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SCOPE OF WORK

Supply of material as per BOQ & system requirement, Installation/Erection, Testing and commissioning, Execution of work as per approved Design, manufacturing (if any), inspection & testing at manufacturers works in accordance with agreed QAP/technical specification, packaging, delivery to site; handling at site – unloading, storage, shifting from point of unloading to store, storage of material and shifting of material from store to the installation site with in project area, cleaning, assembly, touch up painting; installation/erection at site; inspection & testing and commissioning; and operation, maintenance and performance demonstration for specified time limit for the equipment and systems of LED Smart Street Lighting system with all accessories, mounting arrangement etc. including establishment of Centralized Control and Monitoring System (CCMS) with dedicated or cloud server arrangement for Model Economic Township.

1. Approximate length of road considered in this project is 36.5 km and approximate nos. of light poles and Luminaires expected is 650 & 790 respectively.

2 The smart street lighting system shall include minimum components but not limited to the following as per approved technical specification, design and drawing:-

(a) LED Street Light Luminaire with accessories as required with long time warranty/guaranty.

(b) Octagonal Lighting pole with inbuilt Junction Box, RCC foundation, Mounting Brackets, hard wares, and other accessories.

(c) Connecting flexible wire from junction box to luminaires and connecting power Cabling laid in DWC/ HDPE pipes from source to Feeder Pillar and Feeder Pillar to Lighting Poles.

(d) Earthing system for pole and feeder pillars with accessories and termination.

(e) Smart Outdoor Feeder Pillars (OFP) with Smart Controller for Group Control & individual control for street lighting system having dual channel communication facility.

(f) Excavation of trench or Horizontal Drilling for laying DWC/HDPE pipes.

(g) Establishment of Central Control and Monitoring System (CCMS) with all required equipment & accessories etc., GSM/GPRS/RF/Zigbee/Mesh etc. technology based Communication Infrastructure for communication from Light to Feeder Pillar and Feeder Pillar to CCMS.

(h) Dedicated server establishment/Cloud registration; hosting; subscription of licensed software, uploading and managing all data after Mapping of Feeder Pillars and Light poles as applicable installed by BIDDER . The server services charges and subscription of licensed software shall be valid for a period of Ten years.

(i) All mounting and foundation supports and hardware accessories for equipment/system installations.

(j) All civil works associated with installations of the equipment/systems within BIDDER‟s scope including excavation, concreting, back filling of soil for preparation of equipment foundation, laying of DWC/HDPE pipes either by excavating of through HDD; embedment, chipping, punching, making holes, pipe sleeves, fire/ water proof sealing etc.

(k) Any other Civil/Electrical/Mechanical equipment/ component which are not specifically listed above but are necessary to make the system complete and functional in all respect as per specification and statute.

(l) Three months trial run of street lighting system after completion the work and Six months defect liability period hereafter, including all type of labour and material as required for successful operation of the system for a long time span. Cost towards accomplishing the same shall be included in the BID price and no extra claim shall be entertained later.

(m) The electricity bill charges and data communication charges for the smart street lighting system shall be borne by the METL.

3. Carrying out detailed feasibility survey for identifying the roads; RoW cross sections taking into consideration the carriage way and drains/ foot path on either side at different stretches of a particular road; List out the requirements of particular roads; prospective location for mounting the Feeder pillar as per the offered communication technology and the locations for mounting the poles keeping in view of availability of supply, access and ease of maintenance; measure exact road lengths; identifying any bottlenecks/ obstacle for execution & ease of maintenance of existing or proposed civil/mechanical/electrical infrastructure work like laying of HT/LT cables, Public health work, road work etc. along the entire length of the roads; calculating a detailed BOQ; preparation of detail report incorporating all the above and submission to METL for review and approval as per tender drawing and specification.

4. At the early stage of the project, the BIDDER would be responsible to starts beyond the LT tariff meter provided by DHBVN/UHBVN. The Incoming supply at 11kV or 415 V as decided by METL shall be provided by DHBVN/UHBVN/METL from the nearest source point. Supply & Installation of two pole structure for HT supply including erection of PCC poles, cross arms, Stay arrangement, Gang Operated Device (GOD), Drop Out (DO) Fuse, Lightning Arrestors (LA), Insulators & connecting conductors as required, earthing, Transformer on a two pole structures, outgoing cable from transformer LT side, LT Tariff meter panel and all the required civil works shall be provided by DHBVNL/UHBVNL/METL. However, the entire Liaison with DHBVN/UHBVN for accomplishing the above work shall be carried out by Bidder/Contractor on behalf of METL (if required).

5. Submission of equipment data sheets/ system Design Calculation Sheets, Detail Engineering Drawings, GTP, warranty/guaranty certificate, equipment Sizing Calculations etc. for review and approval by METL before execution/ procurement and manufacturing.

6. Carrying out joint Inspection, Testing, Commissioning and Performance demonstration of the entire street lighting system within the Project area and submission of reports for review & acceptance by METL.

7. Any other equipment which are not specifically listed in this specification but are necessary to make the system complete and functional in all respect as per requirement and statute. All design shall comply with the project requirements as specified.

8. All SAFETY considerations in design and manufacturing for safe operation & maintenance and safe practices during installation at site shall be in the scope of the BIDDER. Cost towards accomplishing the same shall be included in the BID price and no extra claim shall be entertained later.

9. Submission of all "As Built" drawings, Data sheets, Calculations etc. after execution and commissioning of the equipment and systems as specified above.

10. Submission of relevant documents and drawings to the concerned statutory authorities/ agencies and getting clearance and approval for the supplied and installed equipment is solely responsibility of the BIDDER.

11. All Liaison activities for obtaining required mandatory approvals/ NOCs from Electrical Inspector and any other Statutory Authority as applicable for drawings & documents, initiation of works, Load release, charging and commissioning of equipment and system etc. are within the scope of works.

12. Operation and maintenance upto the defect liability period of LED Smart Street Lighting and Centralized Control and Monitoring System including setting up of call centre; maintaining a service team, spare parts and providing service for 24 x 7 as per the Service Level Benchmark specified. The same shall also include the following;

(a) Appropriate up-keeping, maintenance, and operation of all network, hardware, and software components, and ensure smooth functioning of the smart lighting system throughout the entire contract period.

(b)) During the guarantee period, if any hardware or software needs to be replaced, the same will be replaced with same or better OEM and with same or higher configuration free of cost.

13. Maintaining a status Dashboard on the progress of the project and submission of periodic report on weekly basis to METL during execution.

14. Maintaining a status Dashboard regarding the road wise operational status of the Light Poles, No of Complaints, resolution status, Preventive maintenance status and submission of periodic report on weekly basis to METL upto the defect liability period.

15. Managing a control room 24X7 and Monitoring the entire system for all parameters through CCMS and reporting the same appropriately to the concerned Authority

16. All Liaison activities with DHBVN/UHBVN and other Statutory Authorities for coordinating and seeking required permissions for carrying out scheduled works during O&M tenure.

17. Arrangement of training program & workshop at site to METL's staff for operation, maintenance and management training of the smart street lighting system before handed over the work after successful completion of defect liability period/contract period.

18. Any consumable material, Apparatus/tools & tackles, Vehicle etc. shall be the integral part of the work & shall be deemed in the Bidder scope of the work.

19. For Civil /Mechanical works PWD (B&R)/CPWD/ METL's relevant specification shall be used for the street lighting works.

Technical Specification-1

GSM/GPRS/PLC BASED SMART STREET LIGHT CONTROL & MANAGEMENT SYSTEM WITH INTEGRATED METERING

1. Scope:

The objective of the inquiry is to propose the Streetlight Control System with GSM/GPRS/PLC Interface with the control station with two way communication using latest techniques of wired & wireless communication.

It is not the intent to specify completely herein all the details of the design and construction of material. However the material shall conform in all respects to high standards of engineering, design and workmanship.

The product is aimed at the streetlight metering and control whereby the streetlights are automatically switched ON and OFF at defined instants on each day. This timed control is defined on the basis of the latitude and longitude of the place where the streetlights operate giving a finer control throughout the year.

2. SERVICE CONDITIONS:

The GSM/GPRS/PLC based street light control with integrated metering to be supplied against this specification shall be suitable for satisfactory continuous operation under the following climatic conditions:

i) Peak ambient temperature :	70°C
ii) Minimum Ambient Temperature in shade :	-5°C
iii) Maximum average ambient temp. :	5°C In 24 hours period in shade
iv) Maximum yearly weighted average ambient temperature :	32°C
v) Maximum temperature attainable by an Object exposed to sun :	60°C
vi) Maximum relative humidity :	95 %
vii) Average number of thunder storm days per annum :	40
viii) Average number of rainy days per annum :	120
ix) Average annual rainfall :	900 mm
x) Number of months of tropical monsoon conditions :	4 Months
xi) Maximum wind pressure :	195 kg/m²
xii) Altitudes :	Not exceeding 1000 mtrs.

The equipment shall be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth.

3. System Requirement

Operational features

The system should have following operational features:

- The complete system configuration, monitoring, control and management **shall be** achieved remotely through dual channel communication i.e. wireless communication and wired communication (optical fiber networking with Ethernet technology). The system shall be enabled with GPRS/GSM (wireless communication) via cellular network as well as wired communication (through optical fiber networking with Ethernet technology) to communicate between switching point controller (Smart intelligent street lighting control Panel) & dedicated Server/Cloud Server for Group Control of Street lights.

- The system shall have the facility of Individual/Group control of street lights via Power line carrier communication (PLCC) , RF Communication (Zigbee/Mesh technology) and GSM/GPRS communication between dedicated Server/Cloud server to Individual light point or Switching point controller to Individual light point.

- However, Wireless communication via cellular network (through GPRS/GSM) is preferred **as a primary source** to communicate between switching point controller (Smart intelligent street lighting control Panel) & Server/Cloud Server.

- Switching of 10-15 kW continuous load consisting of LED Street Lights & LED flood Lights.

- It should be possible to switch ON or OFF the Switch by sending an SMS message from a Mobile Phone, whose no. is authorized by the system or from a remote station.

- The system should send the message back to the Staff Mobile phone and the Central station.

- The system should have a provision for remote and local operation with a selector switch. The remote & Local (Bypass) mode shall also be selected through CCMS.

- In case of MCCB trip or contactor coil failure, the system should generate a message with clear text to the staff Mobile phone and Central station.

- The system shall communicate with the Energy Meter installed in the panel and collect important parameters i. e., 3 phases Voltages and Currents, KWH, Power Factor.

- It should be possible to set a base current from remote (by SMS). Any deviation beyond predefined percentage should be reported as an exception along with snap shop of line parameters to the Staff Mobile phone and Central station by SMS with absolute value of the deviated parameter. The Voltage and Power Factor limits shall be fixed as per the DISCOM's standards and should generate a message in case of an event.

- The system shall have an in-built Real Time Clock (RTC) with crystal-based backed up with resolution of 1 second.

- The system should be able to switch ON or OFF the lights at predefined time stored in the controller .
- The time schedule of the ON/OFF Operation should be modifiable from remote by SMS.
- It should be possible to modify/change the authorized mobile phone no. of the staff from Central station (CCMS) by SMS .
- The system should generate SMS message with embedded Current (each phase) & KWH reading on request from Central station (incoming SMS).
- Uninterrupted operation, even during single phasing.
- Shall able to calculate LED Luminaires Glowing Hours.
- Able to calculate number of hours mains supply not available.
- The system should generate an event message, in case it loses communication with the Energy Meter (for whatsoever reason) and generate an SMS to the Staff Mobile phone and Central station.
- After a Power Supply loss, the system should generate a message for time of loss and resumption of supply, as soon as the power supply is resumed.
- The system shall send all the messages to a short code to any mobile no. directly. This will be applicable for all the messages including
- The communication of the control station shall be on a DSL/Leased line from the service provider's SMS database.
- There will be a dedicated URL (Uniform Resource Locator) which should be accessible from Internet on a browser, which shall list all the messages exchanged through the 3 digit short code.
- The system shall be able to run in power saving mode i.e. if there is phase wise wiring of lamps provided in such cases phase wise ON/OFF is required in late night hours as power saving mode. The device should be able to switch off one or two phases in power saving mode and shall be able to rotate after fixed duration.
- The device shall be having LT capacitors as per the street light load for reactive compensation based on the required power factor correction (if required).
- Meter with maximum 60A rating (Internal switches) and having a built in control circuit device to make light ON/OFF at predefined time and as per the latitude and longitude of the

place of installation, shall also be acceptable. Such type of meters shall be supplied by the bidder. The salient features of these meters shall be as under:

• The system should be compatible to Discom's /METL's billing software.

SALIENT FEATURES OF ENERGY METER

a. Applicable Standards:

The energy meters shall comply against this tender shall conform to the standards mentioned below:

IS 13779	AC Static Watt Hour meters, Class 1.0

The energy meter shall be ISI marked.

b. Accuracy :

The electricity energy meter shall be of class 1.0 accuracy in line with IS 13779.

c. Ratings:

i) Type

The offered meters shall be whole current direct connected meters.

ii) Currents

The offered meters shall be three phase
Basic current (Ib) 10A
Maximum rated current (Imax) 60 A (600 % of Ib)

iii)Voltage & Frequency

The standard reference voltage shall be 240 Volts (Variation +20% to -30%) Phase to Neutral, and standard reference frequency shall be 50 Hz (+5%).

d. other features of the meter and switching device

1.0 The energy meter shall have keypad/buttons to select the display parameters and to enable entry of password for forced operation of street light during maintenance and to change the current week timing table.

1.1 Meter shall have proper terminal block to cater 10-60 A of current without burning of Terminal Block. Display of the meters shall be as follows:

1.1.1. Auto Scroll

1.1.1.1. Current Time and date

1.1.1.2. Cumulative kWH energy

1.1.1.3. Average Power Factor

1.1.1.4. Switch On-Off timing

1.1.2. Manual display

1.1.2.1. Display test

1.1.2.2. Meter Number

1.1.2.3. Cumulative kWh energy register

1.1.2.4. Active load

1.1.2.5. Reactive KVAr load

1.1.2.6. Voltage (V1, V2, V3)

1.1.2.7. Line Current (L1, L2, L3)

1.2. There shall be provision to check the state of switch like:

1.2.1. ON (Default ON due to timed control)

1.2.2. OFF (Default ON due to timed control)

1.2.3. ON FC (ON due to forced control)

1.2.4. OFF FC (OFF due to forced control)

1.2.5. OFF OL (OFF due to overload)

1.2.6. OFF OC (OFF due to over-current)

1.3. The system shall monitor the switch state on continuous basis, if the switch is found welded or there is failure the switch status shall then accordingly be displayed.

1.4. Time of next on / off operation of the switch should be available on display by selection using proper key.

1.5. It shall be possible to define a band of KW loads for operation in form of a KW high limit and a KW low limit, beyond the defined limit the meter shall send an SMS to designated phone number.

1.6. If the Present load in meter is within the load limit the meter shall display "OK" status, this shall be available for each phase.

1.7. Switch ON/OFF hours shall be available on display for each phase.

1.8. The following activities shall be possible in an authenticated way

1.8.1. Change in the current time table

1.8.2. Forced operation of switch for maintenance

1.8.3. Change in High and low load limits

1.8.4. Change in overload limit

1.8.5. Change in over current limit

1.9. The following information shall be available in the meter on display:

1.9.1. Number of times switch ON / OFF in each phase

1.9.2. Number of times overload occurred in each phase

1.9.3. Number of times over-current occurred in each phase

2. Output Device

2.1. The energy meter shall have a bright red colour LED as kWh test output accessible from the front and capable of being monitored by suitable testing equipment.

2.2. Calibration: -The energy meters shall only be factory calibrated and no modification of calibration shall be possible at the site by any means. It shall however be possible to check the accuracy in the field by means of test outputs.

3. Marking of Meters

The following marking shall be provided on nameplates:

- Manufacturers Name

- P.O Details
- "Property of DISCOM/METL"
- Serial Number
- Calibration LED pulse rate
- Voltage, Current, Frequency
- Class of Accuracy

4. Operation feature support

4.1 Switch control

The meter shall have individual switch corresponding to each phase which shall be individually / collectively controlled by the following control methods:

4.2 Timed Switch control

The energy meter shall hold 52 tables of time on / off corresponding to 52 weeks of a year.

The timing shall be configured using the latitude and longitude of the location of the city. We shall provide the latitude and longitude at the time of order.

