars

- b. Location of all earthing stations, route and size of all earthing conductors, manholes etc.
- c. Route and particulars of all cables.
- d. Lighting layout plan for all the floors along with circuit distribution details
- e. External Area Lighting Plan

L GUARANTEE :

At the close of the work and before issuance of final certificate of virtual completion by OWNER, the contractor shall furnish written guarantee indemnifying OWNER against defective materials and workmanship for a period of one year after completion. The contractor shall hold himself fully responsible for reinstallation or replacement, free of cost to OWNER, the following:

- a. Any defective work or material supplied by the contractor.
- b. Any material or equipment supplied by OWNER which is damaged or destroyed as a result of defective workmanship by the contractor.
- c. Any material or equipment damaged or destroyed as a result of defective workmanship by the contractor
- d. Contractor shall give 24 free services (Monthly) for easy and smooth operation of the Electrical System during the defect liability period of 24 months.
- e. Contractor shall operate the system for 6 months (24 x 7 – All 3 Shifts) from the date of commissioning and train the client's staff for operation and routine in-house maintenance.

M SAFETY OF MATERIALS:

The contractor shall provide proper and adequate, storage facilities to protect all the materials and equipment including those issued by OWNER against damage from any cause whatsoever.

N COMPLETION CERTIFICATE:

On completion of the electrical installation (or an extension to an installation) a certificate shall be furnished by the contractor countersigned by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local supply authority. The contractor shall be responsible for getting the electrical installation inspected and approved by the local concerned authorities.

O SITE ENGINEER AND TRAINING :

The contractor shall employ a competent fully licensed qualified, full time Electrical engineer to direct the work of Electrical installation in accordance with

the drawings and specifications. The engineer shall be available all times at site to receive instructions from OWNER, in the day to day activities throughout the duration of contract. The engineer shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority. The engineer coordinates with other services contractor and PMC for any coordination site issues.

Contractor shall give training to technical staff of client for Operating, Control and Basic maintenance for easy operation.

P RESTATING & FINISHING OF CIVIL DAMAGES:

For erection of equipment / Piping / Ducting etc., if any civil structure is required to be broken, the same shall be done, restated and finished as original by the tenderer without any extra cost

1.0 LT PANEL

1.1 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.

1.2 GENERAL SPECIFICATIONS

1.2.1 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.

All the outdoor panel shall be double door type with IP65 protection class construction.

All the 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.

1.2.2 The Panels shall be designed to withstand a heaviest condition at site, with maximum expected ambient temperature of 45° c., 90% humidity and salty, dusty weather.

1.3 STANDARDS AND CODES

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:

IS: 4237: General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V D.C.

IS: 375: Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.

IS: 2147: Degree of protection provided by enclosures for Low voltage switch gear and control gear.

IS: 8197: Terminal marking for electrical measuring instrument and their accessories.

IS: 2551: Danger notice plates

IS: 10118: Code of Practice for selection, installation and maintenance of switchgear and control gear.

IS: 8623: 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: 8828: Miniature circuit breakers.

IS: 2705: Current transformers

IS: 3155: Voltage transformer

IS: 3231: Electrical relay for protection

IS: 1248: Indicating instruments

IS: 722: Integrating instruments

IS: 6875: Control switches and push buttons

IS: 1822: AC motor starters of voltage not exceeding 1000 V

Indian Electricity Act and Rules (as amended up to date) and approval of FIA of India.

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

1.4 **CONSTRUCTION**

1.4.1 CUNICAL TYPE PANELS

a) 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°C. All the electrical component shall be derated for 50°C. The ratings indicated in the drawing are derated for 50°C.

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.

b) Protection class:

All the indoor Panels shall have protection class of IP 51 for indoor installation and IP 65 for outdoor installation.

c) 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.

d) 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.

e) 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.

f) Busbars:

The busbar shall be air insulated and made of high quality, high conductivity, high strength Aluminum.

The busbar shall be of 3 phases and neutral system with separate neutral and earth bar. Any kind of welding in any busbar within a panel is strictly not allowed. The bus bar and interconnection between bus bars and various components shall be of high conductivity Aluminum/copper and as per SLD. 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 (horizontal and vertical compartment) shall have uniform cross-section throughout the lengths. The size of neutral busbar shall be same as phase bus bar

The bus bars and interconnections shall be insulated with heat shrinkable PVC sleeve in all horizontal and vertical bus bar chamber/compartment and shall 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. However, refer SLD for final rating.

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 aluminum/copper PVC heat shrinkable strips and/or FRLS copper/aluminum cable of proper size to carry full rated current. These shall be insulated with insulating tapes in case of Strip.

g) Electrical Power and Control Wiring Connection:

- i. 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 solderless sockets for the cable size as indicated on the appended drawings for the Panels.
- ii. Power connections for incoming feeders of the main Panels shall be suitable for 1100 V grade aluminum conductor (LT XLPE) cables.
- iii. Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.
- iv. Both control and power terminals shall be properly shrouded.
- v. 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.
- vi. 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 rating of respective contactor, but not less than 4.0 sq.mm cross-section area. For all kind of control wiring shall be done with minimum 2.5 sq.mm FRLS insulated copper conductor/ flexible wires. Wires for connections to the door shall be flexible with green color. All conductors shall be crimped with solderless sockets at the ends before connections are made to the terminals.

- vii. 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.
- viii. 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.
- ix. Spring type washers shall be used for all copper and aluminum connections.
- x. Final wiring diagram of the Panels power and control circuit with ferrules numbers shall be submitted along with the Panels as one of the documents against the contract.

h) 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.

i) Wireways:

A horizontal PVC wire way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.

j) 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.

k) Earthing:

GI earth bus as per SLD shall be provided in the Panels for the entire length of the panel without any joint and welding within a 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.

l) 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.

m) Name Plate:

- i. 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.
- ii. Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc. shall suitably be identified by providing stickers.
- iii. Engraved name plates shall preferably be of 3 ply, (Red-White-Red or Black-White-Black) lamincold sheet. However, black engraved Perspex sheet name plates shall also be acceptable. Engraving shall be done with square groove cutters.
- iv. Name plate shall be fastened by counter sunk screws and not by adhesives.

n) Danger Notice Plates:

- i. The danger notice plate shall be affixed in a permanent manner on operating side of the Panels.
- ii. The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.
- iii. The danger notice plate, in general, meet the requirements of local inspecting authorities.
- iv. Overall dimensions of the danger notice plate shall be 200 mm. wide x 150 mm. high.
- v. 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.
- vi. The letters, the figures, the conventional skull and bones etc. shall be positioned on plate as per recommendation of IS: 2551-1982.

- vii. The said letters, the figures and the sign of skull and bones shall be painted in signal red colour as per IS: 5-1978.
- viii. The danger plate shall have rounded corners. Location of fixing holes for the plate shall be decided to suit design of the Panels.
- ix. The danger notice plate, if possible, be of ISI certification mark.
- x. Suitable Voltage rated rubber mates to be provided.

o) 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.

1.5 COMPONENTS

1.5.1 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.

1.5.2 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 a 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.

1.5.3 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.

1.5.4 Air Circuit Breaker

a) Construction

The ACB shall have following features:

- Motorised with 230 V A.C. motor.
- 230 V A.C closing and shunt trip coil
- Draw out type with "service", "test", "isolated" and "maintenance" position.
- Safety shutter of Fibre glass / polycarbonate sheet of 2mm thickness shall be provided
- Mechanically trip free plus anti-pumping feature is to be provided.
- Electrical trip free plus anti pumping shall be provided with relay ONLY and not by contactors.
- Electrical/Mechanical operation counter shall be provided.
- Door interlock with defeat features to be provided.
- ACB shall be lockable in isolation position.

b) RELEASE:

- Thermal Magnetic release shall be direct acting type, tripping ACB mechanically.
- Short circuit, overload and earth fault protection shall be provided.
- Vendor to suggest release type for feeders of supply range characteristic and accuracy.

c) ACB PERFORMANCE:

- ACB performance inside panels at ambient 50 Degree.
- Ith Symmetrical breaking, 35KA
- Making capacity peak 87.5 KA
- Short time rating, 1sec. 35KA

1.5.5 Moulded Case Circuit Breaker

The moulded case circuit breaker (MCCB) shall be air break type and having quick make - quick break with trip free operating mechanism.

Housing of the MCCB shall be of heat resistant and flame retardant insulating material.

Operating handle of the MCCB shall be in front and clearly indicate ON/OFF/TRIP positions.

The electrical contact of the circuit breaker shall be of high conducting non deteriorating silver alloy contacts.

The MCCB shall be provided with thermal / magnetic type bi-metal overload release and electromagnetic short circuit protection device. All the releases shall operate on common trip busbar so that in case of operation of any one of the releases in any of the three phases, it will cut off all the three phases and thereby single phasing of the system is avoided.

The MCCB wherever called for in the appended drawings shall provide an earth fault relay.

The MCCB shall provide two sets of extra auxiliary contacts with connections for additional controls at future date.

The electrical parameters of the MCCB shall be as per the description given in the appended drawings.

The MCCB shall be provided with 230 V A.C motor for closing and tripping / switching off for the feeders if indicated in single line diagram.

1.5.6 Contactors

The contactors shall meet with the requirements of IS: 2959 and BS: 775.

The contactors 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.

1.5.7 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 minimum accuracy Class I and suitable minimum VA burden for operation of associated metering and controls and/or as per SLD. However, burden shall be arrived by contractor as actuals Current transformer shall be in accordance with IS: 2705 - 1964 as amended upto date.

1.5.8 Push Button

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.

1.5.9 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

1.6 DIGITAL MULTI FUNCTION METER :

The load manager shall be digital type with RS485 port. It should measure KW, KVA, KVAR, V, I, PF etc.

1.7 SHOP DRAWINGS:

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

1.8 INSPECTION

At all reasonable times during production and prior to transport of the Panels to site, the supplier / contractor shall arrange and provide all the facilities at their plant for inspection.

1.9 TEST CERTIFICATES

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 approval.

The items/quantities shall be measured and paid upon completion of the linked milestone as per schedule/ BOQ for the respective item.