It shall be possible to change the current week table using a Computer software/SMS (Short Message service) or through meter keypad.

The meter shall have provision to define a set of auxiliary time table, which shall provide additional switching period within a defined time in the tables defined above.

For example if in the main table the switch on time in table 1 is 6:30 pm and off time is 6:00 am. It shall be possible to define a set of time as 11:00 pm to 6:00 am during which power will not be available to the street light.

4.3 Event based switch control

Each of the individual phase switches shall be disconnected on the detection of following events on that phase:

- Over Load
- Over Current

Once a switch disconnects for any of the above event occurrences, it shall get automatically closed after a define interval of time.

4.4 Forced switch operations

The street light shall be forcefully operated at any time in a day for maintenance purpose. The switches can be operated individually/collectively into ON/OFF state overriding the current state of the switch defined by any other control. A third control shall be provided in the form of cancellation of any existing forced on/off control on a switch.

The forced switch control can be exercised by following methods:

a. Through meter keypad using password.
b. Through a SMS from remote station.

4.5 Billing Energy

The meter shall display last 12 months kWh consumption. These should also be available in the memory for downloading.

4.6 Load Survey

The load survey of following parameters for 60 minutes integration period for at least 30 days shall be provided:

- Average Demand
- Average Power factor

5. Hardware

The system shall consist of a control panel with:

i) 4 pole MCCB suitable for Positive Isolation with a Trip Contact

ii) 3 Pole Contactor with Aux Contact and 220 V AC Coil

The three pole contactor shall be used as single pole by shorting the three terminals. In total we use 3 contactors to meet the individual phase operation requirement.

iii) Controller with (or as per system requirements)

a) CPU with DI-09, DO-07
b) RTC
c) 24 V DC Power Supply with battery backup
d) 1 x RS 485 Port (Modbus) for communication with Energy Meter
e) 1 x RS 232 Port for communication with GSM Modem

iv) GSM Modem .

v) Energy Meter with built in controller can be used in case PLC controller is not used.

vi) Aux relay for interposing the command to contactor from Controller .

vii) Class 0.5 or 1.0 Cast resin CTs for connecting the Energy meter.

viii) Isolation Transformer (415 V AC / 200 V AC) for control supply.

ix) 2P MCB for control supply.

6. Panel Enclosure

i) The panel shall be outdoor type, Floor mounting cubicle type with four supports frame structure.
ii) CRCA Sheet steel thickness for complete enclosure to be 2 mm.
iii) Cable entry will be from bottom with a galvanised gland plate made of 3 mm sheet steel.
iv) 25 x 10 mm Aluminium bus bars for each phase and neutral.
v) Bus bars shall be mounted on heavy duty LT insulators of suitable size.
vi) Control wiring shall be 1.5 sq. mm PVC insulated copper cable.
vii) CT wiring shall be 4 sq. mm PVC insulated copper cable.
viii) All control cables shall be ferruled at both ends as per drawing.
ix) Engraved Legend plates shall be provided for equipment designation.
x) 'Danger' plate shall be provided on the LT compartment.
xi) Panel shall be painted in Siemens Grey Paint.
xii) A transparent Acrylic Sheet Shroud shall be provided in the LT compartment housing MCCB & Contactor and live part.
xiii) FRLS wire shall be used of reputed make.
ix) Copper Braided wire of 4 sqmm shall be used for door earthing.
x) Panel shall have the degree of protection IP65 or better.
xi) Prevent unauthorized physical access to the street light Control panel.

7. MCB

- Should be SI mark as per IS 8828:96 and IEC 898 with short circuit breaking capacity as 10 kA.
- Should be classified as per application. B/C Curve in this case.
- Should be suitable for Isolation.
- Should have positive contact indication.
- Let through energy should be of class 3.
- Should have Low energy watt loss .
- Should offer Protection degree of IP 20.
- Should have grooved tunnel terminal.

- Should have captive screws.
- Should have an endurance of 20, 000 Number of operations when energized.
- Resistance to electrical shocks (or dielectric withstand) should be 2.5 KV.
- Should have line-load reversibility.

8. MCCB

1. General

- The circuit breakers shall comply with IEC60947.2 & IS 13947 part 2.
- The breaking capacity performance certificates shall be available for category A to the above mentioned standards. . The test shall be carried out under the breaking performance during the ultimate breaking capacity (Icu). Certificate for all the sequences (Sequence 1 mandatory) should be available.
- All circuit breakers shall have a rated operational voltage of 600V AC (50/60Hz).
- The rated insulation voltage shall be 600V and 660V at 50/60 Hz. for low breaking capacity and high breaking capacity MCCBs respectively.
- There should be different levels of breaking capacities starting from 10kA upto 50kA for flexibility in selection.
- The breaker shall be maintenance free and fully tropicalized.
- It shall 4 poles (switched neutral).
- Production site organisation shall be certified to comply with ISO 9001 standard.

2. Construction

- Operating mechanism shall be of the quick make quick break type, with the speed of operation independent of the operator, and mechanically trip free from the operating handle so as to prevent the contacts from being held closed against short-circuit and overload conditions. The operating mechanism shall be constructed to operate all poles in a multi-pole breaker simultaneously during opening, closing and tripped conditions.
- It shall not require any external power supply to operate the tripping mechanism.
- The breakers shall be operated by a toggle which shall clearly indicate

the three fundamental positions ON, OFF and TRIPPED.

- If required, the breaker will be equipped with rotary handles.
- The breaking and extinction of the electrical arc shall be achieved by means of non-welding contacts and an arc chute surrounding these contacts.

3. Characteristics

The protection unit shall have Short circuit setting fixed at 10In +/- 20% as specified in IEC 947 and IS 13947 part2.

4. Operation

The electrical and mechanical endurance of the moulded-case circuit breakers should be as defined by IEC 947-2 standard.

The moulded-case circuit breakers shall be equipped with a "push to trip" button in front to test operation and the opening of the poles.

5. Options

- Over voltage, under voltage, shunt trip coils shall be an integral part of the MCCB.
- MCCB shall be equipped with Auxiliary Contacts & Trip Alarm contacts Alarm contacts should be available for remote indication of circuit breaker trip condition and auxiliary contacts are required for status feedback of MCCB.
- Copper spreader & Phase barrier should be provided as a standard feature.

6. Installation

The circuit breaker should provide the flexibility of terminating line and load from any direction. Manufacturers should test the circuit breaker for this condition and requisite test certificate should be available.

9. Contactor

- Should be conforming to IEC 60947-4-1, IS 13947
- No. of Poles – 3
- Insulation Voltage – 690 V
- Impulse withstand voltage (Uimp) – 8 KV
- Insulation – Class ‘F’
- Shock resistance 10/15 gn
- Should pick-up @ 85 – 110% of control voltage

- Should drop @ 30-60% of control voltage
- Operating time – 15 to 35 ms
- Suitable for switching (Very high in-rush type Load considering the Capacitance in luminaire)
- The contactor should be designed and tested for at least 5, 000, 000 mechanical operations & 1, 000,000 electrical operations
- Should be possible to inspect the contact wear and easy contact replacement
- Should have Mechanical ON/OFF indicator
- Should have provision for side mounted aux. contacts

10. GSM Modem

- 900/1800 Dual Band, GSM
- GPRS Class B, Class 2 (28.8 Kbps down load, 14.4 Kbps up load)
- Fully Type approved – R&TTE(Radio & telecommunication terminal equipment)
- CE Approved
- AT Command set (GSM 07.05 and 07.07)
- Suitable for Data, SMS, Voice & Fax
- SIM Tool Kit Class 2
- DTMF(DUAL TIME MULTI FREQUENCY) Function
- Data circuit asynchronous, transparent, non transparent up to 14.4 Kbps
- SMS – Text & PDU, Point to Point (MT/MO), Cell Broadcast
- One user programmable I/O port for connecting external devices
- Input Voltage 5 – 30 V DC
- Current consumption: max. 450 mA (avg.), max. 2.5 A Peak, up to 35 mA in idle mode

- SIM Holder
- SMA Antenna (50 Ohm)
- Temperature - Operation : -15 to +70 deg. C, Storage : -20 to 65 deg. C
- GPS Antenna

11. Controller

- AC Power voltage range from 85 to 264 VAC.
- DC Input voltage (positive or negative logic) operating at 24VDC with a range from 20.4VDC to 28.8VDC
- Relay outputs capable of handling over 2 A of power
- TUV certified product line
- confirming to the following EMC standards
- EN 61131-2, Amendment 1
- (CI 7,8,10,11,12)
- EN 50081-2 ; 1993
- EN 50082-2 ; 1995
- confirming to UL standard of Class 1, division 2, Group A, B, C and D
- Internal EEPROM for program backup
- 1 x RS 485 Modbus Master Port
- 1 x RS 232 Port for Modem
- Insulation resistance.
- Between power and ground terminals: 10 M_ minimum (500 VDC)
- Between I/O and ground terminals: 10 M_ minimum (500 VDC)
- Noise resistance. AC power terminals: 1.5 kV, 50 ns to 1 μs. I/O terminals (coupling clamp): 1.5 kV, 50 ns to 1 μs .

- Provision for Plug in EEPROM for programming and memory extension
- Programmable input filter. Input filter time can be changed during configuration. No filtering or filtering at 3 ms or 12 ms. I/O points are configured in groups
- Storage Temperature of -25 deg. C to + 70 degree C and operating temperature from 0 deg. C to + 55 degree C
- processor with a processing cycle time of 1 ms per 1000 instructions
- IEC1131 compliant supporting ladder, Grafcet, instruction list
- Powerful instruction set including arithmetic, logic, numeric, drum control, automation functional blocks, trigonometric & Boolean
- Scanning: Normal (cyclical) or periodic (constant) (2 to 150 ms)
- Execution time: 0.14 μs to 0.9 μs for a list instruction
- Inbuilt analogue adjustment points accessible from the front panel updated from each scan
- Relative humidity handling from 30-95% without condensation
- Should be able to generate AT Commands for Modem
- Capable of embedding Real-time data into an SMS with Time Stamp
- Programmable in Ladder and Grafset
- Should be able to record the time of the last power loss.
- Shall have the facility to control upto 200 luminaires, Modbus RS 485 interfacing facility, digital input connection for further components (e.g. photo sensor, motion sensor, temperature sensor etc.) for meeting the smart city requirements.

12. Software & Web application a.

Control and Monitoring –

i. Allows user to communicate with individual and networked switching points.

ii. Allows user to communicate with individual and group street lights under particular switching point.

b. Intensity Control/Dimming –The Intensity level (10%-100%) of street Lights shall be controlled instantly/ automatically by adjusting/ pre-programmed intensity level.

c. The Street Light Status such as ON hours, voltage, current, power, Energy consumed, Intensity and operating Mode (Auto/Manual) shall be monitored.

d. Remote configuration – It is possible to configure switching points in auto/ bypass mode through web application. Remote configuration includes new ON/OFF /Dimming timings, RTC time, Real time data of each switching point, Energy meter parameters.

- Energy report shall have following parameters :
- Cumulative Active Energy.
- Average Power Factor
- Power quality parameters (harmonics and transients)
- Phase wise voltage, current ,power factor, VA and kW
- Three phase average voltage, current, power factor, VA and kW.

e. Fault Alarms/Alerts – Switching point failures, Network Down failures, Group Luminaires failure, excess voltage/current drawn, no mains power, Luminaires failure and contactor failure.

f. Google Map/Graphical User Interface – Allows user to trace switching points and associated devices through google maps/GUI. It shall be possible to alert for maintenance activity going to be performed on street light Control panel.

g. It shall be capable to suppress or deactivate alarms during maintenance.

h. It shall be possible to configure different modes of communication for the Streetlight control cabinet for the redundancy of the communication.

i. It Shall provide Reports in form of matrix as well as graphical representation for energy consumption.

j. User shall be able to control, monitor and analyse reports of one or more street light control cabinets together, based on the user defined configuration.

k. It shall be able to display the downtime due to power failure for a particular streetlight cabinet controller.

j. It shall be able to record LED luminaires glowing hours of a particular switching point.

k. Shall be a reputed make with special functions required for the project

l. Should have unlimited tags (as the expected no. of tags are expected to touch 1 lac nos. or more.

m. Should support standard databases such as SQL, Oracle, Access etc.

n. Should be OPC compliant

o. Should have all the possibilities of protocols for future up gradation viz., IEC 60870-5-101/104, DNP3.0 etc

p. Should have feature of creating Web Clients for future viewing.

q. Should have Crystal Reports integrated for report generation

13. REPORTING:-

a. Allows user to generate various reports like energy consumed, failure reports, uptime, own time etc.

b. It shall be possible to create reports, both in html and Excel format.

c. It shall be possible generate an alarm report, filtered on alarm severity, alarm type, alarm state, alarm period, number of user defined groups of streetlight control cabinets.

d. It shall be possible to generate a report on all parameters provided by the energy meter.

e. It shall be possible to generate a burn time report.

f. It shall be possible to create a report, based on modules, light commands, alarm, photocell or light status.

g. It shall be possible to create a lamp surveillance report for critical lamp failure, preventive lamp replacement or failures before burning hours.

h. Energy consumption shall be able to visualize graphically based on hourly, monthly or annually time periods.

i. It shall be possible to generate reports from Historical data available in streetlight control system server for following :-

- Switching operations (scheduled and unscheduled)
- Energy consumptions
- Alarms/ Warning generated.

Details list of MIS reports generated at Central Station

All the reports generated will be Group wise / meter wise / exception category wise and shall be generated for a specified period.

1. No SMS delivery report
   Report of all the control points from where acknowledgement of SMS delivery is not received.

2. Exception reports
   MIS report of all exception reports as stated above will be generated at central station. This report will be in details with values of snapshots at the time of event. Load points wise exception summary and summary wise points.

3. Power failure report

   Report of power failure during a day. Data will be taken from the meter reading.

4. Summary exception report

   Summary of exception report will contain the event summary with no of counts

5. Consumption report
   Consumption report shall be generated for active energy in tabular form for a specific period.

6. Successful SMS delivery report
   Report of successful SMS receipt by meter and confirmation of command execution will be generated at central station.

7. Log of switch ON/OFF commands
   Compete log of switch ON / OFF commands send by central station through SMS will be available at central station date wise for a specific period.

8. Over load / under load
   Exception report generated in which load recorded is above or below a specified load.

9. Power “ON” hours report
   Details of power ON hrs during a period for each control point for a period.

10. Load “ON” hours
    Details of load ON hrs during a period for each control point for a period.

11. Any other necessary reports can be generated using the database and using the database query.

12. The energy parameters shall be directly configurable to the existing DISCOM's/METL's billing S/W using the ASCII format.

The above list of MIS reports are not exhaustive and DISCOM's/METL's may ask the bidder to add on any such reports in future.

14. Dedicated Server/Cloud server Requirement –

a. The server/Cloud platform shall be of dedicated Windows server (IIS) with minimum of 16GB RAM with unlimited bandwidth.

b. Following software shall be installed in server:-

i. ASP.NET4

ii. MySQL Server

iii. MySQL Workbench

c. The dedicated server/Cloud platform should support unlimited storage.

d. Dedicated Server/Cloud platform provider shall have capable to perform auto backup and restore facilities.

e. Dedicated Server/Cloud platform provider shall have regular maintenance of the server and immediately address in case of server down.

f. Dedicated Server/Cloud platform shall have minimum uptime of 99%

g. Dedicated Server/Cloud should able to handle minimum of 5000 concurrent connections.

15. PRE-DESPATCH INSPECTION:

All routine and inspection shall be carried out at the place of manufacturer unless otherwise specially agreed upon by the manufacturer and purchaser at the time of purchases. The manufacturer shall offer the inspector representing the Purchaser all the reasonable facilities, free of charge, for inspection and testing, to satisfy him that the material is being supplied in accordance with this specification. The DHBVN's representative/Engineer attending the above testing will carry out testing and issue test certificate approval to the manufacturer and give clearance for dispatch. Representative of the purchaser may jointly inspect the first lot of devices. A soft copy of routine tests for entire lot of devices shall be submitted for giving dispatch clearance.

16. JOINT INSPECTION AFTER RECEIPT AT STORES: Random Sample Testing

From each lot (lot means the total number of devices received in a Store out of inspected and approved lot by purchaser's representative under one approval letter) of devices received at Stores, 5 sample devices shall be drawn (devices received in damage condition shall not be selected as samples) and these devices will be tested by our Testing Engineer in presence of Supplier's representative jointly routine test as per this specification. The 15 days advance intimation will be given to the supplier and if the supplier fails to attend the joint inspection on the date informed, the testing will be carried out by our Testing Engineer in absence of supplier's representative. If the devices failed in above random sample testing, the lot will be rejected.