TECHNICAL DATA SHEET FOR LOW VOLTAGE DISTRIBUTION BOARD

SR. NO.	PARTICULARS	DESCRIPTION
1.0	Site Condition	
1.1	Type	Indoor/Outdoor

SR. NO.	PARTICULARS	DESCRIPTION
1.2	Mounting	Floors
1.3	Ambient Temperature	45° C.
1.4	Atmosphere	Non corrosive, Humid and Dusty
2.0	OPERATIVE CONDITION	
2.1	Voltage	415 V ± 10 %
2.2	No. Of	3
2.3	Phase	3 Ø , 4 WIRE
2.4	System	50 HZ, + 3 % / - 6 %.
2.5	Frequency	As per SLD
	System	
	Fault Level	
	Current	
3.0	CONTROL SYSTEM	
3.1	Voltage	
	For	110 V A.C.
	Indication	110 V A.C.
	For Metering	110 V A.C.
3.2	For	230 V A.C. only
	Protection	
3.3	Control Supply	2.5 MM ² FRLS Cu. Wire
	Through Control	4.0 MM ² FRLS cu. Wire for CT ckt.
	Transformer	
	Control Wiring	
4.0	BUSBAR	
4.1	Phase Bus	
A.	bar Material	Aluminum
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	1.0 Amp. / mm ²
4.2	Neutral Bus bar Material	Aluminum or as per SLD
4.3	Earth Bus bar Material	GI or as per SLD
5.0	Source changeover System	Not Required
6.0	PAINTING	
6.1	Sheet Should Be 7 Tank Processed, Oven Baked At 310°C. With Powder coating.	EPOXY PRIMER PU
6.2	Type Of Primer	
6.3	Type Of Paint Shade Exterior & Interior Degree Of Protection	Shall be confirmed with client
6.4	Max. Temperature Rise Inside The Panel (°C.)	IP 51 for indoor and IP-65 for outdoor
6.5		35 ° C. above ambient

SR. NO.	PARTICULARS	DESCRIPTION
7.0	CONTROL WIRING	
7.1	Wire Size	3 C X 4.0 mm ² as specified However minimum 3 C X 2.5 mm ²
8.0	HARDWARE (ZINC PLATED)	YES
9.0	SPACE HEATER	230 V A.C. with breaker rating 630A and above
10.0	POCKET FOR DRAWINGS AT DOOR	YES

1.10 Technical Specifications of Surge Protection Devices (SPD) for 230 / 415V AC 50 Hz power supply

Surge Protection Device (previously called as TVSS) connected in the mains power supply, needed to protect the electrical and electronic equipment, should confirm to IEC 62305 – Lightning Protection Zone 1 protection (LPZ-1) for 100 KA (10/350 μ sec). Power Line SPD's are to be connected at the mains incoming panel and in addition Distribution Boards which are more than 15 meters away from the incoming panel. DB's that are feeding power to critical and sophisticated electronic equipment, SPD's must be installed ignoring the cable distance. Suitable SPD's also to be used in all Telecommunication, Signalling, automation and instrumentation equipment according to the Zonal concept explained in IEC 62305 for a perfect protection of complete electronic installations. All SPDs should be tested and ensure performance requirements according to IEC 61643

Mains Incoming Panel

Protection at the main in-comer of the power supply system has to be connected at the Main Distribution **Board after the incoming breaker.**
Class B/Class I (according to IEC 61643)

SPD should be connected between Phase and Neutral and between Neutral and Earth with the following ratings:

Sl. No	Parameters	Specifications	
		Line to Neutral	Neutral to Earth
1.	Type	Encapsulated/Non-exhausting Spark Gap	
2.	Nominal Voltage, Un	230V, 50/60 Hz	
3.	Over Voltage withstanding capacity	400V	
4.	Lightning Impulse Current	40 KA(10/350 μ sec)	125 KA(10/350 μ sec)
5.	Voltage Protection Level, Up	\leq 2.5 KV	
6.	Response Time	< 100 nano seconds	
7.	Operating temperature range	-40°C to +85°C	
8.	Mounting on	Din Rail	
9.	Degree of Protection	IP 20	

10.	Back-up Fuse / MPCB	Up to 500 amps max. Depending up on panel design & breaking capacity.
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For 3 phase system, 3 Nos. of Line to Neutral SPD & 1 No. of Neutral to Earth SPD are needed.

For 1 phase system, 1 No. of Line to Neutral SPD & 1 No. of Neutral to Earth SPD are needed.

Sub Distribution Board (SDB)/LT Panel

Second Stage Protection at the Sub distribution board or in LT panel of the power supply system,

Class B+C/Class I+II (according to IEC 61643)

Pluggable type SPD with potential free contact, thermal disconnecter & provision for inbuilt common remote indication for defective arresters has to be connected between Line and Neutral and SPD of Spark Gap type between Neutral and Earth of following ratings should include base element & pluggable arresters.

Sl. No	Parameters	Specifications	
		Line to Neutral	Neutral to Earth
1.	Type	MOV with built in thermal fuse	Spark Gap Encapsulated / Non-exhausting
2.	Nominal Voltage, Un	230V, 50/60 Hz	
3.	Maximum Continuous Operating Voltage, Uc	≥ 320 Volt	255 Volt
4.	Nominal Discharge Current I _n	30 KA(8/20 μsec)	50 KA(8/20 μsec)
5.	Maximum Discharge Current I _{max}	50 KA (8/20 μsec)	
6.	Lightning Impulse Current	7 KA(10/350 μsec)	25 KA(10/350 μsec)
7.	Voltage Protection Level at 1 KA	≤ 750 volts	≤ 1200 Volt
8.	Response Time	< 25 nano seconds	< 100 nano seconds
9.	Operating temperature range	-40°C to +80°C	
10	Mounting on	Din Rail	
11	Degree of Protection	IP 20	
12	Max. Back-up fuse / MPCB	Up to 160 amps max. Depending up on panel design & breaking capacity.	

Visual Indication of the flag in the surge arrester (Line to Neutral):

Healthy condition : Green Colour
 Faulty condition : Red Colour

For 3 phase system, 3 Nos. of Line to Neutral SPD & 1 No. of Neutral to Earth SPD are needed.

For 1 phase system, 1 No. of Line to Neutral SPD & 1 No. of Neutral to Earth SPD are needed.

Equipment Level (UPS, MCB DB's CNC machine/Drives, etc.)

Protection for Sensitive Equipments at the input of the end equipments like UPS, CNC machine, VFD's or at Important MCB DB's feeding power to Computer / Server etc.

Class C/Class II (according to IEC 61643)

3 numbers of pluggable type surge arrester with potential free contact, thermal disconnecter & provision for inbuilt common remote indication for defective arresters to connect between Line and Neutral and one number arrester Spark Gap type to connect between Neutral and Earth of following ratings including base element & pluggable arresters.

Sl.No	Parameters	Specifications	
		Line to Neutral	Neutral to Earth
1.	Type	MOV with built in thermal fuse	Spark Gap Encapsulated / Non-exhausting
2.	Nominal Voltage, U_n	230V, 50/60 Hz	
3.	Maximum Continuous Operating Voltage, U_c	≥ 320 Volt	255 Volt
4.	Nominal Discharge Current I_n	20 KA(8/20 μ sec)	50 KA(8/20 μ sec)
5.	Maximum Discharge Current I_{max}	40 KA	50 KA (8/20 μ sec)
6.	Voltage Protection Level at 1 KA	≤ 1000 Volts	≤ 1200 Volts
7.	Response Time	< 25 nano seconds	< 100 nano seconds
8.	Operating temperature range	-40°C to +80°C	
9.	Mounting on	Din Rail	
10.	Degree of Protection	IP 20	
11.	Back-up fuse / MPCB / MCB	Up to 125 amps max. Depending up on panel design & breaking capacity.	

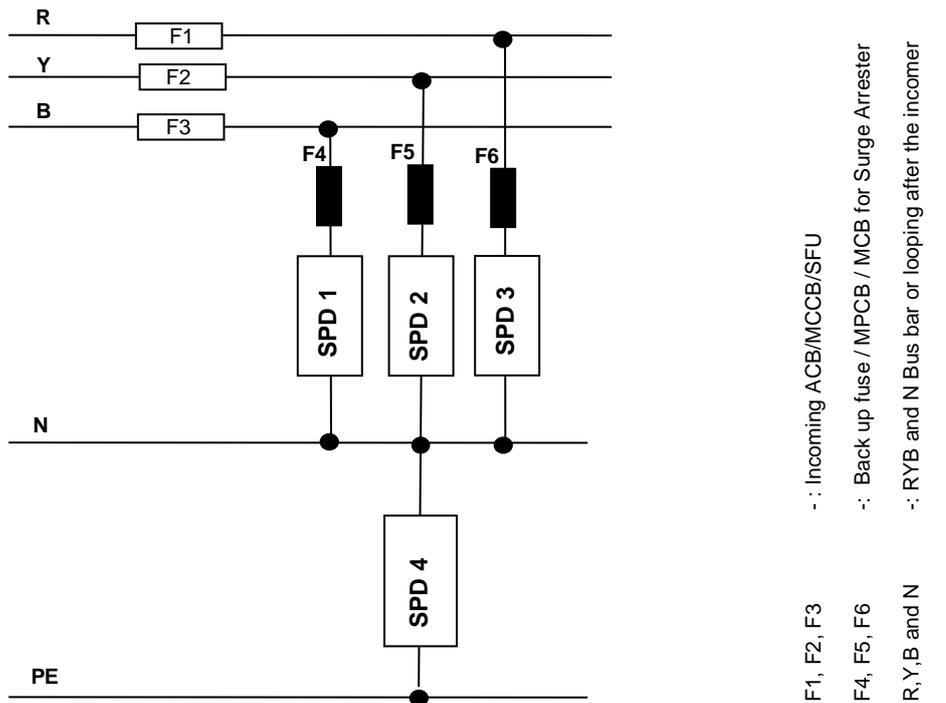
Visual Indication of the flag in the surge arrester (Line to Neutral)

Healthy condition : Green Colour
 Faulty condition : Red Colour

For 3 phase system, 3 Nos. of Line to Neutral SPD & 1 No. of Neutral to Earth SPD are needed.

For 1 phase system, 1 No. of Line to Neutral SPD & 1 No. of Neutral to Earth SPD are needed.

Connection diagram for SPD for 3 phase 4 wire



Technical Specifications of Surge Protection Devices (SPD) for the protection of sensitive Electronic Equipment.

Surge Protection Devices act locally. SPD has to be connected very close to the electronic equipment that need protection. This is called gradual reduction of surges at the respective zonal interfaces and at the equipment input level.

Surge Protection Device for 230 V AC/DC Single Phase Power Supply at Equipment Level.

Nominal Voltage	230 V (50-Hz)
Maximum Continuous Operating Voltage (MCOV) U max AC	255 V AC
Requirement Class as per IEC 61643-1	D, Class III
Lightning Protection Zone (LPZ)	2-3
Nominal Load Current I _L	20 A
Nominal Discharge Current I _n (8/20 μS)	2.5 kA
Maximum Discharge Current I _{max} (8/20μS)	7.0 kA
Response time	≤ 25 nS.
Voltage Protection Level(sym/asym)	≤ 1400 / ≤ 1000 V
Connection cross section, Standard	1-2.5 mm ²
Temperature Range	-40°C to + 80°C
Mounting	35 mm DIN rail

Width	17.5mm
Test	CE

Surge Protection Device for ISDN Telecommunication (fax / Modem)

Max Voltage AC	4.2V
Max Voltage DC	6.2V
Lightning Protection Zone (LPZ)	0-3
Pulsed Current	1.5 kA
Nominal Discharge Current	7.5 kA
Transmission frequency	< 6 MHz
Insertion Loss	0.1 at 144 kHz
Series resistance	4.7 Ω
Connector Type	RJ 45
Protected Cores	UTP 4 cores
Protection Level (sym.) with In C2	≤ 12 V
Protection Level (asym.) with In C2	≤ 500 V
Protection Level (asym.) with 1KV/ μ s C3	≤ 8 V
Protection Level	IP 40
Plug-in system	RJ 45
Test	CE

Surge Protection Device for Analog Telecommunication (fax / Modem)

Max Voltage AC	122 V
Max Voltage DC	170 V
Lightning Protection Zone (LPZ)	1-3
Nominal Discharge Current	7.5 kA
Transmission frequency	< 100 kHz
Insertion Loss	0.5 at 36 kHz
Series resistance	2.2 Ω
Protection Level (sym.) with C2	≤ 300 V
Protection Level (asym.) with C2	≤ 500 V
Protection Level (asym.) with 1kV/ μ s	≤ 245 V
Protection Level	IP40
Plug-in system	RJ11
Test	CE

Surge Protection device for CCTV camera & multiplexer CCTV camera having Co- axial input:

U max AC	4.2 V
U max DC	6.2 V
LPZ	1→3
Type of connection	In series
Nominal discharge surge current (8/20 μ S)	10/0.5 kA
Frequency Range	<200MHz
Insertion loss	0,2 @10 MHz
Series resistance	NIL
Protection level (sym.) with In C2	≤ 12 V
Protection level (asym.) with In C2	≤ 500 V
Protection level (asym.) with 1 KV/ μ s C3	≤ 8 V
Protection rating	IP 40
Plug-in System	BNC Connector

Housing	Aluminum
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RS-232 D-SUB Data line Protector

Description	9 Pin	15 Pin	25 Pin
Maximum Continuous Operating Voltage	18 V		
Nominal Discharge Current	340 A		
LPZ	2-3		
Protection level (Sym). With In C2	≤50V		
Protection level /Asym). With 1KV/μs	≤25V		
Plug-in system	Sub D/Pin 1-9	Sub D/Pin 1-15	Sub D/Pin 1-25
Test	CE		

SPD for RF Coaxial input equipment:

Description	N type Male/Female	BNC type Male/Female
Max voltage AC	130V	130V
Max voltage DC	180V	180V
LPZ	0-2	0-2
Nominal Discharge Current	10 kA	5 kA
Pulsed Current (10/350 μS)	2*2.5 kA	
Wave Resistance	50 Ω	50Ω
Transmission Power	400W	400W
Transmission frequency	0 - 2 GHz	0 - 2.5GHz
Insertion loss	3 at 5.3GHz	3 at 2.5GHz
Voltage protection level	≤ 0.8 kV	≤ 0.8 kV
Temperature	- 40° C to +80° C	- 35° C to +80° C

Surge Protection Device for 2 wire, 5V DC, RS 485 Modbus & Profibus PA

Nominal Voltage	5V
Max Voltage AC	4.2 V
Max Voltage DC	6V
Lightning Protection Zone (LPZ)	0-3
Pulsed Current(10/350 μS)	6 kA
Nominal Discharge Current In	10 kA
Nominal load Current I _L	1A
Inductance	100 μH
Voltage Protection level wire/Earth	≤ 500 V
Voltage Protection level wire/wire	≤ 18 V
Protection Rating	IP 20
Response time	< 1 ns
Width	17.5mm
Connection Cross-section,	1 mm ²
Temperature Range	-40 to +80°C

Krone MDF 10 pair protection for EPABX

Description	Units	Specification
Maximum Continuous Operating Voltage	U _c	180 V
Voltage Protection Level	U _p	< 700 V
LPZ		0-2
Nominal Discharge Current (8/20 μS)	I _n	5 kA/wire

Maximum Discharge Current (8/20 μ S)	I_{max}	10 kA/wire
Impulse Current (10/350 μ S)	I_{imp}	1 kA
Temperature Range		-40 to +80° C

Description	Units	Specification
Maximum Continuous Operating Voltage DC	U_c	58V
Maximum Continuous Operating Voltage AC	U_c	41V
Load Current	I_L	1A
Nominal Discharge Current C2 (Line - Line)	C2	150A
Nominal Discharge Current C2 (Total)		7 kA
Protection Level (Line - Line)	U_P	120 V
Protection Level (Line - Earth)	U_P	700 V
Maximum Voltage	U_{max} @C3 (10A)	90V

2.0 LT XLPE CABLE

2.1 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.

2.2 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	Aluminum conductors for insulated cables	IS : 8130	Indian Electricity Act and Rules.

2.3 DESIGN BASIS & SITE CONDITIONS

All equipment and materials will be selected and rated for use as per site conditions.

2.4 TECHNICAL REQUIREMENTS

2.4.1 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

2.4.2 Material

Medium voltage cable shall be XLPE insulated. PVC sheathed, aluminum or copper conductor, armoured conforming to IS: 7098 Part I.

a) Type

The cables shall be circular, multi core, annealed copper or aluminum conductor, XLPE insulated and PVC sheathed, armoured or unarmoured.

b) Conductor

Uncoated, annealed copper / aluminum, of high conductivity up to 4mm.² size, the conductor shall be solid and above 4mm.², conductors shall be concentrically stranded as per IEC: 228.

c) Insulation

XLPE rated 70° c. extruded insulation

d) 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.

e) 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.

f) Armour

Galvanized steel flat strip / round wires applied helicaly in single layers complete with covering the assembly of cores.

For cable size up to 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

g) 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

a) Rating: Up to and including 1100 Volts.

2.5 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

2.6 Inspection and Testing

2.6.1 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.

2.6.2 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.

a) 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.

b) 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.

2.6.3 Cable Test Before and After Laying of Cables at Site

- a) Insulation Resistance test between phases and phase to Neutral and phase to earth.
- b) Continuity test of all the phases, neutral and earth continuity conductor.
- c) Sheathing continuity test.
- d) Earth resistance test of all the phases and neutral.

2.7 Method of Measurement

2.7.1 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.

2.8 Transport, Delivery and Storage

- 2.8.1 The cable shall be supplied in the actual length as per detailed purchase order.
- 2.8.2 The cable shall be dispatched at client's stores or at site as per detailed instructions given by client at later stage.
- 2.8.3 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.

2.9 Guarantee of Performance

2.9.1 The quotes values of parameters shall be within given tolerance for given period of service life.

The items/quantities shall be measured and paid upon completion of the linked milestone as per schedule/ BOQ for the respective item.

3.0 SUPPLY OF LIGHT FIXTURE

3.1. General Requirement

- a) The Lighting system includes the following items.
 - o Lighting fixtures complete with Lamps and accessories (lumen per watt shall be indicated)
 - o Lighting system equipment (ISI make)
 - o Light control switches, receptacle units with control Switch units, lighting wires, conduits and other similar items necessary to complete lighting system.

- Lighting fixture supports, street lighting poles and flood light towers Main Lighting distribution board, lighting panels.
- Multi core cables for street, boundary and flood lighting.
- PVC Conduits

b) Load balancing of lighting system shall be mad

3.2. Design

The lighting system design shall comply with the acceptable norms and the best engineering practices. The lighting layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirement, local rules etc.

The value of the ratio of spacing (S) to mounting height (H) shall be commensurate with the type of fittings selected and uniformity of illumination.

3.3. Applicable Codes & Standard

All standards and codes of practice referred to below shall be the latest edition including all official amendments and revisions.

•	3 pin plugs & sockets	:	IS 1293
•	General safety requirements for luminaires	:	IS 1913
•	Luminaires for street lighting	:	IS 10322(Paart-5,S 3)
•	Fitting for rigid steel conduits for electrical wiring	:	IS 2667 conduits for electrical wiring
•	Code of practice for interior illumination	:	IS 3646 & IS 6665 illumination
•	Switches for domestic & similar purposes	:	IS 3854 similar purposes
•	Electric ceiling type fans & regulator	:	IS 374
•	Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts)	:	IS 732
•	General lighting LED and LED Modules	:	IS 16101
•	Self-ballast LED lamps for general lighting services	:	IS 16102 (Part-1 & 2)
•	LED modules for general lighting	:	IS 16103(Part-1 & 2)
•	Safety of lamp control gear	:	IS 15885 (Part-2/sec-13)

•	DC or AC supplied electronic control gear for LED modules	:	IS 16104
•	Method of measurement of lumen maintenance of solid state light (LED) sources	:	IS 16105
•	Method of electrical and photometric measurements of solid state light (LED) products	:	IS 16106
•	Luminaires performance	:	IS 16107 (Part 1 &2)
•	Photo biological safety of lamps and lamp system	:	IS 16108

3.4. LED Luminaires

LED luminaires shall be used for internal & outdoor lighting. Luminaires shall be installed to permit ease of maintenance. The Contractor shall provide all equipment necessary to carry out maintenance on the lighting installation and demonstrate its operation to the satisfaction of the Engineer.

MCB + RCCB (DP For single phase and 4P for three phases MCB DB) shall be provided at the incomer of Lighting panels and SP MCB for outgoing feeders.

3.5. Floodlight Luminaries

Metal halide type luminaires shall be complete with accessories like lamps, ballasts, Driver, power factor improvement capacitors, starters etc. These shall be mounted as far as possible in the luminaire housing only. If these cannot be accommodated integral with the luminaire then a separate metal enclosed control gear box shall be included to accommodate the control accessories together with a terminal block suitable for loop-in, loop-out connections.