17. GUARANTEE:

The street light control device shall be guaranteed for the period of five years from the date of commissioning or five and half years from the date of dispatch whichever is earlier. The devices found defective within the above guarantee period should be replaced / repaired by the supplier free of cost within one month of receipt of intimation.

18. PACKING:

The devices shall be suitably packed in order to avoid damage or disturbance during transit or handling. Each device may be suitably packed in the first instance to prevent ingress of moisture and dust and then placed in a cushioned carton of a suitable material to prevent damage due to hocks during transit. The lid of the carton may be suitably sealed. A suitable number of sealed cartons may be packed in a case of adequate strength with extra cushioning, if considered necessary. The cases may then be properly sealed against accidental opening in transit. The packing cases may be marked to indicate the fragile nature of the contents.

The following information shall be furnished with the consignment:

- Name of the consignee
- Details of consignment
- Destination
- Total weight of consignment
- Sign showing upper/lower side of the crate
- Sign showing fragility of the material
- Handling and unpacking instructions
- Bill of materials indicating contents of each package and spare materials.

19. Quality Control:

The purchaser has a right to send a team of experienced engineers for assessing the capability of the firm for manufacturing of devices as per this specification. The team should be given all assistance and cooperation for inspection and testing at the bidder's Works.. The tenderer has to give all facilities for carrying out the testing of these devices. The team may draw samples from the on line production. These samples will be tested for acceptance and testing will be done as per the specification to which each lot is manufactured. The deviation in technical specification of on line production of devices from DISCOM/METL specification should be tabulated. The method adopted to manufacture the devices as per DISCOM's specification should be explained to the visiting team.

20. Minimum testing Facilities:

The tenderer should have the necessary minimum testing facilities for carrying out the tests as per relevant ISS of the components being used in the commissioning of the street light control devices.

21. Bought out items:

A detailed list of bought out items which are used in the manufacture of the device should be furnished indicating the name of firm from whom these are procured. The bidder shall also give the details of quality assurance procedures followed by him in respect of the bought out items.

22. Name plate and Marking:

Devices shall have a nameplate/sticker clearly visible and effectively secured against damage, indelibly and distinctly marked with all essential particulars as per relevant standards. In addition to the standard the following shall be marked on the name plate:

1) Manufacturer's name '
2) Serial number
3) Month and Year of manufacture
4)"Property of METL"
5) Purchase Order No. & date
6) Guarantee period.
7) The following will be printed in bar code on the modem embossing
8) Manufacturer's code No.
9) Manufacturer's Sr. No.
10) Month/ Year of manufacture.

23. Drawing and Literature:

GSM based street light control device manufacturer shall make available all the necessary dimensional drawing for approval and also make available necessary technical catalogue along with the tender.

24. Schedule of Deviations:

The Bidders shall set out all deviations from this specification, Clause by Clause in this schedule. Unless specifically mentioned in this schedule, the tender shall be deemed to confirm the purchaser's specifications.

25. Test Certificate:

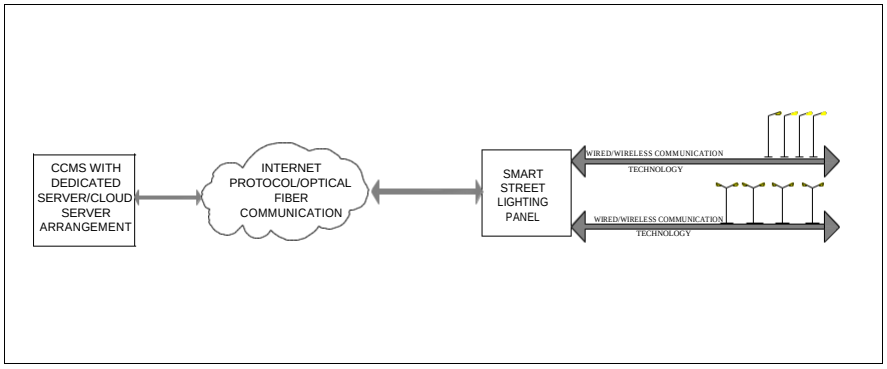
The bidder has to submit the type certificate from Govt. / NABL recognized laboratories at the time of submission of bid. Also a detailed experience list in GSM based street light control device manufacturing process shall also be submitted.

26. SPARES, ACCESSORIES AND TOOLS:

Not Applicable.

27. Guaranteed Technical Particular: To be supplied along with the tender.

28. INDICATIVE SYSTEM ARCHTECTURE FOR SMART STREET LIGHTING SYSTEM



TECHNICAL SPECIFICATION -2

1.1 kV FOUR CORE, THREE & HALF CORE AND TWO CORE XLPE INSULATED & XLPE SHEATHED ARMOURED CABLES

1 SCOPE

To manufacture, testing before dispatch, supply and delivery F.O.R. destination of four core, Three & Half Core, & Twin Core XLPE insulated and XLPE Sheathed Armoured circular cables with aluminum conductor suitable for working voltage up to & including 1100 Volts ISI Marked & Conforming to IS 7098 (Pt-I)/1988 with latest amendments.

2 STANDARDS

Unless otherwise stipulated, the following standards with latest amendments shall be applicable.

1	IS: 7098(Pt-I)/1988	XLPE Insulated (Heavy Duty) Electric cable for working Voltages up to and including 1100 Volts
2	IS: 8130/1984	Conductors for insulated cables.
3	IS: 5831/1984	XLPE insulation and sheath of electric cables.
4	IS: 10810/1984	Method of test for cables.
5	IS: 3975/1979	Galvanized Steel Wire/Strips.
6	IS: 10418/1982	Drums for electric cables.

3 CLIMATIC CONDITIONS:

i)	Location	At various locations in the India
ii)	Max ambient temperature (deg.c) -	50
iii)	Min ambient air temperature (deg. c)	-5
iv)	Max average daily ambient temperature (deg. c)	40
v)	Max. yearly weighed average ambient temperature (deg. C)	32
vi)	Max. altitude above mean sea level (Meters)	1000
vii)	Minimum Relative Humidity (%age)	26
viii)	Max. Relative Humidity (%age)	95
ix)	Avg. no of Rainy days/ year	120

x)	Avg. annual rainfall	900mm
xi)	Maximum wind pressure	195 Kg./mm Sq.

- **Note: Moderately hot & humid tropical climate conductive to rust & fungus growth. The climatic conditions are also prone to wide variations in ambient conditions. Smoke is also present in the atmosphere Heavy lightning also occurs during fume to .**

4 GENERAL REQUIRMENT:

1-The ISI marked XLPE Insulated Armored cables shall conform to IS: 7098(Pt-I)/1988 with latest amendment and bear BIS certification mark. The material used for construction of cables shall be of best qualities complying with the requirement of IS: 7098(Pt-I)/1988 and other relevant standards. The cables shall be suitable for outdoor/indoor installation free in air and shall be capable of withstanding the normal stresses associated with transportation, erection, reeling and unreeling operations without getting deformed.

2 -The cable shall be suitable for use where combination of ambient temperature and temperature rise due to load results in a conductor temperature not exceeding 90 degree C under normal operation and 250 degree C under short circuit condition.

3-The XLPE Insulated Armored LT Cable shall be ISI marked. The tenderer (manufacturer) must furnish valid ISI certificate along with offer. In case the tenderer does not possess ISI license on the date of opening of tender then same shall be furnished before commencement of supplies.

5.0 MATERIAL:

5.1 CONDUCTOR

The conductor shall be composed of aluminum wire complying with IS: 8130/1984 with latest amendments.

5.2 INSULATION

Insulation shall be cross linked Polyethylene (XLPE) conforming to the requirements Table-I of IS: 7098/1984 with latest amendments.

5.3 FILLERS

5.3.1 The filler shall be of vulcanized rubber, un-vulcanized rubber or Thermoplastic material and shall be provided to fill the gaps between cores.

5.3.2 The filler material shall be so chosen so as to be compatible with temperature of the cable and shall have no deleterious effect on other components of the cable. These shall not be harder than XLPE and PVC used for insulation and outer sheath respectively.

5.3.3 The central hole/void, if any, of the cable shall be invariable filled with suitable filler material so that there is no gap in the center.

5.4. ARMOURING

Armouring shall be of galvanized steel strips/wire.

5.5 OUTER SHEATH

The outer sheath shall consist of type ST-2 XLPE Compound conforming to the requirements of IS: 5831/1984.

6 **CONSTRUCTION:**

6.1 CONDUCTOR

The construction of the conductor shall be stranded, as per Clause No. 8.1 of IS:7098 (Pt-I)/1988 & relevant clause of IS:8130/1984.

A protective barrier may be applied between the conductor and insulation. Such barriers when used shall be compatible with insulating material and suitable for the operating temperature of the cable.

6.2 INSULATION :

The conductor (with protective barrier, wherever applied) shall be provided with Cross-Linked Polyethylene (XLPE) insulation applied by extrusion. The insulation shall be so applied that it fits closely on the conductor and it shall be possible to remove it without damage to the conductor. The thickness and tolerance on thickness of insulation shall be as per clause No. 9.2 of IS: 7098 (Pt-I)/1988.

6.3 .CORE IDENTIFICATION:

The core shall be identified by different coloring of XLPE insulation as per Clause No. 10.1 of IS:7098 (Pt-I)/ 1988.

6.4 LAYING UP OF CORES :

The cores shall be laid up together with the suitable right hand lay. The interstices shall be filled with non-hygroscopic material.

6.5 INNER SHEATH (COMMON COVERING):

The laid up cores shall be provided with an inner sheath applied either by extrusion or by wrapping. It shall be ensured that it is as circular as possible. The thickness of inner sheath shall be as given in Table-5 of IS: 7098(Pt-I)/1988.

The inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it without damage to the insulation.

7 **ARMOURING:**

7.1 Application:

Armouring shall be applied over the inner sheath. The armour wires/strips shall be applied as closely as possible. The direction of lay of armour shall be left hand. A Binder Tape may be provided on the armour.

7.2 Type of Armour & Dimension:

The armour shall consist of galvanized steel strips as specified in Table - 6 of IS:7098 (Pt-I)/1988.

7.3 Joints:

The joints in the armour wire / strips shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wire / strips shall be at least 300 mm from the nearest joint in any other armour / wire in the completed cable.

8 OUTER SHEATH

8.1. The outer sheath shall be applied over the armouring.

8.2. The color of the outer sheath shall be black.

8.3. The minimum thickness of XLPE outer sheath shall not fall below the thickness specified in Table -8 of IS: 7098 (Pt-I) /1988.

9 Continuous current rating:

As per Appendix-1

10 Short circuit current rating:

As per Appendix-1

11. TESTS AND TEST CERTIFICATES:

11.1. The cable should meet the requirement of all tests including optional tests as specified at Clause No. 15.4 of IS: 7098 (Pt. I)/ 1988.

11.2. The tenderer shall furnish latest complete type tests and optional test certificates as specified in Clause No. 15.4 of IS: 7098(Pt-I) for all sizes of offered LT XLPE ARMOURED CABLES from NABL accredited testing laboratory or CPRI, Bangalore / CPRI, Bhopal / CPRI, Muradnagar with the tender offer otherwise their offer is likely to be ignored.

11.3. The tenderer must also clearly indicate various testing facilities available at their works for testing the material as per relevant standards. In case of otherwise, particulars of the place where such testing is proposed to be conducted during the course of inspection, shall be indicated with the offer.

12. INSPECTION:

12.1. The inspection may be carried out by the purchaser at any stage of manufacture. The successful tenderer shall grant free access to the purchaser's representatives at a reasonable time when the work is in progress. Inspection and acceptance of any equipment / material under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the

specification and shall not prevent subsequent rejection if the equipment/material is found to be defective.

12.2 The supplier shall keep the purchaser informed in advance about the manufacturing program so that arrangement can be made for inspection.

12.3 The acceptance tests as per IS: 7098(Pt-I)/1988 shall also be conducted by the manufacturer before dispatch in the presence of our Representative / Inspecting Officer as per relevant clause of "General Conditions of Contract" along with verification of lengths & weight and checking the manufacturing defects, if any of samples coils .The mass of aluminum, XLPE, PVC & Filler in sample coils shall also be verified by the Inspecting Officer(s).

Cold bend/ cold impact test (IS: 5831/ 1984) shall constitute the optional tests and shall be conducted on each offered lot of the cables of each size as per Clause No. 15.4 of IS: 7098(Pt-I)/1988.

13 TYPE TESTS:

The first lot offered shall not be less than 10% of ordered quantity of each size of LT XLPE ARMOURED CABLE.

One sample from the 1st Lot of LT XLPE ARMOURED Cable of each size as received in purchaser's store shall be selected and sealed by the inspecting officer nominated by purchaser's for getting it type tested at any CPRI, **Bangalore** / CPRI, **Bhopal** / CPRI, **Muradnagar** /NABL accredited testing laboratory. The charges incurred towards type test of the material received in our stores shall be borne by Supplier. In case sample from first lot fails then:

Supplier shall have to replace the full quantity of the respective inspected lot supplied to various stores and lying unused at stores.

The purchaser reserves the right to insist for witnessing the acceptance /routine tests of the bought out items.

The supplier shall present the latest Calibration Certificate(s) of testing instruments/equipments to be used for the testing of the material covered in the Purchase Order to the authorized inspecting officer /inspecting agency of the purchaser. The testing instruments / meters /apparatus etc. should be got calibrated by the supplier from time to time from an independent testing laboratory / house having valid accreditation from National Accreditation Board for testing and calibrating laboratories for the testing equipment or from original manufacturers having trace ability to NABL/NPL. The calibration certificate(s) should not in any case be older than one year at the time of presenting the same to the inspecting officer / inspecting agency of the purchaser. The

testing instruments / equipment should be duly sealed by the Calibrating Agency and mention thereof shall be indicated in the calibration certificate(s).

14 TEST CHECKING OF MATERIAL:

14.1 SAMPLING:

14.1.1 One number out of each lot / sub-lot of 25 Nos. drums or pert thereof for cables of size 50 Sq. mm. and above.

14.1.2 One number out of each lot / sub – lot of 100 Nos. drums or part thereof for cables of size below 50 Sq. mm.

15 TESTS:

The following tests shall be carried out:

1 Measurement of Resistance of conductor.
2 Tensile & Elongation test for insulation.
3 Thickness of Insulation.

16 CRITERIA FOR ACCEPTANCE:

16.1 If the measured conductor resistance of the sample(s) exceeds beyond 2% as per the resistance specified in the contract, the material shall be rejected and the same shall have to be replaced by the supplier.

16.2 If the measured conductor resistance of the sample(s) exceeds the value specified in the contract but does not exceed by more than 2% of the resistance value specified in the contract, the material pertaining to the relevant lot/ sub-lot to shall be accepted with a deduction @ 1.5% of the cost of cable for increase in resistance for every 1% or part thereof.

16.3 If the sample(s) fails in any other test, the material contained in the pertinent lot/sub-lot shall be rejected and shall have to be replaced by the supplier.

17.TEST CHARGES:

All test charges incurred towards test checking of the material received in our stores shall be borne by the purchaser

18 STANDARD LENGTH:

18.1. The cables shall be supplied in the standard length of 250/500 meters, and tolerance (+/-) 5 % shall be allowed in standard length.

18.2. Only one cable length shall be acceptable by non-standard length measuring not less than 50% of standard length to complete the ordered quantity in each size.

19. QUANTITY TOLERANCES:

The quantity tolerance of (+/-) 2% shall be allowed in each size for completion of supply.

20. **GUARANTEED TECHNICAL PARTICULARS:**

The tendered shall furnish guaranteed technical particulars in the relevant schedule.

21.CONSTRUCTIONAL DRAWINGS:

The tenderer is required to furnish the detailed constructional drawing of the cable clearly showing shape of core, type and size of fillers/ interstices along with centre filler etc. In absence of this the tender is likely to be ignored.