Flood Light Luminaries:

- a) Flood light luminaries shall be of weather proof construction with high pressure die cast aluminum with cooling fins and graphite grey polyester powder coating, resistant to corrosive and saline environments with a separate internal high purity (99.85%) polished, anodised aluminium mirror polished reflector, heat resistant, toughened glass cover and necessary gaskets to prevent ingress of dust.
- b) The housing shall be supported on a cast iron base and capable of being swivelled in both horizontal and vertical directions and locked in any desired position.
- c) For focussing purposes, knobs, shall be provided along with sector plate indicating the angle in degrees between 0 and 90 deg. in vertical direction.
- d) The Luminaries shall be suitable for single and dual Metal Halide (MH) lamps

of 150W/ 250W/ 400 watts etc. as required. The same shall be mounted in a separate sheet metal enclosed/ cast aluminum weather proof control gear box.

- e) The luminaries shall be provided with cable gland on the canopy in down ward direction for cable connection.
- f) It shall be possible to adjust the lamp position to achieve wide beam, medium beam or narrow beam.
- g) It shall be possible to replace the lamp from the canopy without opening the front glass.
- h) The flood light shall be supplied with knife switch enabling safe lamp replacement from rear side.
- i) Retained steel screws with special anticorrosion and anti-gripping treatment shall be provided.
- j) Igniter box shall be thermally isolated from the housing.
- k) Gasket made of silicone platinum material shall be provided.
- l) The floodlights shall contain an internal baffle to improve efficiency and to reduce glare.
- m) Access for re-lamping shall be from the rear of the floodlights with a provision of power cut-off switch to discontinue the lamp current when the rear door is opened.
- n) Precision aiming arrangement by way of external telescope shall be provided in the luminaire.

Accessories for Luminaries:

- a) Reflectors
 - i. The thickness of aluminum shall comply with relevant standards. Aluminum used for reflectors shall be anodized/ epoxy stove enamelled/ mirror polished.
 - ii. Reflectors shall be free from scratches or blisters and shall have a smooth and glossy surface having an optimum light reflecting coefficient so as to ensure the overall light output specified by the Contractor.
 - iii. Reflectors shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be securely fixed to the housing by means of positive fastening device of captive type.
- b) Lamp/ Starter Holders:
 - i. Lamp holders shall have low contact resistance, shall be resistant to

wear and shall be suitable for operation at the specified temperature without deterioration in insulation value. They shall hold the lamps in position under normal condition of shock and vibration met with under normal installation and use.

- ii. The starter holders shall be so designed that they are mechanically robust and free from any operational difficulties. They shall be capable of withstanding the shocks met within normal transit, installation and use.
- c) Ballasts:
- i. The ballasts shall be designed to have a long service life and low power loss. The ballasts shall be of the inductive, heavy duty type copper wire wound, filled with thermosetting, insulating, moisture repellent polyester compound filled under pressure or vacuum. Ballasts shall be provided with taps to set the voltage within the range of variation in supply voltage of $\pm 10\%$ of 240 V. End connections and taps shall be brought out to a suitable terminal block rigidly fixed to the ballast enclosure. Ballasts shall be free from hum and such of those which produce hum shall be replaced by Contractor free of cost.
 - ii. Ballasts shall be mounted using self-locking, anti-vibration fixings and shall be easy to remove without demounting the fittings. They shall be in dust tight, non-combustible enclosures.
 - iii. All the luminaries other than Flood Light Fixtures shall have integral control gear.
 - iv. All gas discharge/ MH type lamps shall be provided with control gear, with Copper wound and polyester filled low loss ballast, igniter and PF correction capacitor.
 - v. Contractor to provide comprehensive technical details of the luminaries and the lamps being offered. The details must be sufficient to take in to consideration maximizing of energy efficiency and minimizing overall shop power consumption.
 - vi. All the outdoor purpose luminaries, including Street light luminaries shall be with ingress protection of IP 65 minimum.
- d) Starters:
- i. Starters shall have bimetal electrodes and high mechanical strength.
 - ii. Starters shall be replaceable without disturbing the reflector or lamps and without the use of any tool.
 - iii. Starters shall have brass contacts and radio interference capacitors.
- e) Capacitors:
- i. The capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.

- ii. The capacitors shall be suitable for operation at specified supply voltage conditions and shall have a value of capacitance so as to correct the power factor of their corresponding lamps circuit to the extent of 0.95 lag or better.
 - iii. The capacitors shall be hermetically sealed preferably in a metal enclosure to prevent seepage of impregnate and ingress of moisture.
- f) Lamps:
- i. Lamps shall be capable of withstanding small vibrations and the connections at lead in wires and filaments/ electrodes shall not break under such circumstances.

3.6. Street / Flood Lighting System

The illuminance level for road lighting in India is governed by IS 1944 (Part 1 & 2): 1970/ Code of practice for lighting of public thoroughfare.

The layout for street lighting system will be planned in such a way that uniformity ratio as required by IS: 1944 is maintained.

All the Poles shall be designed to withstand the maximum wind speed as per IS 875. The top loading .i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BSEN 40- 3:2000, pr EN-40-3-3.

All pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations .i.e. from inside and outside.

The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

Aesthetic appearance - All the grooves and carvings of the pole unit shall be free from any kind of distortion for a pleasing aesthetic appearance.

The poles and bracket shall be hot dip galvanized as per is 2629/ IS 2633/ IS 4759 standard with average coating thickness of 75 micron. The galvanizing shall be done in single dipping.

Top Mountings -The galvanized mounting bracket shall be supplied along with the Poles for Installation of the luminaries.

The pole manufacturing & galvanizing unit shall be ISO 9001: 2000 & ISO 14001 certified to ensure consistent quality & environmental protection.

Electrical connections - Four way connectors shall be provided along with Slide lock suitable for connecting 1.1 kV grade, 4 core Al cable. It shall also in house 1 no. 6 amps SP MCB, 2.5 sqmm connectors for looping with 2.5 Sqmm Copper wires for connecting to the luminaire through 1.1 kV grade, 3 core X 2.5 mm² PVC insulated copper conductor flexible un-armoured Cable from the terminal block to the fixture within the pole. All the cables laid through the pipe shall be without any joint.

Two nos. earth boss shall be provided at the bottom of the pole (diagonally opposite) suitable for connecting 25X6 mm GI earth strip or 6SWG GI wire for earthing of the poles.

Two nos. 50 mm NB HDPE Sleeves of suitable length shall be provided through the foundation upto the Junction Box for entry of power cable.

The BIDDER shall carry out all the relevant tests and inspection in the presence of the PURCHASER or Third Party Agency, as may be selected by the PURCHASER, before the dispatch of the poles at no extra cost to the PURCHASER.

The BIDDER shall inform the PURCHASER at least FIFTEEN (15) days in advance, about the manufacturing programme so that arrangement can be made for inspection. PURCHASER reserves the right to waive the inspection at any stage.

All the material/equipment/accessories shall be supplied with manufacturer's test certificates.

BIDDER shall submit the Proposed Product Catalogue, Detail Data sheet, spare parts list and drawing of Pole & Bracket along with the BID for each product quoted.

BIDDER shall arrange for all the tools and equipments.

M20 concrete foundations shall be provided for all the poles. Approx dimension of the foundation for evaluation purpose is 600X600X1700 mm. However, BIDDERS shall design as per the stability requirement and Soil bearing Capacity of each location. The Poles shall be bolted on a pre-cast foundation with minimum four foundation bolts for greater rigidity.

3.7. Applicable Standards

Sr. No.	Brief Title	IS/IEC Code
1.1	Testing procedure of photometric testing for LED luminaires	LM 79
1.2	Testing procedure on the lifespan of LEDs	LM 80
1.3	National Lighting Code	SP72
1.4	Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources	IS:16105
1.5	Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products	IS:16106
1.6	Limits of Harmonic Current Emissions	IS 14700-3-2
1.7	DC or AC supplied electronic control gear for LED modules performance requirements	IEC 62384
	Lamp control gear: particular requirements	

Sr. No.	Brief Title	IS/IEC Code
1.8	for DC or AC supplied electronic control gear for LED modules	IEC 61347-2-13
1.9	Environmental Testing: Test Z- AD: composite temperature/ humidity cyclic test	IEC 60068-2-38
1.10	Electro Magnetic compatibility (EMC) - Limits for Harmonic current emission- (equipment input current ≤ 16 A per phase.	IEC 61000-3-2
1.11	EMC Immunity requirement	IEC 61547
1.12	LED modules for general Lighting- Safety requirements	IEC 62031
1.13	Classification of degree of protections provided by enclosures (IP Codes)	IEC 60529
1.14	Fixed general purpose luminaries	IEC 60598-2-1
1.15	General Lighting - LEDs and LED modules rms and Definitions	IS:16101 / IEC TS 62504
1.16	LED Modules for General Lighting Part 1 Safety Requirements	IS:16103(Part1)
1.17	LED Modules for General Lighting Part 2 Performance Requirements	IS:16103(Part2)
1.18	Safety of Lamp Control Gear, Part 2 Particular Requirements Section 13 D.C. or A.C. Supplied Electronic Control gear for Led Modules	IS:15885(Part2/Sec1 3)

3.8. Environmental Condition

The average atmospheric condition during the year is mentioned below. The equipment shall be designed to work in such environmental conditions:

- Maximum ambient air temperature: 50° C
- Max. Relative humidity: 100%
- Average Rainfall: 55 inches
- Atmosphere: Dusty and Heavy chemical smoke at times in certain areas.
- The equipment shall be suitable to sustain and work in the humid and corrosive atmosphere of the city.

3.9. Luminaire Description

- The Luminaires shall have a sturdy and corrosion resistant high pressure Die cast Aluminum housing with weatherproof gasket for lamp and control gear accessories. The Housing shall be Epoxy coated, without any cracks or thorough holes, made in a single piece of die-cast LM6 aluminum alloy. The luminaries shall be totally enclosed, dust tight and water proof.
- Heat sink used should be aluminum extrusion having high conductivity. The

dimensions of luminaries shall be optimum and adequate to permit sufficient heat dissipation, through the body itself, so as to prevent abnormal temperature rise inside the lantern and consequential damage to the cover and gasket materials, LEDs, lenses and electronic drivers. Heat sink must be thermally connected to MCPCB/ LED light source.

- c) The Luminaries Housing shall be suitable for termination of Cable with Double Compression Cable Glands.
- d) Housing protection: IP-66. If the LEDs and LED Driver are in different compartments, then the two compartments must be individually IP-66. For achieving IP-66, proper gaskets should be provided. Test certificate of NABL accredited laboratory is to be submitted for the luminaire model/rating offered.
- e) Luminaires should conform to the photometric Distribution / requirements of Cut-Off / -Semi Cut off light distribution and optics as classified in IS 1944.
- f) Suitable number of LED lamps shall be used in the luminaries. The manufacturer shall submit the proof of procurement of LEDs from OEMs at the time of testing.
- g) The Luminaries shall be provided with high tensile heat resistant toughened glass or UV resistant polycarbonate cover fixed with stainless Steel screws.
- h) An extruded silicon loop gasket shall be provided in the lantern body to ensure a weather proof seal between the cover and the metal housing to exclude the entry of dust, water, insects, etc. Luminaries should conform to degree of protection of IP 66 or above. Felt gasket will not be accepted.
- i) Year of Manufacture, Batch No., Serial Number or Identification No. Luminaries **Manufacturer's Name / Logo, Wattage and Frequency should** be embossed on the housing
- j) LED luminaries, should conform to the various National / International standards for safety & performance. Manufacturer should provide test reports as per LM 79 & LM80. Lumen maintenance report as per LM 80 guidelines shall be submitted for the LEDs used along with the BID.
- k) Luminaries should conform to the IS standards for Safety & Performance and test certificates as per IS 16107 should be provided by the manufacturer. In case of luminaries are imported, the BIDDER shall conform to test parameters as per UL or equivalent standards.
- l) The electrical component of the LED and LED driver must be suitably enclosed in sealed unit to function in environment conditions mentioned earlier.
- m) All the connecting wires inside the Luminaries shall be low smoke halogen free, fire retardant cable.
- n) Adequate protection against Overloading, Short Circuit, Over Voltage, over temperature, Under Voltage, String Open shall be provided within the Luminaries.

- o) Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.
- p) The equipment should be compliant to IEC 60598-1, IEC 62031 and IEC/ PAS 62612 depending on the type of luminary.
- q) All the material used in the luminaries shall not contain any toxic material/ metal like mercury; shall be halogen free and fire retardant confirming to relevant standards.
- r) The Manufacturer shall have all the relevant testing facilities certified by an accredited laboratory and shall be offered for inspection to the PURCHASER for verification of the required parameters and tests. BIDDER shall confirm the same in the BID.
- s) The control gear shall comply with the provisions of IEC 61347-2-13, IEC 62031 and IEC 62384 as appropriate.
- t) The lighting fixtures offered shall comply with the following requirements;

3.10. LUMINAIRE DATASHEET

Sr. No.	Parameter	Requirement / Value
1.	Type	LED Luminaries complete with all accessories
2.	Rated Voltage	230 V
3.	Expected Frequency	50 Hz +/- 3%
4.	Operating Voltage Range	140 V to 270 V but luminaires shall be tested for 100V to 300 V AC
5.	Power Factor	> 0.90
6.	Operating Temperature Range	0 Deg C to 50 Deg C
7.	Working Humidity	10% - 90% RH
8.	Driver Type	Constant Current based Electronic Driver
9.	Driver Efficiency	> 85%
10.	Driver Life	>20000 hrs.
11.	Protection required in Driver module	
a.	Short Circuit	Yes
b.	Over Voltage	Yes
c.	Over Temperature	Yes
d.	Under Voltage	Yes
e.	String Open Protection	Yes

Sr. No.	Parameter	Requirement / Value
12.	Luminaire IP Protection	Minimum IP-65 and above
13.	Minimum Surge Protection	>4 KV
14.	THD	<10%
15.	Rated Minimum LED Life (L70)	>50000 Burning Hours
16.	Rated Minimum Driver Life	20000 Burning Hours
17.	CRI	As per Standard mentioned in Design Criteria
18.	Junction temperature rise	< 85 Deg C
19.	Solder point temperature	< 70 Deg C
20.	Maximum temperature rise for Driver	<30 Deg C at 50 Deg C ambient
21.	Make of LED	Cree / Nichia/ Philips / Osram
22.	Make of Driver	Cree / Nichia/ Philips / Osram
23.	Operating Hours	Dusk to Dawn (max 12 Hrs.)
24.	Luminous Efficacy	> 135 Lumens/watt (at operating current(design) and Tj = 85 deg C)
25.	System Efficacy	>100lm/W
26.	Colour Temperature	5000K 6000K
27.	Illumination Regulation	<5%
28.	Material used for following	
a.	Housing	Single housing, Side entry, Corrosion free High Pressure Aluminum die cast/extruded Aluminum, grey color corrosion resistant polyester powder coating, with separate optical and control gear compartments, fixing arrangement Maintenance friendly.
b.	Heat Sink	Aluminum extrusion
c.	Clip / Fasteners	Stainless steel.
d.	Diffuser	Toughened glass/ UV stabilized Poly carbonate material
29.	Maximum temperature of Heat sink	<70 Deg C
30.	IK protection of Optic Cover	>IK07
31.	Wires used Inside	Cu conductor, low smoke retardant e-

Sr. No.	Parameter	Requirement / Value
	Luminaries	beam cable
32.	Cable gland IP protection	IP 66

3.11. Testing of Luminaire

(a) The Routine test on each of the offered Luminaire shall be carried out by the BIDDER before dispatch. Following tests shall be carried out as routine tests by the BIDDER for the offered Luminaries;

- (i) Visual and Dimensional check
- (ii) Checking of documents of purchase of LED
- (iii) Insulation resistance test
- (iv) HV test
- (v) Reverse polarity

(b) The Acceptance test shall be carried out by PURCHASER or

Purchaser's representative on a sample of the lot offered for Acceptance. The Lot shall be different from the lot from which the Type test samples have been drawn. The cost of the testing shall be borne by the BIDDER. Following tests shall be carried out as Acceptance tests by the BIDDER for the offered Luminaries;

- (i) Visual and Dimensional check
- (ii) Checking of documents of purchase of LED
- (iii) Insulation resistance test
- (iv) HV test
- (v) Over voltage protection
- (vi) Surge protection
- (vii) Reverse polarity
- (viii) Lux measurement

(c) Following Type tests reports shall be provided by the BIDDER for the offered Luminaires along with the BID;

- (i) Resistance to humidity
- (ii) Insulation resistance test
- (iii) HV test
- (iv) Over voltage protection
- (v) Surge protection
- (vi) Reverse polarity
- (vii) Temperature rise Test
- (viii) Ra (Colour Rendering Index) measurement test
- (ix) Lux measurement
- (x) Fire retardant Test
- (xi) Test for IP 66 protection
- (xii) Endurance Test,
- (xiii) Life Test
- (xiv) Photometric Measurements Test Report (IES LM 79)

- (xv) LED Lumen Maintenance Test Report (IES LM 80)
- (xvi) Vibration test as per ANSI
- (xvii) Drop Test

3.12. Streetlight Feeder Pillar

- (i) All OFP shall be Wall/ Column/ Steel Support mounting, double door, single front, non-compartmentalised enclosure with locking facilities.
- (ii) The OFP shall be of sheet steel enclosed and shall be fully dust and vermin proof, providing as degree of protection of IP 55 or more with canopy. The sheet steel used shall be cold rolled and 2 mm thick. The gland plate shall be 3mm thick.
- (iii) The fabricated enclosure shall not have any welds or bolt heads apparent from outside. All fabrication work like cutting, drilling, punching, shearing & welding etc. related to the enclosure shall be complete before proceeding to 7 tank process. The fabricated body shall be thoroughly cleaned and treated by chemical agents as required to produce a smooth surface free of scales, grease and rust.
- (iv) Sheet metal components shall be pre-treated using the seven tank phosphating process consisting of de-greasing, acid pickling, de-rusting, phosphating and passivation including repeated rinsing in between each process. On completion of passivation of the components they shall be preheated and then epoxy powder coated with selected shade for exterior as well as interior and Glossy White shade for the gland plates (Inside the panel) and component mounting plate.
- (v) All interiors and exteriors of the enclosure shall be finished and painted to prevent rusting and corrosion. The paint should be carefully selected to withstand tropical heat, rain and environmental effects. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. Thickness of all painting shall be minimum 80 - 100 microns DFT.
- (vi) All the feeder pillars shall be Outdoor type with permanent rain canopy and shall be dust, damp and vermin proof. All the feeder pillars shall be minimum IP55 certified. The gasket shall be of neoprene rubber suitable to withstand all weathers for long tenure of service. All hardware shall be HD Galvanized or stainless steel. Door shall be with concealed type hinges & captive screws.
- (vii) Both the doors shall have an Inspection/ View Window for monitoring the energy meter reading without opening the door. The window on the external door shall be provided with a metal flip cover which can be moved up and down for viewing the meter.
- (viii) Both the doors shall have panel type lock with keys in duplicate as per the requirements of the PURCHASER.
- (ix) All the feeder pillars shall be of uniform height and shall be mounted with the bottom of the panel at 1200mm above the Finished Ground or Floor level as the case may be.