Appendix-1

1100v Two core and Three and half core, XLPE insulated Armoured power cable with aluminium conductor for earthed system:-

1. **<u>Continuous current rating-</u>**

Nominal cross sectional area of conductor (sq mm)	Continuous current rating for Three and half core cables (Amps)		Continuous current rating for Two core cables (Amps)	
	In Ground	In Air	In Ground	In Air
10	-	-	57	53
16	-	-	78	70
25	95	99	-	-
35	116	117	116	117
50	140	140	140	140
95	200	221	200	221
120	225	258	225	258
150	255	294	255	294
185	285	339	285	339
240	325	402	325	402
300	370	461	370	461
400	435	542	435	542
500	481	624	481	624
630	537	723	537	723

Two Core armoured cables- dimensional details as per IS 7098 (Part-1)			
Nominal area of conductor (sq. mm.)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
10	0.70	0.30	1.24
16	0.70	0.30	1.40
35	0.90	0.30	1.40
50	1.00	0.30	1.40
95	1.10	0.40	1.56
120	1.20	0.40	1.56
150	1.40	0.50	1.72
185	1.60	0.50	1.88
240	1.70	0.50	2.04
300	1.80	0.60	2.20
400	2.00	0.70	2.36
500	2.20	0.70	2.68
630	2.40	0.70	2.84

Three and half Core armoured cables- dimensional details as per IS 7098 (Part-1)			
Nominal area of conductor (sq. mm.)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
35	0.9	0.3	1.4
50	1.0	0.3	1.4
95	1.1	0.4	1.6
120	1.2	0.4	1.7
150	1.4	0.5	1.7
185	1.6	0.5	1.9
240	1.7	0.6	2.2
300	1.8	0.6	2.2

400	2.0	0.7	2.5
500	2.2	0.7	2.7
630	2.4	0.7	3.0

Conductor resistance and short circuit current capacity (for 3.5 core)		
Nominal area of conductor (sq. mm.)	Maximum DC resistance at 20° C (Ohms/km)	Short circuit current for conductor (KA/sec)
25	1.20	2.35
35	0.87	3.29
50	0.64	4.70
95	0.32	8.93
120	0.25	11.28
150	0.21	14.10
185	0.16	17.39
240	0.13	22.56
300	0.10	28.20
400	0.78	37.60
500	0.61	47.00
630	0.47	59.22

Technical Specification-3

LED Street Light/Area light Luminaire

The LED Luminaire will meet the following specifications:

1. LED street light luminaire shall be made of pressure die cast aluminium housing with appropriate heat sink fins with corrosion resistant powder coat.

2. Manufacturer shall submit INSITU Thermal report indicating maximum temperature point on LED array. This value shall not exceed junction temperature (Specified in LM 80 report at which life > 50000 hrs)

3. The luminaire shall have UV stabilized Heat resistant clear toughened glass protector with minimum IK07 (impact resistance) rating. However, preference would be given for higher Impact resistance than IK07.

4. Total System Power Consumption should be within the tolerance of ±10% with typical system Light output of >130LPW

Test Certificate from Govt. Approved Lab/NABL accredited Lab/UL to substantiate lumen output as per LM 79 must be furnished for evaluation.

5. The fixture shall have Ingress Protection of IP 66 Rated (Both for Optical & Electrical Compartment). Test Report for the same need to be furnished from any Govt. Approved/NABL accredited Laboratory.

6. Luminaire should consist of Universal Voltage driver to operate wide voltage range from 130V to 280V 50/60Hz application with in built short circuit, over voltage, overload and mis-wiring protection.

7. The fixture shall be designed so as to have lumen maintenance of at least 70% at the end of 50,000 hours with life of 50000 hrs.

8. IES LM-80 report for the LED chip package employed in the proposed luminary product must be submitted.

10. Luminaire shall have side pole mounting option with outer Diameter 50 to 60mm.

11. The luminaire efficiency shall be greater than >100±5% lumen per watt

12. The colour temp of LED shall be 5700K +/- 300K

13. The CRI of LED shall be >70±2 with Warm white/White Light.

14. The LED shall be provided with structured LED array for optimized roadway photometric distribution with photometric lenses designed to optimize application efficiency and minimal glare

14a. Driver compartment to be top maintainable with IP66 level of protection.

15. Driver should have Surge Protection as per IEC 6100-4-5 level-4 of min 5KV and shall have external surge protection device of 10KV built into fixture.

16. The driver shall be 1-10V analog dimmable driver.

17. The driver efficiency shall be >85% & power factor of the electronic driver shall be >0.95 and THD shall be <10%.

18. The driver shall be provided with capability to work within 140-310V AC input.

19. The solder point temperature of the LEDs should be less than 85°C under actual user condition at an ambient of 35°C

20. The luminaire manufacturer shall have full-fledged testing lab with all optical test equipment like Integrated Sphere and Type-C Rotating Mirror Photo Goniometer to test the LED luminaries and the lab shall be government of India accredited.

21. Housing with supplier word mark /name shall be Engraved / Embossing on the die cast housing/ Body part. No sticker will be accepted.

22. PCB shall be MC PCB type of high grade aluminium (AL5052) and should have a thermal conductivity of >1W/mK.

23. The luminaire light shall be constant. The voltage variation / fluctuations in the specified voltage range shall not impinge upon the lumen it produces. Maximum +/- 2% is allowed throughout in the input operating voltage range. Necessary supporting document from Govt. Approved/NABL accredited Laboratory shall be furnished with lumen output for 150V, 180V, 200V, 220V & 240V voltage.

24. The connecting wires used inside the luminaire, shall be low smoke halogen free, fire retardant and MCB protection shall be provided in input side.

25. Type Test Certificate of luminaire from Govt. accredited Test Lab/ERTL/ NABL shall be submitted.

TECHNICAL SPECIFICATION-4

OCTAGONAL STREET LIGHTNG POLES & HIGH MAST POLE

1. SCOPE :

This specification covers the design, manufacture assembly and testing of Octagonal Uniform tapered flanged type poles to be fixed on the foundation bolts with base plate arrangement.

2. SERVICE CONDITIONS:

The material to be supplied against this specification shall be suitable for satisfactory operation under the following climatic Conditions as per IS-2026 (Part-I) latest revision

i)	Location	At various locations
ii)	Max ambient temperature (deg.c) -	60
iii)	Min ambient air temperature (deg. c)	-5
iv)	Max average daily ambient temperature (deg. c)	40
v)	Max. yearly weighed average ambient temperature (deg. C)	32
vi)	Max. altitude above mean sea level (Meters)	1000
vii)	Minimum Relative Humidity (%age)	26
viii)	Max. Relative Humidity (%age)	95
ix)	Avg. no of Rainy days/ year	120
x)	Avg. annual rainfall	900mm
xi)	Maximum wind pressure	195 Kg./mm Sq.

The equipment shall be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth

3. GENERAL STANDARD:

3.1 The Octagonal Poles and bracket shall comply to the requirement of latest Indian Standard.

3.2 The material used shall comply BSEN 10025 with yield strength of 355 MP for Octagonal Pole shaft.

3.3 Hot dip Galvanising shall in accordance with IS 2629 or latest IS specification.

3.4 Steel Tubes used for fabrication of bracket shall comply with IS 1161-1979 (or latest).

4 DESIGN:

4.1 The Octagonal Poles and brackets shall be suitable for use in severe climatic conditions. They shall be designed and fabricated from such material and provided with such finish as to withstand the atmospheric conditions.

4.2 Calculation of wind pressure shall be as per IS 875 part-III

4.3 Deflection: The maximum horizontal deflection of the top point of the Octagonal Poles. When subject to two thirds of the design wind speed shall not exceed 1/40 of the length above the ground & should be as per BSEN 40-3-3:2003.

4.4 Safety Factor which is defined as ratio of yield stress to Allowable stress must be allowed as 1 .25 in the design.

5 MATERIAL:

5.1 The HT steel used by the manufacture of Octagonal Pole shall be as per BSEN 10025 Grade 355 J and the material for the base plate (Fe 410) shall be as per IS 2062., & bracket (as per IS 1161).

5.2 The Steel used shall be weld able, aging resistant and suitable for hot dip galvanizing which should be in accordance to IS 2629 or upgraded IS specification.

6 GALVANISING:

6.1 All components of the pole and brackets shall he hot dip galvanized as per BSEN ISO 1461 after completion of fabrication. No further touching up finalizing or modification shall be done after galvanizing. It is recommended that the overall length of each section bracket is immersed in one dipping operation to ensure smooth and aesthetic finish.

6.2 The galvanizing coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale or blister nor be removable while handling or packing. The average coating thickness of 70 micron.

7 DESIGN RECOMMENDATIONS:

7.1 The Octagonal Pole shall evenly tapered from base to top.

7.2 Octagonal Pole shall preferably be fabricated in one single section.

7.3 There shall be no circumferential well joint in Octagonal Poles.

7.4 Electrodes used shall be compatible with the grade of steel being used and have mechanical properties a lease equal to those of the steel used.

7.5 All welds shall ensure no fissures inside or outside surface, no undercutting on the outside surface, and no blow holes,

7.6 Door Reinforcement must be firm with looking arrangement with LN keys.

7.7 Fixing of poles shall be on foundation bolts with base plate arrangement.

7.8 4 x 25 sq. mm Al cable shall be used for loop in/loop out wiring between street light poles.

7.9 lugs of appropriate size of proper quality suitable for 4x 25 sq. mm cable should be used inside the terminal box.

7.10 Wiring between terminal box and bulb box fitting shall be with 2 nos. copper wire of 3 core 2.5sqmm.

7.11 Terminal box inside the pole shall have locking arrangement with LN keys.

7.12 Octagonal poles shall be in single length of 7/8 mtr as required.

7.13 The single/double arm bracket shall be at an angle of 15 degree.

7.14 Details of the Octagonal pole with dimensions shall be as under:

For 12 mtr long Pole:- 100mm Top dia ,200mm Bottom dia ,320 x 320x 20 mm base Plate

8 M.S. GALVANIZED BRACKET WITH CAP

The brackets shall be made by 50 NB, medium class, 1.5 mt. long pipe,3.25 mm thick have a sleeve with cap & forming an angle of 12 deg. To 15 deg. With horizontal frame. The bracket shall be galvanized with cap.

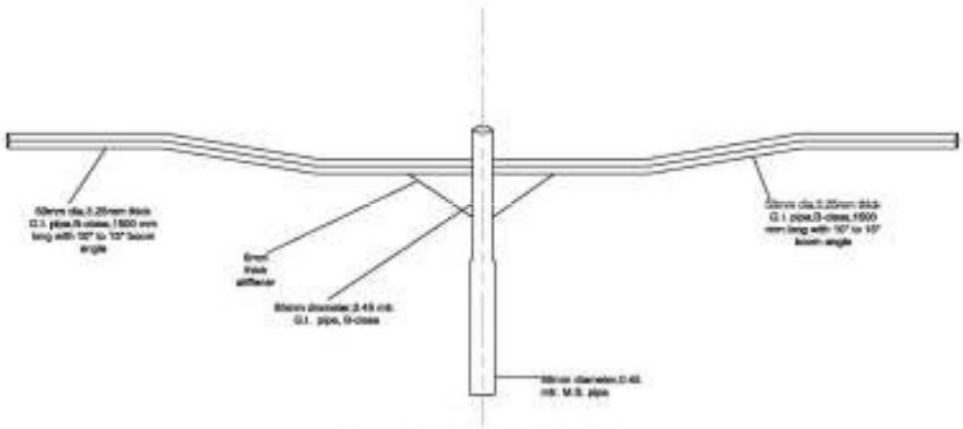


Figure 1- Double arm bracket

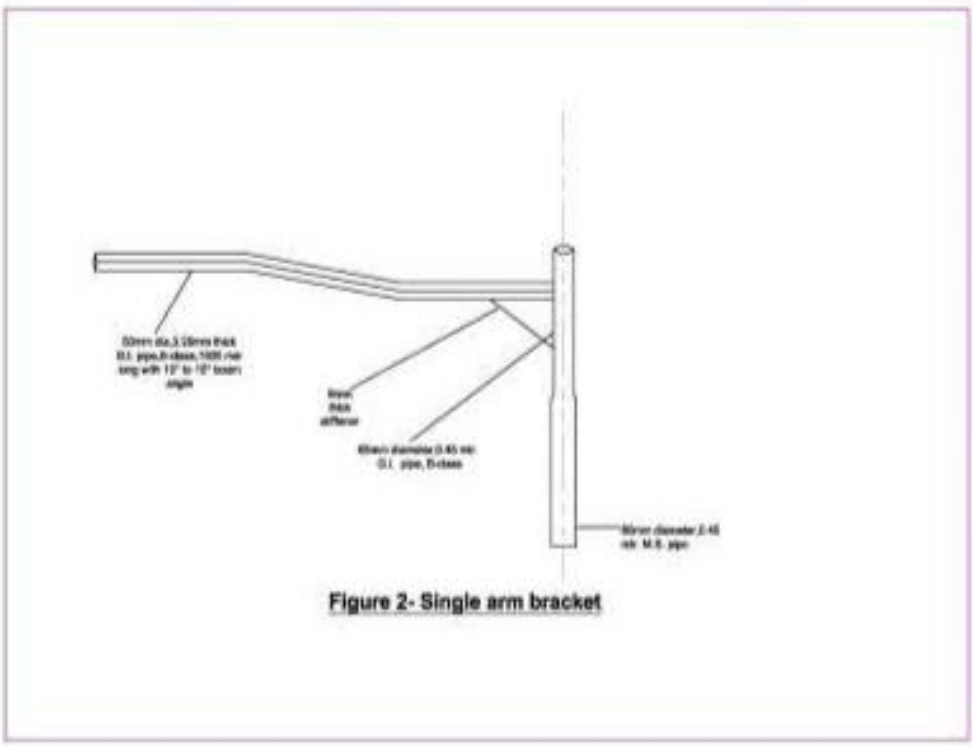


Figure 2- Single arm bracket

9 EARTHING

Appropriate arrangement shall be made for earthing of the poles, fittings and the junction boxes.

The arrangement shall include the following:

The lighting fitting shall be earthed by running two lengths of 6 SWG GI wires along with power cable from the fitting up to the pole/ junction box through inside of the pole and connecting at both ends. The pole/junction box shall be earthed by connecting them to the armour of the connecting cable.

An earth pit shall be provided for every fourth pole conforming to the provision in general technical requirement.

10 INTERNAL WIRING

The internal wiring from the fuse box up to the street lighting fitting shall consist of 3 core 2.5 sq. mm PVC insulated cu conductor cable conforming to IS-694. This cable quantity is included in BOQ. Octagonal poles shall consist of two 6 SWG GI wires & one 6 SWG GI wire shall run along the wire for drawing out and fixing the cable if it becomes defective.

11 TESTS

Following acceptance tests shall be conducted on selected samples of finished poles before providing M.S. decorative brackets as per BS EN 40-3-2-2000 PART 3-2

a) Galvanization thickness test
b) Physical dimensional test
c) Deflection test

12 ERECTION OF POLES

The pole should be erected on the R.C.C.1.1.5:3 for foundation of suitable size for

octagonal Pole as per approved drawing of octagonal pole enclosed including the cost of supply erection of foundation bolts centering, shuttering and de-shuttering etc. complete no extra charges will be paid for hard rock, water logging etc. The bidder should be numbered as per the direction of engineer-in-charge.

13 DESIGN/ ERECTION PHILOSOPHY

The Street lighting shall be planned with high degree of aesthetics with lights on each road. The roads shall be poles on both the sides of the road or on one side, depending upon the road width & architectural plan.

14 Illumination Levels

Main Roads

Illumination level of 50 Lux at 1 M above ground & min. 30-25 Lux at GL shall be adopted for outdoor lighting. However, the requirement of illumination level for roads with high traffic density shall be as per the recommended codes.

Ratio of Min lux level to Average. Lux Level less be maintained greater than 0.3 at 1 meter above ground.

Internal Roads

Illumination level of 30 Lux at 1 M above ground & min. 20-25 Lux at GL shall be adopted for outdoor lighting.

Ratio of Min lux level to Average. Lux Level less be maintained greater than 0.5 at 1 meter above ground.

Park Lighting/ Garden Lighting

Illumination level of 20-15 Lux at ground shall be maintained, if not otherwise specified. Ratio of Min lux level to Average. Lux Level less be maintained greater than 0.75 at ground.

15 Street Lighting Erection Configuration

135 Watts LED fittings have been proposed on 18/15 mts. Wide roads. at a spacing of 32 mts. on 12 mt. high Poles placed on road side.

135 Watts LED fittings have been proposed on 24 mts. Wide roads. at a spacing of 50 mts. on 12 mt. high Poles in staggered manner.

210 Watts LED fittings have been proposed on 30 mts. Wide roads. at a spacing of 40 mts. on 12 mt. high Poles placed on road side.