- (x) A danger notice board written in English and Hindi shall be made of 2mm thick GI plate and shall be provided on the front door of the feeder pillar.
- (xi) The details of connected load in KW, service No., Meter No., area in which Street-light poles erected name of the agency and year of erection shall be labelled using radium sticker/radium paint.
- (xii) The enclosures shall be manufactured by hand layup process in approved moulds or any other approved process so as to ensure smooth finish on mould side i.e., on external face and reasonable smooth finish on internal face. There shall be confluency in the product equality and finish on surfaces.
- (xiii) The feeder pillar shall consist of Incoming Four Pole (FP) MCCB, 3 Phase Energy Digital Meter, FP Contactor for each outgoing circuit, Astronomical Timer, Outgoing FP MCB/MCCB apart from all the smart control components like Gateway controller, Power Supply Unit for the Gateway unit, Battery for Back up etc. It shall also consist of FP Isolator for isolating the smart lighting control equipment without discontinuing supply to the light pole during the outage of the smart control system.
- (xiv) The other power and control components are as listed below;
 - a) All the contactors shall have high rupturing capacity rated for 3 phase 440 V, 50 Hz, Four Pole, AC 3 duty.
 - b) Astronomical timer having Single channel and capable of Auto resetting when power resumes, provision of manual over ride, switching ON / OFF the circuit as per the Sun set and Sun rise timings along the year.
 - c) 25X3 Copper bus bar with SMC support insulators shall be provided for power distribution within the feeder pillar. The size of phase and neutral shall be equal.
 - d) Outgoing FP MCB Current-limiting type, Characteristic Curve C, Breaking capacity 10 kA for 1 sec.
 - e) Terminal connectors suitable for terminating the above-mentioned cables. Separate terminals shall be provided for tapping power for the luminaire with 2.5 sq mm Copper conductor PVC insulated Un-armoured cable. Twenty percent spare terminals shall be provided.
 - f) Under voltage and Over voltage Monitoring Relay for connection and disconnection of the power during off band abnormal voltage within a time band.
 - g) All connecting power & control wiring shall be carried out with stranded copper conductor PVC insulated LSHF wires. Minimum size of control wiring shall be 1.5 sq mm and power wiring shall be 4 sq mm.
 - h) Space Heater with MCB and Thermostat and 7W LED Luminaire with lamp shall be provided inside with a door limit switch. The lamp and the heater shall be tapped from the outgoing of the meter with separate DP MCB circuits.
 - i) Earth Leakage circuit breaker conforming to IS-12640/1988 & BS 4293/1983 with latest amendment having sensitivity 110 mA and suitable for 3-phase, 4 pole having characteristic of quick acting & tripping with all advance feature with suitable enclosure box/mounting rail.
 - j) An Aluminum / GI Earth bus shall be run at the bottom of the Feeder Pillar which shall be connected to the earth leads at the two extreme ends for connecting the GI earthing strip from the electrode.

- k) Cast Resin CT of appropriate rating (---/5A) shall be provided at the incomer of each phase for measurement of the current.

3.13. The Data Sheet of the 3 PH Energy Meter Is as Follows;

Sr. No.	Particular	Specifications
1.	Type of Meter/Design designation	AC Static Watt-hour Meter
2.	Standards	IS13779, CBIP-304
3.	Class of Accuracy	Class 1.0
4.	Rated Current	10-60A (10A basic current)
5.	Rated Maximum current as percentage of basic current	600% of Basic Current
6.	Rated voltage (volts)	3 X 240 V Phase to Neutral 3 X 415 V Phase to Phase
7.	Rated frequency (Hz)	50 Hz \pm 3%
8.	Specified operating voltage range	0.8 to 1.1 V ref.
9.	Limit voltage range of operation	0.7 to 1.2 V ref.
10.	Temperature range of operation a) Specified operation range b) Limit range of operation c) Limit range for storage and transport	As per IS13779
11.	Relative humidity a) Annual mean b) For 30 days these days being spread in a natural manner over the years. c) Occasionally on other days	As per IS13779
12.	Power consumption at rated current a. Active b. Apparent	1 W 4VA

Sr. No.	Particular	Specifications
	c. Power consumption	1 VA
13.	Percentage minimum current which shall start the meter and continue to run thereafter at rated voltage and unit power factor of basic current (% of basic current)	0.2% of basic current
14.	Tamper & Fraud Protection details	As per IS 13779

- i. Two nos. Pipe earthing electrode shall be provided for each Feeder pillar and connected with 25X6 mm GI earth strip. The pipe electrode shall be as per the latest version of IS 3043.
- ii. HDPE pipe of suitable for conveniently accommodating the above incoming and outgoing cables shall be laid upto the feeder pillar for carrying the buried cables upto the feeder pillar for termination. The GI strip for earthing shall also be laid through the same pipes.
- iii. The feeder pillar shall be mounted on prefabricated Galvanised Steel Support structure duly fastened with a concrete foundation with M20 concrete.
- iv. All the material/equipment/accessories must confirm to the relevant IS with its latest amendments. All the material/equipment/accessories shall be supplied with manufacturer's test certificates.
- v. Insulation resistance between live parts and earth terminal shall be 5 MΩ minimum. All power equipment shall be able to withstand high voltage (HV) test at 1.5 kV for 1 minute between live parts (current carrying parts) and earth terminal without breakdown of insulation.

3.14. Smart Street Lighting System

Technical Specifications for Smart Street lightController System with communication system.

- (i) Controller and Metering unit
 - (a) Schedule the timing of lights (pre-programmed based on astronomical clock or on field or through central control)
 - (b) ON / OFF Switch (on field or centrally)
- (ii) Capture the energy usage and other parameters at pre-determined interval and store data for 30 days
 - (a) Ability to connect with a communication device
 - (b) Ability to download data in field
 - (c) System protection against surges

(d) Ability to upgrade firmware on field using a communication device

(iii) Enclosure

- (a) Shall be as specified above
- (b) Wiring inside the enclosure box should be done neatly with proper use connectors & numbering with use of Ferrule PVC Tube.

(iv) Communication Module

- (a) Ability to communicate securely with via cellular networks (GSM / GPRS/ Ethernet/City OFC network/LoRA /RF)
- (b) Communication technology between CCMS unit and central server should be 3G hardware device which should be capable to run 2G/3G/4G as per availability in the site.
- (c) Two-way communicator
- (d) Ability to send data regarding energy usage, ON/OFF status etc. from controller
- (e) Ability to give commands from a central level for switching ON/OFF scheduling etc. The software for CCMS UI should have provision for providing dimming in case same is provided in the lights.
- (f) Ability to remotely upgrade the CCMS device firmware from central server

3.15. Street Light Controller

i) Functional Specifications

Sr. No.	Function/Feature	Details
Input / Output		
1	Data	The CCMS unit Should be able to capture (record) and provide following parameters at variable time-intervals <ul style="list-style-type: none"> • Cumulative Active Energy • Average Power Factor • Power on Hours • Monthly Load on/off Controller has the provision to store last 30 days data at one hour interval. All these data is accessible for reading, recording by downloading through HHT (Hand Held Unit) through optical port or USB/Bluetooth given on controller front. For HHT, a smart phone-based solution for collecting /accessing data is also acceptable.
2	RTC	The controller has a built-in calendar & clock, having an Accuracy of +/- 1 minute per year or better, however meter may confirm to accuracy as

Sr. No.	Function/Feature	Details
		per IS 13779. A separate internal Lithium battery back-up is provided for continuous operation of controller RTC for at least two years under controller un-powered conditions.
3	Tampers	Following tampers are logged with occurrence and restoration in FIFO manner : <ul style="list-style-type: none"> • Low Load • Over Load • Low Power Factor • Under Voltage • Over Voltage • Magnet
4	Astronomical Calendar for switching operation	On the basis of latitude and longitude of the installation place controller itself decides switch on off timings.
5	Maintenance Mode of switching	In case of any emergency or for maintenance purpose, switching can be done using keypad - before operation password has to be punched using keypad. For maintenance, the interface for data access should be available.
6	Switch Weld & Switch	When Switch "on" operation failed condition is logged as switch fail event and when Switch "off" operation Fails condition is logged as switch weld event.
	Fail events	
7	Switch on off operation events	Switching events with the following reasons will be logged: Timed operation – As per astronomical calendar Unscheduled operation In maintenance mode Event based like on over current, overload switching Last 20 events will be logged in controller.
8	Power on-off events	Last 20 power on-off events with power off duration will be logged.
9	Separate Energy Consumption registration for unscheduled switch on period	Last 20 events of maintenance mode with snap of energy register and date/time is logged in meter. In BCS, with these events, duration of these events and energy consumption during that period is also shown.
10	Switching on Overload /Over current	Controller will continue monitor over current & overload condition against the threshold defined in controller and if condition persist for predefined time period (default 5 minutes) then disconnection of switch will occurred. Controller will reconnect the switch after some predefined time interval (default 10 minutes) and will check again for the event condition, if condition persist again, switch will disconnected again else will run normally.

Sr. No.	Function/Feature	Details
		In case of disconnection, controller will try for defined trial count (default 5 count) and after that will disconnect the switch for long defined sleep period (default 30 minutes). After sleep period switch reconnect activity will restart in same described manner. Every switching operation will be logged in meter.
11	LED	Flashing RED LED is provided on controller front.
12	Communication	Controller stored data can be downloaded through its optical port or USB using HHT (Hand held Unit) or directly by Laptop using Base computer software. Controller should be able to interface with the communication module through a serial port
13	Surge Protection	Standard CAT B 6000 V protection (IEC 61000-4-5)
14	Programmable Scheduling	The schedule for light operations can be programmed on field or during installation overriding the astro-clock.
15	Operating temperature	0 Deg. C to 70 Deg. C
16	Storage temperature	(-)20 Deg. C to 80 Deg. C
17	Humidity	95% non-condensing

ii) Controller Gateway (Communication Module)

(a) The Controller Gateway shall have power supply of 240V AC. The Communication model of Gateway shall have open protocol and should be suitable for communication with Cloud Serve.

iii) Features:

- (a) Remote ON/OFF in case bad weather, maintenance or emergency
- (b) Remote RTC Synchronization of Street Light Controller
- (c) Communication should be encrypted by 128 bit encryption
- (d) Alert message in pre-defined abnormal system conditions through SMS (5 numbers) and mobile/web based application GSM/GPRS/RF/LORA:
- (e) Phase-wise currents on crossing threshold values*
- (f) Phase-wise voltages on crossing threshold values*
- (g) MCB trips
- (h) Group failure of lights
- (i) No output supply

iv) Web hosting charges consider for 10 year and that will be paid to lighting vendor. Any data as and when required by the Purchaser/Client shall be given by the bidder. The cost for the same shall be borne by the bidder.

v) CCMS will be part of lighting vendor.

vi) Web Application & User Interface Specifications

Control and Monitoring:

- (a) Allows user to communicate with networked switching points.
- (b) Allows user to communicate group street lights under particular gateway.
- (c) The Street Light Status such as ON hours, voltage, current, power, Energy consumed, Intensity and operating Mode (Auto/Manual) shall be monitored.
- (d) Fault Alarms/Alerts Switching - point failures, Network Down failures, Group Luminaires failure, excess voltage/current drawn, no mains power, **Luminaires' failure and contactor failure.**
- (e) GIS Map Allows user to trace switching points through standard maps overlay of status.
- (f) Reports Allows user to generate various reports like energy consumed, failure reports, uptime % etc.
- (g) Web application LICENSE & server support for 10 year WITH hosting on cloud server and integration if required by BSCDCL in control center (Including O&M) shall be carried out by selected BIDDER. Any data as and when required by the Purchaser/Client shall be given by the BIDDER. The cost for the same shall be borne by the BIDDER.
- (h) The cloud hosting service provider shall have minimum Tier 2 certification.
- (i) The BIDDER shall resolve the complaint raise by BSCDCL, in case of minor and major problem associated with Web hosting server / system.
- (j) The BIDDER shall do service level agreement (SLA) with BSCDCL.
- (k) The BSCDCL shall impose penalty in case of non-attendant complaint as per their penalty clause.

3.16. Drawings and Data

All Drawings, data, technical particulars, calculations, detailed literature, catalogues, test certificates etc. shall be submitted along with the bid/ after award of contract as specified in Bid Document.

4.0 SUPPLY OF EARTHING SYSTEM

4.1 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.

4.2 Code & 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.

S r.	Item	Relevant IS / IEC
1	Code of Practice for Earthing	IS 3043
2	Insulation Co-ordination Application Guide	IS 3716
3	Indian Electricity Rules, 1956	
4	Indian Electricity Act, 1910	
5	National Electrical Code	
6	Low Voltage Electrical Installations-Part 5-54: Selection & Erection of Electrical equipment- Earthing arrangement & protective conductors.	IEC 60364
7	Protection Against Lightning –Part 3: Protection of structures & life Hazards	IEC 62305

4.3 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 per site condition.

4.4 Technical Requirements

4.4.1 The earth grid shall consist of main grounding grid conductors forming a closed ring network with required number of Rod 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.

4.4.2 Earthing system should offer a resistance of less than 2 ohms throughout the year. In places where Soil resistivity is more, total length of the earthing rod has to be increased by adding 1m length rods (one over the other) to achieve low and stable resistance value. In rocky places, multiple earth rods have to be installed and inter-connected to get the required value.

Minimum length for each earthing station to be 3 meters.

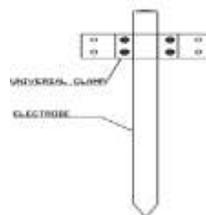
4.4.3 The earth bus in required numbers shall be installed in various plant open areas and rooms. Each earth bus shall be provided two distinct connections by GI/Cu flats / Cu. Flexible cable from the main grounding grid conductors available nearby. The plant/building equipment, metallic structures, tanks, etc. shall be brought to earth by providing two distinct connections between earth bus installed nearby and that equipments, tank, apparatus, etc.

4.4.4 Solid Copper coated rods are recommended as earth electrode than a pipe due to the fact that solid rods have much longer life and can be easily driven by electric/hydraulic hammers. Copper has much longer life than all other materials as explained in IS 3043.

4.4.5 General Construction Details

A. Pipe Electrode Earth station

1. Copper coated Solid steel Rods shall be made of high tensile low carbon steel rod, molecularly bonded with 99.9% electrolytic copper with minimum coating thickness of 250 microns as per IEC 62561 part -2: Requirement for Conductor & Earth Electrodes.
2. The length of the earth rod shall be 1 meter at least or as per manufacturer's recommendation, so that driving into the ground is easier. For dry areas, length of the rods can go up to several meters by driving the rods one over the other.
3. For all the installation minimum length of the earthing rods shall be 3 mts minimum by adding similar rods.
4. Earth rods should be of diameter 20 mm minimum. Additional rods should be added without external couplers. The earth rods should have peg & bore arrangement or similar such arrangement so that additional rods are added without external couplers.
5. Interconnecting Strips / Earthing Conductor: Copper coated steel strips / tapes should be used to interconnect different earthing rods as well as horizontal earthing (Ring earthing). These strips should have a coating thickness of minimum 70 microns.
6. The earth resistance shall be maintained with a suitable soil treatment.
7. The earth lead shall be fixed to the pipe with a nut and safety set screws. The clamp shall be permanently accessible
8. Connectors/fasteners for connecting Electrode with Earthing conductor/strip should be of Stainless Steel as it is compatible with all other materials viz Copper, GI etc. Fasteners should be made of Stainless steel



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.

10. Inspection Chamber :

Should have an inner dimension of 250 mm X 250 mm X 250 mm made of FRP material. Flush Mounted, removable cover of the earth pit should be able to withstand moderate loads.

The area inside the inspection chamber should be such that, the UNIVERSAL CLAMP/EBB/Bus bars not too deep inside the inspection chamber or projecting out of inspection chamber.

The chamber should have facility for marking earth resistance and latest testing date by paint at the cover and previous recorded values inside the cover.

If the earthing is shown in road ways subject to vehicular movement, the Inspection Chamber to be of Cast Iron Type to absorb the vehicular loads without any deformation / damage.

11. Earth Enhancement material:

This is a conductive mineral compound to provide low resistance to the earth termination system. Earth enhancing compound should contain minerals which in normal use is reliable and without creating any hazards to persons and the surroundings.

The material shall be chemically inert to sub soil and shall not pollute the environment. It shall provide a stable environment in terms of physical and chemical properties and exhibit low resistivity. It shall not be corrosive to the earth electrode itself. The material should have low resistivity less than 50 Ohm meter

B. G.I. Pipe Earth Station

Electrodes shall be made of G.I. pipe of internal diameter of 100 mm dia. The pipe electrode shall be as far as practicable embedded below permanent moisture level. The length of the pipe electrode shall not be less than 3 m. except where rock is encountered, pipes shall be driven to a depth of at least 2.5 mtr. Where rock is encountered at a depth of less than 2.5 mtr. The electrode may be buried inclined to the vertical and the inclinations not more than 30o C from the vertical. The pipe electrode shall be made of one piece. Earth leads to the electrode shall be laid in a heavy duty GI pipe and connected to the pipe electrode with brass bolts, nuts and washers. GI pipe shall be terminated in a wire meshed funnel. The funnel shall be enclosed in a masonry chamber of 450mm x 450mm dimensions. The chamber shall be provided with C.I. frame and CI inspection cover. The earth station shall also be provided with a suitable permanent identifications label tag. The earth electrode shall conform to IS: 3043 latest edition. The soil around the earthing electrode shall be treated to reduce the resistivity of the soil by filling the complete depth of electrode with alternative layers of charcoal and salt.

C. Plate Earth Station

Plate electrodes shall be made of copper (CU) plate of 3 mm thick and 600 x 600mm size. The plate shall be buried vertically in ground at a depth of not less

than 2.5 meters to the top of the plate, the plate being encased in charcoal to a thickness of 300mm all round. It is preferable to bury the electrode to a depth where subsoil water is present. Earth leads to the electrode shall be laid in a heavy duty GI pipe and connected to the plate electrode with brass bolts, nuts and washers. A GI pipe of not less than 19 mm dia shall be clamped with bolts vertically to the plate and terminated in a wire meshed funnel. The funnel shall be enclosed in a masonry chamber of 450mm x 450mm dimensions. The chamber shall be provided with GI frame and CI inspection cover. The earth station shall also be provided with a suitable permanent identifications label tag. The earth electrode shall conform to IS: 3043.

4.4.6 Earthing Conductors

All earthing conductors of Transformers / DG neutral shall be of high conductivity copper and shall be protected against mechanical damage and corrosion. The connection of earth electrodes shall be strong secure and sound and shall be easily accessible. The earth conductors shall be rigidly fixed to the walls, cable trenches, cable tunnel, conduits and cables by using suitable clamps.

Main earth bus shall be taken from the main medium voltage panel to the earth electrodes. The number of electrodes required shall be arrived at taking into consideration the anticipated fault on the medium voltage network.

Earthing conductors for equipment shall be run from the exposed metal surface of the equipment and connected to a suitable point on the sub main or main earthing bus. All switch boards, distribution boards and isolators disconnect switches shall be connected to the earth, bus. Earthing conductors shall be terminated at the equipment using suitable lugs, bolts, washers and nuts.

All conduits cable armouring etc. shall be connected to the earth all along their run by earthing conductors of suitable cross sectional area. The electrical resistance of earthing conductors shall be low enough to permit the passage of fault current necessary to operate a fuse/protective device or a circuit breaker and shall not exceed 1Ω .

4.4.7 LOCATION OF EARTH ELECTRODE

- The following guidelines shall be followed for locating the earth electrodes
- An earth electrode shall not be situated less than 3 meters from any building. The excavations for electrode shall not affect the column footings or foundations of the buildings. Entrances, pavements and road ways shall not be used for locating the earth electrode. In such cases electrode may be further away from the building.
 - Earth mat locations – Earth mats shall be constructed at a suitable place in the station area as near to ASS as possible.
 - The location of the earth electrode / mats shall be such where the soil has reasonable chance of remaining moist, as far as possible.

4.4.8 METHOD OF INSTALLING WATERING ARRANGEMENT

In the case of plate earth electrode, a watering pipe of 50mm diameter of B class GI Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel

attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300 mm. A cast iron/MS frame with cover having identity mode "EARTH" and having locking arrangement shall be suitably embedded in the masonry enclosure.

4.4.9 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.

4.4.10 Electrical and Performance Requirements

A. 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. Nonmetallic 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

4.5 Drawings & Information

As per tender drawing

4.6 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

4.7 Method of Measurement

Provision of earthing station complete with excavation, electrode, watering pipe, soil treatment, chamber with 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 / wiring 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

4.8 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.

4.9 Guarantee & Warranty

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.

4.10 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.

All other items required for installation shall be as approved by site in-charge.

4.11 Installation of System

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.

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.

The items/quantities shall be measured and paid upon completion of the linked milestone as per schedule/ BOQ for the respective item.