2x210 Watts LED fittings have been proposed on 36/45 mts. Wide roads. at a spacing of 40 mts. on 12 mt. high Poles placed on central verge.

Phase wise circuits shall be maintained from pole to pole to ensure energy conservation i.e. 1/3rd of illumination can be switched off at a time.

Accordingly 515 nos. 135Watt LED luminaries and 135 nos. 210W LED luminaries have been proposed.

It is further proposed to provide 16 mt. High Mast Lights at 3 no. points and 30 mt High Mast Lights at 2 nos. points.

The lighting pattern shall be approved by METL, The make of Luminaries shall be approved by METL.

In case the required illumination levels are not achieved with the above layout, outdoor lighting shall be provided along the pavements on each side of the road.

All cabling for the street & area lighting shall be underground. Proper pipes shall be provided along each pole at the bottom for incoming & outgoing cables for looping. Wherever required cable crossing shall be done along the roads through RCC Hume pipes. All cable terminations are in the scope of bidder for entire street lighting system.

Each Street light pole & junction box shall be earthed by 6 SWG GI wire run along the cable and pipe type earth pit (station) shall be provided after every fourth pole. 6 SWG wire shall be connected to this earth pit to maintain earth continuity.

HIGH MAST POLES

MAST STRUCTURE :

Good and pleasing appearance which is based on proven in tension design conforming to the Technical report no.7 – 1996 of the Institution of Lighting Engineers, UK to give an assured performance and reliable service. The structure is suitable for loading as per IS 875 (part 3) 1987.

CONSTRUCTION :

High mast is fabricated from steel plates conforming to BSEN 10025, cut and folded to from a polygonal section. Masts are of 16 Mtr. And 30 Mtr. longitudinal weld conforming to BS 5135/AWS. The mast is provided with a fully penetrated flange which is free from any laminations or incursions. The welded connection of the base flange is fully developed to the strength of the entire section. The base flange is provided with supplementary gussets between bolt holes to ensure elimination of helical stress concentration. For environmental protection of the mast, the entire fabricated mast is Hot Dip Galvanized (Single Dip) internally and externally, having uniform coating thickness of 85 / 65 microns for bottom / top sections respectively.

DOOR OPENING:

An adequate door opening is provided at the base of the mast. The opening is such that it permits clear access to equipment's like winch, cable, wire rope, plug & socket etc. and also facilitates easy removal of the winch for servicing. The door opening is complete with a close fitting vandal resistant allen key locking with provision for external lock. The door opening is carefully designed and reinforced with adequate steel section so that the mast section at the base is unaffected, and undue buckling of the cut portion is prevented under heavy wind condition.

DYNAMIC LOADING:

Our mast structure is designed to sustain an assumed maximum reaction arising from wind speed as per IS 875 (Part 3) 1987 (three seconds) which is measured at a height of 10 mtr above ground level. Our standard masts are suitable for a wind speed of 180 Km/hr (50M/Sec) we can also offer masts suitable for a wind speed of 225 Km/hr (62.5 M/sec).

ACCESSORIES:

The high mast is provided with accessories as per customer requirements. Generally these include a raising and lowering system (R & L), trailing cable, power tool, feeder pillar for automatic switching operation of luminaries, lighting finial and aviation obstruction warning light.

The R & L system will comprise of a double drum winch, SS wire ropes, head frame and lantern carriage. The winch is self lubricating and self sustaining type. It does not require any brake or clutch and has a lifting capacity of SWL 750 Kg.

The wire ropes are of stainless steel grade AISI316 with minimum 6mm diameter and 7/19 construction. Its central core is also SS and has a minimum breaking strength of 2350Kg. The power tool is integral / external type suitable for handling the total head load. It has a mechanical torque limiter to ensure safety and also a manual handle is provided. Suitable for use in open areas, airports, railway stations, road junctions, container yards etc.

Max. Design Wind Speed	180 km/hr.	180 km/hr.

HIGH MAST & ACCESSORIES TECHNICAL DETAILS

Nominal height of mast (mtr.)	**16 Mtr. (Cat.Ref.HM-1116 A)**	**30 Mtr. (Cat Ref.HM-1230)**
Material of Construction	**BSEN 10025**	**BSEN 10025**
Normal Thickness	Base Section - 4mm Top Section - 3mm	Base Section - 5mm Middle Section - 4mm Top Section - 4mm
Cross Section of Mast	20 Sided Polygon	20 Sided Polygon
Length of Individual Section(Approx)	Base Section – 8.375 mtr Top Section – 8.375 mtr	Base Section – 10.5 mtr Middle Section – 10.5 mtr Top Section – 10.5 mtr
Base & Top Diameter(Approx.) (Note: No circumferential weld is allowed)	Base Dia- 350 mm Top Dia - 150 mm	Base Dia- 600 mm Top Dia - 150 mm
Size of Base Flange Diameter& Thickness (Approx)	Diameter - 560 mm Thickness - 25 mm	Diameter - 730 mm Thickness – 32 mm

Details of Template	P. C. D. – 4 60 mm	P. C. D. - 730 mm
No. of Foundation Bolt	8Nos.	16 Nos.
No. of Foundation Bolt	8Nos.	16 Nos.

DYNAMIC LOADING

LANTERN CARRIAGE

Diameter of Carriage Ring (mm) Inc. Arms	2400 mm (Approx)	2400 mm (Approx)
Number of Joints	2 Sections	3 Sections
Load Carrying Capacity	Approx 500 kg	Approx 1250 kg
Number of Luminaries	6 to 9 Nos	. 9 to 12 Nos.

\DOUBLE DRUM WINCH

Capacity	750 kg	1500 kg
Method of Operation	Manual / Electrical	Manual / Electrical

STAINLESS STEEL WIRE ROPE

Wire Rope	**Stainless Steel**	**Stainless Steel**
Number of Ropes	2 For winch 3 For Lantern Carriage	2 For winch 3 For Lantern Carriage
Diameter (mm)	6 mm	6 mm
Construction	7/19 with Central Core SS	7/19 with Central Core SS

POWER TOOL

Input Supply	440V 50 HZ	440V 50 HZ
Wattage	1.5 KW	1.5 KW

Reversible	Yes	Yes

TORQUE LIMITER

Type	Mechanical	Mechanical
No. of Luminaries	06 Nos / 09Nos	09 Nos / 24Nos

STANDARD ESSENTIAL ACCESSORIES OFFERED WITH HIGH MASTS:

Mast shaft, head frame with pullies lantern carriage, luminaries mounting arms (6 no), 'u' bolts, lighting finial, stainless steel wire ropes 3 nos. for lantern carriage + 2 no for winch. Transient plate, double drum winch, power tool, winch & power tool mounting bracket, foundation bolts & nuts, anchor & tem – plate top junction box & twin LED type aviation obstruction light.

TECHNICAL SPECIFICATION-5

11 Mt. PCC POLES WITH WORKING LOAD 400 KG. (FOS 2.5)

1 SCOPE -

This specification covers manufacture, assembling and inspection before dispatch at manufacturer's works of PCC poles with an overall length of 11 Mt and working load of 400 Kg. at 0.6 from the top.

2. APPLICABLE STANDARDS –

The poles shall comply with relevant provisions made in the following Indian Standards Specifications:

a) IS - 1678/1960/1978 specifications for pre-stressed concrete poles for overhead power, traction and telecommunication.

b) IS-2905/1966 Methods of test for concrete poles for overhead power and telecommunication lines.

c) IS-7321/1974 code of practice for selection, handling and erection of concrete poles for overhead power and telecommunication lines.

d) IS:1343-1980 code of practice for pre-stressed concrete.

e) IS:456-1978 code of practice for plain and reinforced concrete.

f) IS: 1785 for HT steel wires for pre-stressed concrete.

3. CLIMATIC CONDITIONS – The PCC poles are required to be under the following site conditions –

i)	Location	At various locations in the India
ii)	Max ambient temperature (deg.c) -	60
iii)	Min ambient air temperature (deg. c)	-5
iv)	Max average daily ambient temperature (deg. c)	40
v)	Max. yearly weighed average ambient temperature (deg. C)	32
vi)	Max. altitude above mean sea level (Meters)	1000
vii)	Minimum Relative Humidity (%age)	26
viii)	Max. Relative Humidity (%age)	95

ix)	Avg. no of Rainy days/ year	120
x)	Avg. annual rainfall	900mm
xi)	Maximum wind pressure	195 Kg./mm Sq.

4. TERMINOLOGY –

For the purpose of this standard the following definition shall apply.

4.1 AVERAGE PERMANENT LOAD –

That fraction of the working load which may be considered for long duration over period of one year.

4.2 LOAD FACTOR

The ratio of ultimate transverse load to the transverse load at first crack.

4.3 DIRECTION OF LOAD

The direction of **11.4.3 TRANSVERSE** the line bisecting the angle contained by the conductor at the pole. In the case of straight run this will be normal to the run of the pole.

4.4 TRANSVERSE LOAD AT FIRST CRACK

For design, the transverse load at first crack shall be taken as not less than the value of the working load.

4.5 WORKING LOAD –

The maximum load in the transverse direction, that is ever likely to occur, including the wind pressure on the pole. This load is assumed to be at a point 600 mm below the top with the butt end of the pole planted to the required depth as intended in the design.

4.6 ULTIMATE FAILURE –

The conditions existing when the pole ceases to sustain a load increment owing to either crushing of concrete, or snapping of the pre-stressing tendon of permanent stretching of the steel in any part of the pole.

4.7 ULTIMATE TRANSVERSE LOAD –

The load at which failure occurs, when it is applied at a point 600 mm below the top and perpendicular to the axis of the pole along with the transverse direction with the butt end of the pole planted to the required depth.

5. MATERIALS:-

5.1 CEMENT: - The cement used in the manufacture of pre-stress concrete poles shall be ordinary or rapid hardening Portland cement conforming to IS: 269/1989 (specifications for ordinary and low heat Portland cement) or IS: 8041/1990 (specification for rapid hardening Portland cement).However, evolving of mix design is necessary. However, quality of water used in manufacturing and curing of poles should be got tested from recognized Govt. Lab.

5.2 AGGREGATES:-

Aggregates used for the manufacture of pre-stressed concrete shall confirm to IS: 383/1970 (specification for course and fine aggregate from natural sources for concrete).The nominal max. size of aggregate shall in no case exceed 10 mm.

5.3 WATER:-

Water should be free chlorides, sulphates, other salts and organic matter, potable water will be generally suitable

5.4 ADMIXTURES:-

Admixture should not contain calcium chloride or other chlorides and salts which are likely to promote corrosion of pre-stressing steel.

5.5 PRE-STRESSING STEEL:-

The pre-stressing steel wires, including those used as un-tensioned wires, should conform to IS: 1785/Part-I/1966 (specification for plan hard drawn steel wire for

pre-stressed concrete Part-I cold drawn stress relieved wire (IS : 1785/Part-II) 1967 (specification for plan hard drawn steel wire for pre-stressed concrete Part-II As drawn wire) or IS : 6003/1970(specification for indented wire for pre-stressed concrete).

5.6 CONCRETE MIX:-

The concrete mix shall be designed to the requirements laid down for controlled concrete (also called design mix concrete) in IS: 1343/1960(code of Practice for pre-stressed concrete) and IS: 456/1964 (code of practice for plain and reinforced concrete) subject to the following special conditions:

a) Min. works cube strength at 28 days should be at least 400 Kg/cm.

b) The concrete strength at transfer should be at least 200 Kg. /cm.

c) The mix should contain at least 380 Kg. of cement per cubic meter of concrete.

d) The mix should contain as low water content as is consistent with adequate work ability, if it becomes necessary to add water to increase the work ability, the cement content also should be raised in such a way that the original value of water cement ratio is maintained.

e) Random casting of CC cubes testing from the mix being used by pole manufacturers should be done and it should be got tested from the recognized Govt. Lab. to ascertain a comprehensive strength of the concrete. Concrete cubes should be cured under similar condition as that of poles by placing it on poles.

6. WELDING & LAPPING OF STEEL:-

The high tensile steel wire shall be continuous over the entire length of the pole/tendon. Welding shall not be allowed in any case, however, jointing or coupling may be permitted provided the strength of the joints or coupling is not less than the strengths of each individual wire.

7 **MANUFACTURE:-**

7.1 All pre-stressing wires and reinforcements shall be accurately fixed and maintained in position during manufacture. The un-tensioned reinforcement should be held in position by the use of strips which should go around all the wires.

7.2 All wires shall be accurately stretched with uniform pre-stress in each wire. Each wire or group of wires shall be anchored positively during casting. Care shall be taken to see that the anchorages do not yield before the concrete attains the necessary strength

7.3 COVER:-

The cover concrete measured from the outside of the pre-stressing tendon shall be normally 20 mm.

7.4 CAMPACTING:-

The concrete shall be compacted by spinning, vibrating shocking or other suitable mechanical means. Hand compaction shall not be permitted.

7.5 CURING:-

The concrete shall be covered with a layer of sacking, canvas, hessian or similar absorbent material and kept constantly wet up to the time when the strength of concrete is at least equal to the minimum strength, of concrete is at least actual to the minimum strength, of concrete at transfer of pre-stress, thereafter, the pole may be removed from the mould and watered at intervals to prevent surface cracking of the unit, the interval should depend on the atmospheric humidity and temperature.

7.6 The pre-stressing wires shall be de-tensioned only after the concrete has attained the specified strength at transfer i.e. 200 Kg/cm2. The cubes cast for the purpose of determining the strength at transfer should be cured as for as possible, under conditions similar to those under which the poles are cured. The transfer stage shall be determined based on the daily tests carried out on concrete cubes till the specified strength indicated above is reached. Thereafter the test on concrete shall be carried out as detailed in IS: 1343/1980 (code of practice for pre-stressed concrete). The manufacturer, shall supply when required by the purchaser or his representative, results of compressive test conducted

in accordance with IS: 456/1978 (code of practice for plain and reinforced concrete) on concrete cubes made from the concrete used for the poles. If the purchaser so desires, the manufacturer shall supply cubes for test purposes and such cubes shall be tested in accordance with IS: 456/1964/1978 (code of practice for plan and reinforced concrete). The de-tensioning shall be done by slowly releasing the wires, without imparting shock or sudden load to the poles. The rate of de-tensioning may be controlled by any suitable means either mechanical (screw type) or Hydraulic. The poles shall not be de-tensioned or released by cutting the pre-stressing wires during flames or bar choppers while the wires are still under tension.

8. EARTHING –

Earthing shall be provided

a) By having length of 8 SWG GI wire embedded in concrete during manufacture and the ends of the wires, left projecting from the pole to a length of 175 mm, at 250 mm from top and 450 mm below ground level.

b) By providing two holes of suitable dimensions 250 mm from top and 150 mm below ground level to enable the GI wire to be taken from the top hole to the bottom hole through control hollow.

The earth wire shall not be allowed to come in contact with the pre-stressing wires.

9. TESTS –

9.1 TRANSVERSE STRENGTH TEST –

9.1.1 Poles made from ordinary Portland cement shall be tested only on the completion of 28 days and poles made from rapid hardening cement only on the completion of 14 days after the day of manufacture.

9.1.2 The pole may be tested in either horizontal or vertical position. If tested in horizontal position, provision, shall be made to compensate for the overhanging weight of the pole. For this purpose the overhanging portion of the pole may be, supported on movable trolley or similar device.

9.1.3 The pole shall be rigidly supported at the butt end at a distance equal to the agreed depth of planting i

9.1.4 Load shall be applied at a point 600 mm from the top of the pole and shall be steadily and gradually increased to the design value of the transverse load at the first crack. The deflection at this load shall be measured.

A pre-stressed concrete pole shall be deemed not to have passed the test if visible cracks appear at a stage prior to the application of the designed transverse load for the first crack.

The load shall then be reduced to zero and increased gradually to a load equal to the first crack load plus 10% of the minimum ultimate transverse load and held up for 2 minutes. This procedure shall be repeated until the load reached the value of 80 percent of the minimum ultimate transverse load and thereafter load until failure occurs.

Each time the load is applied, it shall be hold for 2 minutes. The load applied to pre-stressed concrete pole at the point of failure shall be measured to nearest five kg.

The poles shall be deemed not to have passed the test if the observed ultimate transverse load is less than the designed ultimate transverse load.