5.0 MAKE OF MATERIAL ELECTRICAL

SR. NO.	ITEM	STANDARD MAKE
1	DRY and Oil TYPE TRANSFORMER	ABB / SCHNEIDER/ VOLTAMP / SUDHIR / KIRLOSKAR/ POWERLITE / CROMPTON/SIEMENS/ RAYCHEM
1A	Unitized Compact	ABB/ C&S/ SCHNEIDER /VOLTAMP/ SUDHIR /

SR. NO.	ITEM	STANDARD MAKE
	substation	KIRLOSKAR/ SIEMENS
1B	HT ring main Unit (RMU)	SIEMENS / SCHNEIDER / ABB/ C&S/ GE/ STELMEC/KIRLOSKAR
2	LT PANELS ENCLOSURE	LEGRAND / SCHNEIDER / SIEMENS / L&T / ABB / RITTAL / C&S / CPRI APPROVED
3	DISTRIBUTION BOARDS	LEGRAND - EKINOXE / SCHNEIDER - ACTI9 / SIEMENS / HAGER L&T / ABB / C&S / HAVELLS
4	MEDIUM VOLTAGE CABLE	FINOLEX / RAVIN / POLYCAB / RR KABEL / GEMSCAB / AVOCAB / KEI
5	CABLE TRAY (LADDER TYPE / PERFORATED)	OBO BETTERMANN / LEGRAND / INDIANA / PROFAB/ LOCAL FABRICATORS/ BHARATI/SLOTCO/ STEELWAYS / RICO / MEM
6	UPS	EMERSON/ABB/ RIELLO POWER/ NUMERIC / EATON/ APC/CONSUL NEOWATT/SOCOMEK
7	SPD (SURGE ARRESTER)	PHEONIX CONTACT / OBO / LEGRAND / SCHNEIDER
8	LT SWITCHGEAR (ACB)	LEGRAND – DMX3 WITH MP4 RELEASE / SCHNIEDER – NW MASTERPACT 6P RELEASE/ SIEMENS – 3WL WITH ETU-45B RELEASE / L&T U-POWER MTX 3.5EC RELEASE / ABB EMAX PR123 RELEASE / MITSUBISHI/ GE C&S / EATON / OTHER LOWER RANGE MENTIONED AS ABOVE
9	LT SWITCHGEAR (MCCB)	LEGRAND – DPX3 / SCHNIEDER - NSX / SIEMENS – 3VA / L&T - DSIGN / ABB – TMAX / MITSUBISHI/ GE C&S / EATON / OTHER LOWER RANGE MENTIONED AS ABOVE.
10	LT SWITCHGEAR (MCB)	LEGRAND - DX3 / SCHNIEDER – ACTI 9 / SIEMENS - 5SL(10kA) / L&T-AU / ABB - S800 / MITSUBISHI/ GE C&S / EATON / OTHER LOWER RANGE MENTIONED AS ABOVE.
11	LT SWITCHGEAR (CONTACTOR, RELAY, MPCB)	LEGRAND - DTX3/MPX3/RTX3 / SCHNEIDER / SIEMENS / L&T / ABB / MITSUBISHI C&S / EATON / OTHER LOWER RANGE MENTIONED AS ABOVE.
12	BUSBAR TRUNKING	LEGRAND / SCHNEIDER / C & S / SIEMENS / L & T/ GODREJ/GE
13	METERS (ANALOG)	MECO / RISAHBH / NIPPEN / CONSERVE /

SR. NO.	ITEM	STANDARD MAKE
		AE/SECURE/ ELMEASURE/ CRYSTAL/ NAPTUNE
14	METERS (DIGITAL)	AE / SCHNEIDER / NIPPEN / CONSERVE / L&T/SECURE/ ELMEASURE/ CRYSTAL/ NAPTUNE
15	ENERGY METER	SCHNEIDER / L&T / NIPPEN / HPL / SOCOMEC/SECURE/ ELMEASURE/ CRYSTAL/ NAPTUNE
16	LOAD MANAGER	SCHNEIDER / NIPPEN/ L & T / HPL / SOCOMEC/SECURE/ ELMEASURE/ CRYSTAL/ NAPTUNE
17	INDICATING LAMPS	SCHNEIDER / L & T / SALZER/ GE/ ABB/
18	ELECTRIC TIMER	SIEMENS / LEGRAND / L&T / LEGRAND / MECO/ SIEMENS/ BCH
19	ROTARY SWITCH	SIEMENS / KEYCEE / SALZER / MECO
20	PUSH BUTTON AND PUSH BUTTON SET	SIEMENS / SCHNEIDER ELECTRIC / L & T / LEGRAND / C&S / ABB/ GE
21	SELECTOR SWITCH	KEYCEE / SALZER / MECO/ SIEMENS/ L&T/ SCHNEIDER/ ABB
22	APFC RELAY	ENERCON / L & T / TRINITY / BELUK/ DUCATI/ SIEMENS/ EPCOS/ ABB/ SCHNEIDER
23	LT CAPACITORS	L & T / EPCOS / LEGRAND / SCHNEIDER SUBODHAN / VISHAY / SHREEM / PMX/ DUCATI/ EPCOS/ ABB/ SCHNEIDER
24	LUGS	DOWELL'S / 3D / HEX JAINSON / COMET / HMI/ CCI/
25	BIMETALLIC LUGS	DOWELL'S / 3D / HEX JAINSON / COMET / HMI/ CCI/
26	CABLE GLAND	3D / COMET / HMI/ GRIPPWELL/ DOWELS
27	PVC CONDUITS AND ACCESSORIES	PRECISION / DIAMOND / ASTRAL / NIHIR / POLYCAB/ ANCHOR BY PANASONIC/ AKG/ BEC/ FINOLEX/ ATUL/ NELCO
28	M.S. CONDUIT AND ACCESSORIES	AKG / BEC / STEELCRAFT/ ANCHOR BY PANASONIC/ FINOLEX/ ATUL/ NELCO
29	MODULAR SWITCHES, SOCKETS & OTHER ACCESSORIES	MK - BLENZE / LEGRAND-ARTEOR / SCHNEDIER-ZENCELO / NORISYS / L&T ANCHOR - WOODS/ HPL - SMART / C&S-PRIMO / HAVELLS - CRABTREE/ ABB/ WIPRO/ SIEMENS/ CLIPSAL & MODEL SHALL BE AS APPROVED AS PER ARCHITECT
30	METAL CLAD SOCKET WITH MCB	LEGRAND / HENSEL / SCHNEIDER / SCAME / SPELSBERG/ HAGER/ L&T/ ABB/ SIEMENS
31	PVC TAPE	STEEL GRIP

SR. NO.	ITEM	STANDARD MAKE
32	PVC JUNCTION BOX	HENSEL / CLIPSAL / SPELSBERG / SCAME / SINTEX
33	WIRES FOR INTERNAL WIRING	FINOLEX / HAVELLS / POLYCAB / RR KABEL / KEI ANCHOR / C&S / HPL / AVOCAB/ RAJNIGANDHA/ UNIVERSAL/ CCI/ NICCO/ SKYTONE/ LAPP/ RPG
34	FLEXIBLE WIRE	FINOLEX / HAVELLS / POLYCAB / RR KABEL / KEI ANCHOR / C&S / HPL / AVOCAB / RAJNIGANDHA/ UNIVERSAL/ CCI/ NICCO/ SKYTONE/
35	SIGNAL CABLE	ENERCON / LAPP INDIA / SYSTEM TEK / CALIPLAST / EMINENT / RAJNIGANDHA
36	MULTICORE FLEXIBLE CABLE	FINOLEX / POLYCAB / HAVELLS / RR KABEL / CALIPLAST / EMINENT / RAJNIGANDHA
37	CONNECTORS (COLOURS AS PER PHASE & NEUTRAL)	WAGO / PHOENIX CONTACT/ CONNECTWELL
38	INDOOR LIGHT FIXTURES	PHILIPS / HAVELLS / CGL /KLITE/SURYA / ANCHOR BY PANASONIC/ SYSKA/ BAJAJ/ & MODEL AS PER APPROVED BY ARCHITECT
39	OUTDOOR DECORATIVE LIGHT LUMINAIRE	PHILIPS / CG / K-LITE/SURYA/ ANCHOR BY PANASONIC/ SYSKA/ SCHREORDER & MODEL AS PER APPROVED BY ARCHITECT
40	CONTROL TRANSFORMER [PT/ CT]	ASHMOR / KAPPA / ELMEX/ AE/ PRECISE/ PRAGATI/ / ECS/ KALPA
41	PAINT	NEROLAC / ASIAN PAINTS/ BERGER/ ICI
42	CEILING FAN / EXHAUST FAN	CROMPTON / BAJAJ / ORIENT / HAVELLS/ ANCHOR BY PANASONIC/ USHA
43	FLOOR TRUNKING	MK / LEGRAND / OBO BETTERMANN/ SCHNEIDER
44	FLOOR JUNCTION BOX	LEGRAND / MK / OBO BETTERMANN/ SCHNEIDER
45	FIRE EXTINGUISHER	FIREX/ MINIMEX / SAFEX / CEASEFIRE
46	CHEMICAL EARTHING	OBO BETTERMANN / ASHLOK / JEF / POWERTRACK
47	CONVECTIONAL LPS	ERICO / OBO / ABB / POWERTRACK / DEHN OR ANY LOCAL SYSTEM/ FURSE
48	UP TO 33 KV VCB	SIEMENS / SCHNEIDER / ABB/ C&S/ GE/ STELMEC/KIRLOSKAR
49	UP TO 33 KV HT CABLE	FINOLEX / RAVIN / POLYCAB / RR KABEL / GEMSCAB / KEI

SR. NO.	ITEM	STANDARD MAKE
50	UP TO 33 KV HT END TERMINATION KIT	RAYCHEM / 3M / RPG
51	DC BATTERY CHARGER	CHHABI / HBL
52	SMF BATTERY	EXCIDE / AMARARAJA / ROCKET / AMARON/ STANDARD/ AMCO/ PRESTOLITE
53	SOLAR PV CELLS	CANADIAN SOLAR / SONALI / ZINCO / WAREE / BOSCH / VIKRAM
54	GRID TIE INVERTER	HITACHI / ABB / BOSCH / TATA / DELTA / SMA
55	DG SET	SUDHIR/SUPERNOVA/MAHINDRA/ JACKSON/ STERLING/ TIL

6.0 TECHNICAL SPECIFICATIONS FOR INSTALLATION OF EARTHING SYSTEM

6.1 Scope of Work

This specification intended to cover assembly, installation and testing of earthing system complete in all respect with all equipments, fittings and accessories for efficient and trouble-free operation. The material to be supplied by the Contractor and work to be carried out by the Contractor shall be in general, but not limited to, conforming to the specification laid down for each item.

6.2 Code & Standard

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	

6.3 Material 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.

All other items required for installation shall be as approved by site in-charge.

6.4 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.

6.5 Inspection and Testing

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 1 ohm in each case. In case of more earth resistance, the Contractor shall have to carry out necessary modification in the system without any cost implication to the Client.

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 and report should be submitted in two sets.

The items/quantities shall be measured and paid upon completion of the linked milestone as per schedule/ BOQ for the respective item.