9.2 MEASUREMENT OF COVER:-

After completion of the transverse strength test, the sample pole shall be taken and checked for cover. The cover of the pole shall be measured at 3 points, one within

1.8 Mtr from the butt end of the pole, the second within 0.6 Mtr. from the top end the third at an intermediate point and the mean value compared with the specified value. The mean value of the measured cover should not differ by more than 1 mm from the specified cover. The individual value should not differ by more than ± 3 mm from the specified value.

If these requirements are not met, the work man ship with reference to aligning of the end plates and pre-stressing wire and assembly of moulds should be improved and inspection production stage tightened suitably.

10. INSPECTION:-

Inspection of material and supervision of tests in accordance with the relevant ISS as mentioned in column 2 above and supporting drg. and schedule and approved manufacturer specification shall be carried out by the purchaser or duly authorized representative. The material shall be inspected and tested before dispatch by an authorized representative in respect of quality.

The purchaser reserves the right to inspect the material and the process at any time and the manufacture shall provide to the Inspecting Officer necessary access and facility without charge to satisfy him that the material is being manufactured in accordance with the specifications.

The purchaser or his authorized representative shall have access at all reasonable time to manufacturer's work to inspect and witness the tests of the material manufactured. The purchaser has the right to have the tests carried out at the cost of supplier by an independent Govt. Agency whenever there is dispute regarding the quality of material supplied.

In order to ensure that the poles are manufactured strictly in accordance with the above specifications, the supplier shall also intimate to the purchaser from time to time its time table for the manufacture of the poles and actual date of commencement of

manufacture of each lot so that the Inspecting Officer can be deputed to check the following during the course of manufacture of poles

a) tensile strength of steel wire.

b) Release of stress from the steel wires after 5 to 8 days depending upon the quality of cement and curing.

c) Method of curing.

d) Quality of aggregate concrete and cement.

e) Water cements ratio and mixing lines.

f) Cube mould testing from concrete mixture to ensure that honey combing is not present in the mixture.

g) Cube mould testing from concrete being used.

h) Use of proper type of vibrators.

The purchaser's authorized representative will supervise the manufacturing of the poles at various stages to ensure that the same are being manufactured in accordance with approved specification and drawings.

11. STACKING: -

The supplier shall stack, the poles in such a way that it is possible for the Inspecting Officer to select and inspect the poles, as he may choose to inspect. All such facilities for taking out the selected poles will be extended by the supplier free of charge.

12. MARKING:-

The poles shall be clearly and indelibly marked with the following particulars during manufacture before testing at a position so as to be easily read after erection position.

a) Date month and year of manufacture.

b) Working load of pole in kg.

c) Maker's Serial No. or mark.

-------and planting depth will hence forth be embossed on each pole.

Firms will give month wise schedule of manufacture against P.O. to facilitate inspection during manufacturing process.

Checking of cover over Out of every 500 poles, one the steel. may be taken for ultimate strength testing, cover checking after crushing and checking of un-tensioned tensioned wire.

13 SCHEDULE OF GUARANTEED AND OTHER TECHNICAL PARTICULARS FOR PCC POLES (TO BE SUBMITTED BY THE TENDERER).

1. Overall length of pole	M.
2. Working load at 0.6 M from top	Kg.
3. Factor of safety	
4. Bottom depth	cm
5. Top depth	cm
6. Breadth	cm
7. No. of tensioned wire per pole	Nos.
8. No. of un-tensioned wire per pole	Nos.
9. Length of each un-tensioned wire	M
10. Concrete quantity	m3 per pole
11. Steel quantity	kg/pole
12. Cement quantity	kg/pole

TECHNICAL SPECIFICATION-6

OUTDOOR TYPE 11 kV/433 V,25 & 63 DISTRIBUTION TRANSFORMERS

1. SCOPE:

This specification covers, Engineering, manufacture, assembly, stage testing, inspection and testing before supply, ready to use besides delivery at site of oil immersed, naturally cooled 3 phase 11 kV/433V, 25 & 63 kVA Distribution Transformers with LT fuse cum distribution board for outdoor installation on PCC Pole equipped with suitable rating of Al. bus bar links .

1.1. It is not the intent to specify completely herein all the details of the design and construction of equipment. However the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the Bidder's guarantee, in manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such, components be deemed to be within the scope of Bidder's supply interceptive of whether those are specifically brought out in this specification and / or the commercial order or not.

1.2. Standard Ratings: The standard Ratings shall be 25 & 63 kVA.

2. STANDARDS:

2.1. The material shall conform in all respects to the relevant Indian /International standard Specification, with latest amendments thereof some of them are listed below:

Title	India standard	International& Internationally recognized standard
Specification for power Transformer outdoor distribution Transformer up to including 100 KVA	ISS-2026/1977 ISS-1180	IEC 76
Specification for Copper wire rod	IS-12444	ASTM B-49
Specification porcelain Transformer bushing	ISS-3347/1967	DIN 42531, 23,3

Specification for Transformer oil	ISS-335/1983	BS 148, D-1473, D-1533-1934 IEC Pub 296-1969
Specification for colors for ready mixed paints porcelain bushings	ISS-5/1961	
Specification for High voltage porcelain bushings	ISS-2099/1973	IEC Pub 296-1969
Specification for Low voltage bushings	ISS-7421/1974	
Specification for outdoor Bushings	ISS-3347	DIN 42531 to 33
Specification for Al wire rods	ISS-5484	ASTM B-233
Insulating Kraft Paper	ISS-9335	IEC 554
Specification for Insulating press Board	ISS-1576	IEC 641
Guide for loading of Oil immersed T/Fs	ISS-6600/1972	IEC-76

The bidder shall use ISS, however, where this standard is not available corresponding IEC may be followed.

Material conforming to ISS or the internationally accepted standards, which ensure equal or higher quality than the standards mentioned above, would also be acceptable. In case the Bidders who wish to offer material conforming to the standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English translations shall be furnished along with the other.

3. SERVICE CONDITIONS:-

The Distribution Transformers & other equipment/material to be supplied against this Specification shall be suitable for satisfactory operation under the following climatic Conditions as per IS-2026 (Part-I) latest revision

i)	Location	At various locations in the state of Haryana
ii)	Maximum ambient temperature (C°)	60
iii)	Minimum ambient air temperature (C°)	-5
iv)	Maximum average daily ambient temperature (C°)	40
v)	Maximum yearly weighed average ambient temperature (C°)	32
vi)	Maximum altitude above mean sea level (m)	1000

vii)	Minimum Relative Humidity (%)	26
viii)	Maximum Relative Humidity (%)	95
ix)	Average no of Rainy days/ year	120
x)	Average annual rainfall	900 mm
xi)	Maximum wind pressure	195 kg/m sq.

The equipment shall be for safe operation in moderately hot and humid tropical climate, conducive to rust and fungus growth.

4. PRINCIPAL PARAMETERS:-

The transformers shall be suitable for outdoor installation with three phase 50 Hz, 11 KV system in which the neutral is effectively earthed and they should be suitable for service under fluctuations in supply voltage up to plus 10 to minus 15%.

S No.	ITEM		
1	Continuous rated capacity	25 kVA	63 KVA
2	System Voltage (max.)	12.5 KV	12.5 KV
3	Rated voltage HV	11 KV	11 KV
4	Rated voltage LV	433 V	433 V
5	Line current HV	1.31 A	3.306 A
6	Line current LV	33.33 A	84.0 A
7	Frequency	50c/s +5%	50c/s +5%
8	No. of phases	Three	Three
9	Connection HV	Delta	Delta
10	Connection LV	Star(Neutral Brought out)	Star(Neutral Brought out)
11	Vector group	Dyn-11	Dyn-11
12	Type of cooling	ONAN	ONAN
13	changing arrangement	Not applicable	Not applicable

14	Noise level at rated voltage and frequency	45 db	45 db
15	Permissible temperature rise over ambient i) if top oil measured by thermometer	35 Deg.C	35 Deg.C
	ii) if winding measured by resistance	40 Deg.C	40 Deg.C
	Maximum clearances i) HV phase to phase (phase to earth (mm) ii) LV phase to phase (phase to earth)	----------As per ISS-1180 latest---------- ----------255 140---------- ----------75 40----------	

5. TECHNICAL REQUIREMENTS:

5.1. MATERIAL – CRGO METAL

5.1.1. The core shall be stack / wound type generally of high grade rolled grain annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise.

The complete design of core must ensure permanency of the core losses with continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used be clearly stated in the offer. The bidder should offer the core for inspection and approval by the purchaser during manufacturing stage.

Bidder shall give notice for inspection with the following documents as applicable as a proof towards use of prime core material.

5.1.1.1. Invoice of the supplier
5.1.1.2. Mills Test Certificate
5.1.1.3. Packing List
5.1.1.4. Bill of Loading
5.1.1.5. Bill of entry certificate to customs

5.1.2. Core clamping for CRGO Stacked core.

5.1.2.1. MS channel shall be used on top and bottom
5.1.2.2. Core channel on LV side to be reinforced at equidistance, if holes/cutting is done for LT lead in order to a avoid bending of channel.
5.1.2.3. MS channel shall be painted with varnish or oil resistant paint
5.1.2.4. Clamping & Tie-rods shall be made of HT steel and shall be parkarised.

5.1.3. Core clamping for CRGO wound core.

5.1.3.1. Core clamping shall be with top and bottom U-shaped core clamps made of sheet steel clamped HT steel tie rods for efficient clamping
5.1.3.2. MS core clamps shall be painted with varnish or oil-resistant paint.
5.1.3.3. Suitable provision shall be made in the bottom core clamp/ bottom plate of the transformer to arrest movement or the active part.

5.1.4. The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) upto 12.5% without injurious heating at full load conditions and shall not get saturated. The Bidder shall furnish necessary design data in support of this situation.

5.1.5. No load current shall not exceed 3% of full load current and will be measured by energizing the transformer at 433 volts, 50c/s on the Secondary. Increase of voltage of 433 volts by 12.5% shall not increase the no load current by 6% of maximum full load current. Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of an, bn, cn voltage will be carried out.

5.1.6. ‘’The core material should be imported directly from the reputed manufacture. Core material shall be processed by slitting only. Core cutting/slitting be done in front of inspecting officers. Details of the core shall be filled & supplied as per Annexure-II.

5.2. AMORPHOUS METAL.

5.2.1. The core shall be high quality Amorphous ribbons having very low loss formed into wound cores of rectangular shape, bolted together to the frames firmly to prevent vibration or noise. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the flux density allowed in the design shall be clearly stated in the offer. Curve showing the properties of the metal shall be attached with the offer.

5.2.2. Core Clamping for Amorphous metal Transformers.

5.2.2.1. Core clamping shall be with top and bottom U-shaped core clamps made of sheet steel clamped HT steel tie rods for efficient clamping.

5.2.2.2. MS core clamps shall be painted with varnish or oil-resistant paint.

5.2.2.3. Suitable provision shall be made in the bottom core clamp/ bottom plate of the transformer to arrest movement of the active part.

5.2.3. The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) upto 12.5% without injurious heating at full load conditions and shall not get saturated.

The Bidder shall furnish necessary design data in support of this situation.

5.2.4. No load current shall not exceed 3% of full load current and will be measured by energizing the transformer at 433 volts, 50c/s on the Secondary. Increase of voltage of 433 volts by 12.5% shall not increase the no load current by 6% of maximum full load current. Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of an, bn, cn voltage will be carried out.

NOTE:

Wherever variable prices are provided IEEMA formula should be applicable in such a way that indices applicable for CRGO are used for amorphous material also since the indices for latter are not declared by IEEMA.

The value of maximum flux density allowed shall be 1.6 T.

5.3. WINDINGS:-

5.3.1. Double paper covered insulation/super enameled with class C insulation varnish on electrolytic Aluminum Conductor for windings and electrolytic copper for leads.

5.3.2. LV winding shall be in even layers so that the neutral formation will be at top.

5.3.3. The winding construction of single HV coil wound over LV coil can be used.

5.3.4. Inter layer insulation shall be Epoxy dotted Kraft paper.

5.3.5. Proper bonding of inter layer insulation with the conductor shall be ensured. Test for Bonding Strength to be conducted.

5.3.6. Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in GTP.

5.3.7. Vertical ducts and spacers shall be provided within each coils for H.V and L.V winding.

5.3.8. Current density for HV and LV coils. This should not be more than 1.5 A/sq. mm. for windings & 0.8 A/sq. mm for leads.

5.4. OIL: - The insulating oil shall comply with the requirements of relevant standards IS 335/1993 or BS: 148.

5.5. LOSSES: The total losses (includes no-load & load losses) at 50% and 100% loading equivalent to BEE 4-Star rating shall not exceed the values given below:

Voltage Ratio	kVA Rating	Max. losses at 50% (Watts)	Max. losses at 100% (Watts)
11000/433	25	190	635
11000/433	63	340	1140

The above losses are maximum allowable and here would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive. Bidders are requested to quote the price as FOR destination on standard losses. The Bid will be evaluated on the basis of standard losses instead of Equated capitalized cost. No benefit of low losses to the bidder in case the losses are less than standards losses at any time.

5.5.1. Percentage Impedance: The value of Impedance of transformer at 75 Deg. C shall be 4.5% subject to the tolerance specified in the standard IS: 2026-1977.

5.5.2. Temperature rise: The temperature rise over ambient shall not exceed the limits described below:

i) Top oil temperature rise measured by thermometer: 35 deg. C

i) Winding temperature rise measure by resistance: 40 deg. C

Bids not meeting the above limits of temperature rise will be treated as non-responsive.

5.6. PENALTY FOR NON PERFORMANCE:

5.6.1. Purchaser reserves the right to reject any transformer during the test at supplier's works, f it is found that actual measured losses are more than the values quoted by the bidder

5.6.2. Transformer with temperature rise and impedance beyond the guaranteed values.

5.6.2.1. Purchaser reserves the right to reject any transformer during the test at supplier's works, if the temperature rise exceeds the guaranteed values.

5.6.2.2. Purchaser reserves the right to reject any transformer during the test at supplier's works, if the impedance values differ from the guaranteed values including tolerance.

5.6.2.3. Purchaser also reserves the right to retain the rejected transformer and take it into service until the Bidder replaces it with a new transformer at no extra cost. The delivery as per contract will be counted when the new transformer as per specification is provided by the manufacture.

5.7. INSULATION MATERIAL:-

5.7.1. Material:-Electrical grade insulation Kraft papers and press Boards of standard should be used. For the use standard material the names of following firms have been approved.

Sr. No.	Name of insulating material	Name of the firms
1	Press board	a. Senapathy whitely b. Raman Board c. Umang Board (p) Ltd. Jaipur
2	Craft paper	a. Ballarpur b. Padamjee c. Triveni d. M/s Skytouch Tapes Ltd., Mumbai. e. M/s KLIM Enterprises, Mumbai. f. M/s Vijaya Mercantile Ltd. New Delhi. g. M/s Badri Enterprises, New Delhi.
3	Press pahn paper	Senapathy whitely
4	Gaskets	a. New cork b. Talbros c. M/s Skytouch Tapes Ltd., Mumbai. d. M/s KLIM Enterprises, Mumbai. e. M/s Vijaya Mercantile Ltd. New Delhi. f. M/s Badri Enterprises, New Delhi.

5.7.2 All spacers, axial wedges / runners used in windings shall be made of pre-compressed pressboard-solid, conforming to type B 3.1 of IEC 641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges/ runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such out in such a way, that there should not be any burr and dimensional variations.

5.8. TANK:-

The rectangular transformer tank can be with radiator fins/rounded or elliptical cooling tubes. The main tank of the transformers shall be made of good quality steel having a minimum thickness of sides of the tanks 3.15 mm and a minimum thickness of 5.0 mm for top and bottom plates. The tank shall be capable of withstanding a pressure up to 0.8 kg/cm2 and (-) 0.7 kg/cm2 for 30 minutes and 30 minutes respectfully as per IS-1180/Part-I/2014. The word "METL, PROPERTY" shall be engraved on the top cover plate and side of the tank body. No negative tolerance shall be allowed. The side wall of the transformer shall be engraved with serial number of the transformer, purchase order no. & date and make of the manufacturer. In addition, the word METL, is to be embossed on the body of transformer on any side.

5.8.1. For Rectangular plain tank:-

5.8.1.1. The transformer tank shall be of robust construction rectangular in shape and shall be built up of tested MS sheets.

5.8.1.2. The internal clearance of tank shall be such that, it shall facilitate easy lifting of core with coils from the tank without dismantling L.V bushings.

5.8.1.3. All joints of tank and fittings shall be oil tight and no bulging should occur during service. The tank design shall be such that the core and windings can be lifted freely. The tank plate shall be of such strength that the complete transformers when filled with oil may be lifted bodily by means of lifting lugs. Inside of tank shall be painted with varnish/ Hot oil.

5.8.1.4.Manufacturer should carry out all welding operations as per relevant ASME standards and submit a copy of the welding procedure qualifications and welder performance qualification certificates to the customer.

5.8.1.5. The four walls of the tank shall be made of Two ''L'' shaped sheets (without joints) fully welded at the corners from inside so that the joint is stronger due to V-shape welding fillet and also outside of the tank for withstanding a pressure of 0.8 kg/cm2 for 30 minutes.

5.8.1.6. The tank shall be reinforced by welded angle on all the outside walls on the edge of the tank to form two equal compartments. Permanent deflection when the tank without oil is subject to a vacuum of 525

mm of mercury for rectangular tank and 760 mm of mercury for round tank, shall not be more than 5 mm in accordance with clause 22.5 of IS:1180 (Part-I/1989) upto 750 mm length and 6mm upto 1250 mm length.

5.8.1.7. The radiators can be of tube type or fin or pressed type steel type to achieve the desired cooling to limit the specified temperature rise. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise Bidder shall submit the calculation sheet.

5.8.1.8. Lifting lugs: 4 Nos. welded heavy duty lifting lugs of MS flat 8 mm thick (min) suitably reinforced by vertical supporting flat welded edgewise below the jug on the side wall.

5.8.1.9. Pulling lugs: 4 Nos. of welded heavy duty pulling lugs of MS plate 8 mm thick (mm) shall be provided to pull the transformer horizontally.

5.8.1.10. Top cover fixing bolts of G.I adequately spaced and 6mm Neoprene bonded cork gaskets conforming to IS 4253 part-II shall be placed between tank and cover. The bolts outside tank shall have 2 flat washers & one spring washer.

5.8.1.11. Pressure release value as standard fitment shall be provided on the top of tank of transformer which should operate at a pressure of 0.3 to 0.5 kg/cm2.

5.8.2. CONSERVATOR: -

On Transformers of ratings up to 100 KVA with rectangular plain tank the provision of conservators is optional with the clarification that:-

• the transformer with conservator shall comply with IS: 1180 Part-I (Non sealed type)

When a conservator is provided oil gauge and the plain or dehydrating breathing devise shall be fixed to the conservator which shall also be provided with a drain plug and a filling hole (1¼") normal size thread) with cover. The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations, In addition the cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank. The inside diameter of the pipe connecting the conservator to the main tank should be within 20 to 50 mm and

it should be projected into the conservator so that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to -5 deg C) should be above the sump level.

5.9. SURFACE PREPARATION & PAINTING.

5.9.1. General

5.9.1.1. All paints shall be applied in accordance with the paint manufacturer's recommendations. Particular attention shall be paid to the following:

5.9.1.1.1. Proper storage to avoid exposure as well as extremes of temperature.

5.9.1.1.2. Surface preparation prior to painting.

5.9.1.1.3. Mixing and thinning.

5.9.1.1.4. Application of paints and the recommended limit of time intervals between coats.

5.9.1.1.5. Shelf life for storage.

5.9.1.2. All paints when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

5.9.1.3. All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacture's recommendations. However, whenever airless spray is not possible, conventional spray be used with prior approval of purchaser.

5.9.1.4. The supplier shall prior to painting nameplates, lettering gauges sight glasses, light fittings and similar such items.

5.9.2. Cleaning and Surface preparation

5.9.2.1. After all machining, forming and welding shall been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

5.9.2.2. Steel surfaces shall prepared by Short blast cleaning or Chemical by Seven Tank process including Phosphating to the appropriate quality.

5.9.2.3. The pressure and volume of the compressed air supply for blast cleaning shall meet the work requirement and shall be sufficiently free from all water contamination to ensure that the cleaning process is not impaired.

5.9.2.4.Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale shall only be used where blast cleaning is impractical. Manufacture to explain such areas in his technical offer clearly.

5.9.3. Protective Coating:

5.9.3.1. As soon as all items have been cleaned and within four hours of the subsequent drying. They shall be given suitable anti-corrosion protection.

5.9.4. Paint Material.

Followings are the types of paint that may be suitably used for the items to be painted at shop and supply of matching paint to site:

5.9.4.1. Heat resistant paint (Hot oil Proof) for inside surface.

5.9.4.2. For external surfaces one coat of Thermo Setting powder paint or 1 coats of Zinc chromate primer /Epoxy followed by 2 coats of Synthetic Enamel /Polyurethane base paint. These paints can be either air-drying or stoving. The coating of inside surfaces shall be made with heat resistant paint

5.9.4.3. The color of the finishing coats shall be as per requirement of the purchaser.

5.9.5. Painting procedure

5.9.5.1. All painting shall be carried out in conformity with both Specification and with the paint manufacture's recommendation. All paints in anyone particular system, whether shop or site applied, shall originate from one paint manufacture.

5.9.5.2. Particular attention shall be paid to the manufacturer's instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacture's e.g. brush, roller, conventional or airless spray and shall be applied under the manufacture's recommended condition Minimum and maximum time intervals between coating shall be closely followed.

5.9.5.3. All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours whichever is sooner.

5.9.5.4. Chemical treated steel surface shall be primed as soon as the surface is dry and while the surface is still warm.

5.9.5.5. Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the Supplier shall remove the unsatisfactory paint coating and apply another. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%. In all instances where two or more coats of the same paint are specified, such coating may or may not be of contrasting colors.

5.9.5.6. Paint applied to items that are not be painted shall be removed at Supplier's expense, leaving the surface clean, unstained and undamaged.

5.9.6. Damaged Paintwork

5.9.6.1. Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that originally employed.

5.9.7. Any damage paint work shall be made good as follows:

5.9.7.1. The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

5.9.7.2. A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

5.9.7.3. The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

5.9.8. Dry Film Thickness

5.9.8.1. To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats may or may not be of the same colour.

5.9.8.2. Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.

5.9.8.3. Particular attention must be paid to full film thickness at edges.

5.9.8.4. The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below.

Sr. No.	Paint Type	Area to be painted	No. of coats	Total Dry film thickness (mm)
1	Thermo setting paint Inside	Inside outside	01 01	30 microns 60 microns
2	Liquid paint a) Zinc chromate (primer) b) Synthetic Enamel/ Poly Urethene (Finish coat) c) Hot oil paint	 Outside Outside inside	 01 02 01	30 microns 25 microns each 35/ 10 microns

5.10. BUSHINGS:

5.10.1. The bushings shall conform to the relevant standards specified and shall be outdoor. The bushing rods and nuts shall be made of brass material 12 mm diameter for both HT & LT.

The HT bushings shall be fixed to the transformers on side with straight pockets and in the same plane or the top cover but LT bushing shall be provided on the side of the tank.

The tests as per latest IS 2099 and IS7421 shall be conducted on the transformer

bushings.

5.10.2. For 11 KV, 17.5 KV class bushings shall be used and for 0.433 KV, 1.1KV class bushings shall be used. Bushings of plain shades as per IS-3347 shall be mounted on the side of the Tank and not on top cover.

5.10.3. Dimensions of the bushings of the voltage class shall conform to the Standards specified.

5.10.4. A minimum phase to phase clearance of 75 mm for LV (upto 1.1 KV bushings) and 255 mm for HV bushings shall be obtained with the bushing mounted on the transformer.

5.10.5. The bushings shall be fixed on sides with pockets in the same plane and not on the top cover. Arcing horns or lightning arrestors shall be provided on HV bushings.

5.10.6. Brazing of all inter connections; jumpers from winding to bushing shall have cross section larger than the winding conductor. All the Brazers shall be qualified as per ASME, Section-IX.

5.10.7. The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for manufacture of insulators.

5.10.8. The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

5.10.9. The LV bushings & micro-processor based MCCB with time current characteristics in compliance with IS:6600 (if provided) shall be housed within the metallic enclosure with sealing arrangement so as to avoid any possibility of tapping of supply from the bushing terminal. The enclosure shall be made with sheet metal of thickness not less than 2mm and powder coated. Enclosure shall have provision for pad locking arrangements.

5.11. Terminal connectors:

The HV bushing stems shall be provided with suitable terminal connectors so as to connect the jumper without disturbing the bushing stem. Connectors shall be with eye bolts so as to receive 55 mm2 conductors for HV. Terminal connectors should must be type tested as per IS : 5561.

5.12. Terminal markings

High voltage and Low voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter IU, IV, IW and low voltage winding for the same phase marked by corresponding small letter 2u, 2v, 2w. The neutral point terminal shall be indicated by the letter 2n.Neutral terminal to be brought out and connected to local grounding terminal by an Earthing strip.

5.13. FITTINGS:

The following standard fittings shall be provided.

5.13.1. Rating and terminal marking plates non-detachable

5.13.2. Ear thing terminal with lugs -2Nos.

5.13.3. Lifting lugs for main tank & top cover.

5.13.4. Terminal connectors on the HV & for LV bushings-Lugs, glands (being covered in the box)

5.13.5. Thermometer pocket with cap -1 No.

5.13.6. Air release device

5.13.7. HV bushings -3 Nos.

5.13.8. LV bushings - 4 Nos.

5.13.9. Pulling lugs – 4 Nos.

5.13.10. Stiffener angle 40x40x5 mm and vertical strip of 50x5 mm flat

5.13.11. Radiators – No. & length may be mentioned (as per heat dissipation calculations)

5.13.12. Arcing horns or 9 KV 5 KVA lighting arrestors on HT side -3 Nos.

5.13.13. Prismatic Oil level gauge.

5.13.14. Drain cum sampling valve

5.13.15. Oil filling hole having p. 1- ¼"thread with plug and drain valve on the conservator

5.13.16. Silica gel breather

5.13.17. Base channel 75x40 mm.

5.13.18. Pressure relief device.

5.14. FASTENERS:

All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.

Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals. All nuts and pins shall be adequately locked. Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position. All ferrous bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanizing, except high tensile steel bolts and spring washers which shall be electro-galvanized / plated. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals. Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided. The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members. Taper washers shall be provided where necessary. Protective washers of suitable material shall be provided front and back or the securing screws. 2 No., anti-theft fasteners of steel on two

diagonally opposite corners of the tank shall be provided. All nuts & pins shall be adequately locked.

5.15. MOUNTING ARRANGEMENT :

The under base of all transformers shall be provided with two 75X40 mm channels 460 mm long with holes to make them suitable for fixing on a platform or plinth

5.16. OVERLOAD CAPACITY

The transformers shall be suitable for loading as per IS: 6600/ 1972

6. TESTS :

a) All the equipment offered shall be fully type tested by the bidder or his collaborator as per the relevant standards including the additional type tests mentioned at clause 6.2. The type test must have been conducted on a transformer of same design. The Bidder shall furnish four sets of type test reports along with the offer. Offers without type test reports will be treated as Non-responsive. The type test certificates should not be more than three years old on the date of bid opening.

b) Special tests other than type and routine tests, as agreed between purchaser and Bidder shall also be carried out as per the relevant standards.

c) The requirements of site tests are also given in this clause.

6.1. ROUTINE TESTS:

6.1.1. Measurement of winding resistance

6.1.2. Measurement of voltage ratio and check phase displacement.

6.1.3 Measurement of short circuit impedance and load loss at 50% & 100% load.

6.1.4. Measurement of No load loss and current.

6.1.5. Insulation resistance

6.1.6. Induced over voltage withstand test. 6.1.8. Separate source voltage withstand test.

6.1.7. Separate source voltage withstand test.

6.1.8. Air pressure and vacuum test (During stage inspection)

6.1.9. Oil Leakage test

6.1.10. Neutral current measurement

6.1.11. Oil samples test for BDV.

6.1.12. Measurement of 50% load & 100% load losses and magnetizing current at rated frequency and at 90%, 100% and 110% voltage.

6.1.13. Magnetic balance test.

6.1.14 Temperature rise test on 1 no. unit out of offered lot.

Note: Oil sample from each lot shall be sealed by inspecting officer and same be tested at Govt. approved NABL Lab as per IS 1866

6.2. TYPE TESTS TO BE CONDUCTED ON ONE UNIT:

In addition to the Tests mentioned in para 6.1 following Tests shall be conducted.

6.2.1. Temperature rise test for determining the maximum temperature rise after continuous full load run. The ambient temperature and time of test should be stated in the test certificate.

6.2.2. Impulse voltage test: As per Clause No. 13 (With chopped wave) of IS - 2026 part-III latest version. BIL for 11KV shall be 75 KV peak.

6.2.3. Air Pressure Test: As per IS- 1180/part-I/2014.

6.2.4. Short Circuit withstand test: Thermal and dynamic ability.

6.2.5. Magnetic Balance Test

The prototype transformer on which type test got conducted shall be supplied duly sealed after completion of type testing in the beginning itself before commencement of supply. The bidder shall furnish an affidavit that all his balance transformers shall meet with prototype in all respects (internal & external). The purchaser can randomly select any transformer & verify the internal / external details with the prototype sample at any time during warranty period. Type test certificates for the tests carried out on prototype of same specifications shall be submitted along with the bid. The purchase may select any transformer from the offered lot for inspection during subsequent lots for carrying out temperature rise test from any Govt. approved lab. Further the purchaser may select the transformer for type tests randomly. The type test report(s) submitted by the bidder/ supplier from any NABL accredited laboratory shall be acceptable for participation of the bidder in the procurement/ empanelment process. In case NABL accredited laboratory happens to be that of manufacturer itself added precaution shall be taken to get type test and other tests witnessed in the laboratory by representative at the time of acceptance of material.

6.3. TESTS AT SITE:

The purchaser reserves the right to conduct all tests on Transformer after arrival at site and the manufacturer shall guarantee test certificate figures under actual service conditions.

6.4. ACCEPTANCE TESTS:

The transformers shall be subjected to the following routine/acceptance test in presence of purchaser's representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS: 1180/Part-I/2014 and IS: 2026 with latest amendments.

6.4.1. Checking of weights, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP/QA Plan and contract drawings.

6.4.2. Physical verifications of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report.

6.4.3. All tests as specified in clause 6.1.

6.4.4. One transformer per lot shall be tested at NABL accredited independent laboratory for performance measurement at free of cost.

6.5. TOLERANCES:

Unless otherwise specified herein the test value of transformers supplied would be within the tolerance permitted in the relevant standards. No positive tolerance is allowed on guaranteed 50% Load and 100% Load losses.

7. INSPECTION:

All tests and inspections shall be made at the place of manufacturer and unless otherwise especially agreed upon the manufacturer and the purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facility, without charge to satisfy him that the material is being furnished in accordance with specification.

The manufacturer shall provide all services to establish and maintain quality of workman ship in his works and that of his sub-contractors to ensure the mechanical/electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per METL intends to purchase only high quality material. For this purpose stringent testing of material can be done. Inspection can be got done from third party inspection agency or from METL own officers. METL reserves the right of 100% testing of transformers. The details of source material shall be supplied suly filled as per Annexure-III

7.1 STAGE INSPECTION

The purchaser's representative may carry out stage inspection of the transformers during manufacturing / assembling stage. The purchaser shall have absolute right to reject the raw material/component / sub assemblies or complete equipment not found to be conforming to the requirement of specification or being of poor quality / workmanship. The stage inspection will particularly include following tests / check besides the general Routine tests to be conducted during manufacturing stages as per manufacturer's standard practice.

a) Physical inspection / checking of winding insulating material, core material for annealing and prime quality and other accessories /fitting of Transformer.

b) Measurement of Core area and flux density.

c) Verification of HV & L.V coils, conductor's size, I.D., O.D., Axial length, Weight, Insulation covering etc.

d) Measurement of thickness of tank plates (Top, bottom and sides) and to conduct air pressure & vacuum tests as specified in the specification, to ensure the adequate strength of the transformer tank body.

e) Sample testing of core material for checking specific loss and thickness of core plates.

f) Visual and dimensional check during assembly stage of core.

g) Check for proper provisions of spacers and bracing outline drawing, provision for all fittings, finishing etc. The purchaser at his option may collect the sample of the following raw material / component for independent testing:

a) CRGO Lamination - One specimen sheet of 300- 500 mm length and 50-75 mm width (for each lot)

b) HV Winding wire- 1250 mm length specimen for each type

c) LV Winding wire- 1250 mm length specimen for each type

d) Transformer oil - 2 samples of 5 Liters each

To facilitate stage inspection, the supplier should intimate complete schedule of manufacturing program of the transformers at least 15 days in advance to the concerned purchasing authority. At least 25% of the transformers shall be offered in the

shape of finished core - coil assembly. The inspecting officers during the course of stage inspection may seal these core-coil assemblies.

e) The manufacturing program shall not be interrupted in case purchaser's representative does not reach within seven days of the date of intimation.

8. DOCUMENTATION:

The Bidder shall furnish along with the bid the dimensional drawings of the stems offered indicating all the fittings.

9.1. Dimension's tolerances

9.2. Weight of individual components and total weight.

9. PACKING & FORWARDING:

10.1. The packing shall be done as per the manufacturer's standard practice. However, it should be ensured that the packing is such that, the material would not get damaged during by Rail/ Road/ Sea.

10.2. The marking on each package shall be as per the relevant IS.

11. MANDATORY SPARES:

Mandatory spares shall be supplied as per the purchaser's requirement.

12.0 SELF PROTECTED-HT SIDE

Internal HV fuse of suitable rating shall be provided on the HT side of transformer.

Specification of HV fuse: Expulsion/any other suitable type of fuse placed in series with the primary winding. The fuse is mounted normally inside of the primary bushing for the three phases and connected to high voltage winding through a terminal block. This has to protect that part of the electrical distribution system, which is ahead of the distribution transformer from faults, which occur inside the distribution transformer i.e. either on the winding or some other parts of the transformer. It shall be ensured that fuse does not blow for faults on secondary side of the transformer.

13.0 RATING & TERMINAL MARKING PLATES

There shall be rating plates on the Transformer containing the information specified in clause 13.1 and 13.2 of IS-1180/Part-I/2014. The following additional information must also be punched on the plate & imposed on two opposite sides of the body of T/F

I. Purchase Order No. & date
II. Date of inspection
III. Make
IV. Guarantee period

4-star rating label in accordance with colour design, logo, etc. shall be provided on the transformer as per design/ recommendations of Bureau of Efficiency (BEE).

14.0 TERMINAL MARKING PLATE AND STANDARD MARK. Shall be provided as per clause No. 13.2 to 13.4.1 of IS-1180/Part-I/2014

15.0 GUARANTEED TECHNICAL PARTICULARS

The Guaranteed Technical Particulars of the Transformer shall be given by the tenderer (Annexure-I) along with the tender. Tenders without GTPS shall be out rightly rejected.

Important note:-

Whenever the position of METL,JHAJJAR specification are superior to the provisions in the IS:1180 (Part-1) :2014 the former shall over ride the later. However, where the provisions in the IS:1180 (Part-1) :2014 are superior than the provisions in the UHBVNL/DHBVNL specifications, the former shall over ride the later

ANNEXURE-1

GUARANTEED & OTHER PARTICULARS FOR DISTRIBUTION TRANSFORMERS (To be furnished by the Manufacturer)

Sl.No	Description	25 kVA	63 KVA
1.	Make & Manufacturer		
2.	Place of Manufacture		
3.	Voltage in KVA	-------- 11000/433 V----------	
4.	Rating in KVA	25 KVA	63 KVA

5. Core Material used and Grade
a) Flux density
b) Over fluxing without Saturation
(Curve to be furnished by the Manufacturer in support of his claim)
6. Maximum temperature rise of
a) Windings by resistance method
b) Oil by Thermometer
7. Magnetizing (No load) Current at
a) Normal Voltage
b) Maximum Voltage
8. Core loss in watts
a) Normal Voltage
b) Maximum Voltage
9. Resistance of Windings at 20 deg. C (with 5% tolerance)
a) HV Winding (ohms)
b) LV Winding (ohms)
10. No- Load losses (watts)
11. Total Losses at 100% load at 75 deg. c
12. Total Losses at 50% load at 75 deg. c
13. Current density used for
a) HV Winding
b) LV Winding
14. Clearances
a) Core & LV
b) LV&HV
c) HV Phase to Phase
d) End insulation clearance to Earth
e) Any point of winding to tank
15. Efficiency at 75 deg. C.

a) Unity P.F. &
b) 0.8 P.F
1) 125 % load
2) 100 % load
3) 75 % load
4) 50 % load
5) 25 % load
16. Regulation at
a) Unity P.F.
b) 0.8 P.F. at 75 deg. C
17. % Impedance at 75 deg. C
18. Flash Test
a)HV 28 KV/ 50 HZ for 1 minute
b)LV 3 KV/ 50 HZ for 1 minute
19. Over potential Test Double Voltage &
20. Double frequency for 1 minute
21. Impulse test
22. Weight content of
a) Core Lamination (min.)
b) Windings (min.)
c) Tank & Fittings
(Thickness of side walls & thickness of top/bottom plate of DT)
d) Oil
e) Oil qty (min.)
f) Total Weight
23. Oil Data
1. Qty for first filling (mm)
2. Grade of oil used
3. Maker's name
4. BDV at the time of filling
24. Transformer:
1) Overall length X breadth X height
2) Tank length X breadth X height
3) Thickness of plates for
a) Side plate (min.)
b) Top & Bottom plate (min.)
25. Radiation:
1) Heat dissipation by tank walls exclusive & bottom

2) Heat dissipation by cooling tube

3) Dia. & thickness of cooling tube

4) Whether calculation sheet for selecting cooling area to ensure that the transformer is capable of giving continuous rated output without exceeding temperature rise is enclosed.

26. Inter layer insulation provided in design for

1) Top & bottom layer

2) In between all layer

3) Details of end insulation

4) Whether wedges are provide at 50 % turns of the HV coil

27. Insulation materials provided

a) For Conductors

(1) HV

(2) LV

b) For Core

28. Material and Size of the wire used

1) HV

a) SWG/mm

b) Dia

2) LV

a) Strip size.

b) No. of Conductors in parallel.

c) Total area of cross section (sq. mm.)

29. Is the name plate gives all particulars as required in Tender

30. Whether BEE recommended 4-star Label Plate fixed on the DT

31. Particulars of Bushings HV/ LV

i) Maker's name

ii) Type IS-3347/IS- 1180

iii) Rating as per I.S.

iv)Dry power frequency voltage withstand test

v)Wet power frequency voltage withstand test Note:

The following shall be specifically confirmed

1. Whether the offer conforms to the limits of impedance mentioned in the specification

2. Whether the offer conforms to the limits of temperature rise mentioned in the specification.

3. Whether the losses of the transformers offered are within the limits specified

4. Whether the transformers offered is already type for the design and test reports enclosed.

ANNEXURE-II

ADDITIONAL DETAILS

Sl. No.	Description
1.	Core Grade
2.	Core diameter (mm)
3.	Gross Core area (cm)
4.	Net Core area (cm)
5.	Flux density (Tesla)
6.	Wt. of Core (kg.)
7.	Loss per kg. of Core at the Specified Flux density (Watts)
8.	Core window height
9.	Center to center distance of the core (mm)
10.	No. of LV. Turns
11.	No. of HV turns
12.	Size of LV Conductor bare/ covered (mm)
13.	Size of HV conductor bare/ covered (mm)
14.	No. of parallels
15.	Current density of LV winding amps/sq.mm.
16.	Current density of HV winding amps/ sq.mm
17.	Wt. of the LV winding for Transformer kg.
18.	Wt. of the HV winding for Transformer kg.
19.	No. of LV Coils/phase
20.	No. of HV coils/phase
21.	Height of LV Windings mm
22.	Height of HV Windings mm
23.	ID/OD of LV Winding mm
24.	ID/OD of HV winding mm
25.	Size of the duct in LV winding mm
26.	Size of the duct in HV winding mm
27.	Size of the duct between HV & LV mm
28.	HV winding to LV winding clearance mm
29.	HV winding to tank clearance mm
30.	Calculated impedance %
31.	HV to earth creepage distance mm
32.	LV to earth creepage distance mm

ANNEXURE-3

SOURCE OF MATERIALS/PLACES OF MANUFACTURE TESTING AND INSPECTION

SI. No.	Item	Source of Material	Place of Manufacture	Place of testing and inspection
1.	Laminations			
2.	Aluminium Conductor			
3.	Insulated winding wires			
4.	Oil			
5.	Press Boards			
6.	Kraft Paper			
7.	MS Plated / Angles/ Channels			
8.	Gaskets			
9.	Bushing HV/ LV			
10.	Paints			

TECHNICAL SPECIFICATION-7

CABLING SYSTEM & EARTHING SYSTEM

1 **Scope :**

a) Installation, testing and commissioning of Earthing System

b) Installation, testing and commissioning of Cabling System

c) GI Earthing Tapes & GI Earthing Plates/Pipe

d) GI wire

e) PVC Insulated Green or Yellow + Green Earthing Wires (FR)

f) Earth Test Links

g) Earthing Station

2 **General Requirements**

The intent of this specification is to define the requirement for the supply, installation, testing and commissioning of the cabling & Earthing system.

CABLING SYSTEM

In this street lighting works the LT cable is proposed from RMU's LT compartment or pole mounted distribution sub-station to LT panel/ Smart street lighting panel.

The pole to pole power distribution is fed through Smart street lighting panel board which are planned to install at various location of the project area.

It is proposed to laid the all types of LT cable in HDPE pipes. The HDPE pipes of suitable sizes shall be laid in ground 1 meter below. The laying of HDPE pipes shall be done according to the relevant Indian standard and standard practice of PWD (B&R)/CPWD suitable for street lighting works.

RCC NP-2 pipes of suitable size shall be provided for Road crossing wherever required. Horizontal boring methodology shall be used for crossing as per site requirement.

The HT/LT cabling for Pole mounted distribution system medium class, GI pipe 100mm dia, of 3 mtr. Long shall be provided with suitable arrangement//support for mechanical protection of the cable.

In case of direct burial of cable, the cable shall be laid 1 mtr. Below ground by using sand & bricks as per standard practice of PWD (B&R)/CPWD.

EARTHING SYSTEM

All non-current carrying metal parts of equipment including the metal case of all Panels and DB's (single/three phase) metal frames, lighting fixtures, socket, outlet, cable trays, conduits, bus duct and bus bar, etc shall be earthed by means of copper tape/ GI tape or PVC insulated green or yellow + green copper wire (FR) as called for and in accordance with particular specifications. On test the earth continuity resistance shall not exceed the value specified in the ISI regulations.

The Pole mounted distribution sub-station shall be earthed as per Indian electricity rules and code of practice for earthing (IS 3043). However, it is proposed to provide six nos. G.I pipe type earthing station.

The HT RMU/LT panel/ Smart street lighting panel board shall be earthed with two no. each G.I. pipe type earthing station. The panel body shall be connected to the earthing station by G.I earthing strip of suitable size.

For G.I pole/High mast pole earthing, G.I. Pipe type earthing station is proposed. The earthing station for lighting poles shall be provided at an interval of five poles each. The high mast pole shall be provided with two nos. earthing station.

For Pole to Pole earthing two run of 6 SWG G.I. wire laid in HDPE pipe along with LT cable is used. The G.I wires shall be connected with earthing stations.

3 Code And Standards

The earthing system shall comply with all applicable Indian Standards, Indian Electricity Act and Indian Electricity rules:-

IS 3043 (1987) Code of practice for earthing.

4 Quality Assurance

The contractor shall ensure that all materials furnished and installed by him under the contract shall meet the requirements of relevant Indian Standards. The Contractor shall also verify all test results and ensure that these are in accordance with the requirements as mentioned in the specifications.

5 Guarantee

Manufacturer shall provide guarantee for work under this section. However, such guarantee shall be in addition to and not in lieu of all other liabilities which manufacturer and Contractor may have by other provisions of the contract document.

6 Delivery, Handling and Storage

The earthing material shall be inspected for the following:

Damage Compliance with specifications Quality while on site the material shall be stored in proper manner to prevent rusting/ damage.

7 Products

General Details

The earthing material shall be brand new and in good condition. Earthing strips/earthing plate/earthing pipes shall be GI/Copper as called for in particular specifications/ BOQ. GI tapes/ Copper Tapes/ PVC insulated green earth wires shall also be in accordance with details as mentioned in the SLD/BOQ.

8 Earthing Stations

Earth electrode (Plate/ pipe) shall be driven to a sufficient depth to reach permanently moist soil. Electrode shall preferably be situated in a soil which has a fine texture and which is packed by watering and ramming as tightly as possible. Wherever practicable, the soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrode.

In case of Pipe earthing the earthing pipe shall be minimum 40mm dia, B-class GI pipe. Pipe Length shall be min. 6000 mm.

The charcoal/coke & salt shall be used at 100-150 mm interval of the entire depth of the earthing station.

The top of the pipe shall be provided with a funnel and the mesh for watering the earth through pipe.

The electrode shall have a clean surface, not covered by paint, enamel, grease or other material of poor conductivity.

Two nos. G.I. earthing strip of 25 x 6 mm shall be welded with the GI pipe & connected/jointed with the G.I. clamp at the top of the pipe.

Earth electrode/ funnel shall be covered with heavy duty cast iron cover housed on a masonry chamber approximately 300mm x 300 mm x 300 mm deep. The cover shall be fabricated from 5 mm thick MS plate to the frame work. The covers shall have study locking arrangement. They shall also be provided with stumbling free, non protruding lifting arrangement.

9 Installation, Testing and Commissioning Erection

All LT panels and Feeder Pillars shall be independently earthed with a minimum of two nos. of independent earthings made out of 40m GI pipe, 6000mm long put in the ground, connected to the equipment with 50x6mm GI Flat.

Transformer body shall have two nos. separate earthings made out of Pipe Electrode in treated earthing pit as per IS. The minimum size of pit shall be 600mm & 6000mm deep filled with homogeneous mixture of salt and charcoal as per IS. The earth electrode shall be 50x6mm GI Flat.

Transformer Neutral shall have two separate earthings of Plate type as indicated above with Pipe Electrode in treated earthing pit as per IS. The minimum size of pit shall be 600mm & 6000mm deep filled with homogeneous mixture of salt and charcoal as per IS. The earth electrode shall be 50x6mm GI Flat. In case of Neutral the earth electrode shall be PVC sleeved.

The lightning arrestors used for pole mounted distribution sub-station shall have two separate earthings of Plate type as indicated above with Pipe Electrode in treated earthing pit as per IS. The minimum size of pit shall be 600mm & 6000mm deep filled with homogeneous mixture of salt and charcoal as per IS. The earth electrode shall be 50x6mm GI Flat.

All other metal parts like Fence, Poles, metallic cross arms etc shall be earthed by using 8 SWG GI wire or 25x6 mm GI flat.

Main earthing conductors shall be taken from earth connections at main switch boards/ LT panel to an earth electrode with which the connections are to be made. Sub-main earthing conductors shall run from the main switch boards/ LT panel to the sub-distribution boards/ feeder pillars. Final distributions boards earthing conductors shall run from sub-distribution boards/ feeder pillars.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor or its Distribution board. Metal conduits, cables sheathing and armoring shall be earthed at the ends adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors which the flexible cord, switches, accessories, lighting fitting etc. which are rigidly secured in effective electrical contact with a run of metallic conduit shall be considered a part of the earthing conductor for earthing purposes, even through the run of metallic conduit is earthed.

Neutral conductor, water pipes, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system. The electrical resistance measured between earth connection at the main switch board and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuse or circuit breakers, and shall not exceed one Ohm.

Each separate building containing its own switch board shall be treated as a separate installation for earthing purposes and a main earth provided accordingly. All equipment including the metal case of SDB's, DB's, metal frames, lighting fixtures, socket outlets, cable trays and conduits etc shall be made by means of bare Copper tapes or PVC insulated green copper wire as called for and in accordance with relevant clauses of the specifications. On test the earth continuity resistance shall not exceed the value specified in the ISI regulations.

A removable test link shall be provided outside the building as near as possible to the earth electrode for isolating of the earth electrode/ earth pits to check their resistance periodically. Where tape is fixed to the building structure it shall be by means of purpose made saddles. Fixing shall be made by using purpose made plugs and damps. Fixings requiring the drilling of the hole tough the strip shall not be used. Joints in tapes shall be tinned before assembly and riveted with a minimum of two rivets severed solid. A drawing showing the proposed arrangement shall be submitted by the

contractor for approval before any work is carried out at site. Normally an earth electrode shall not be situated less than 2.0m from any building. Care shall be taken that the excavations for earth electrode may not affect the column footings or foundation of the building, in such case electrodes may be further away from the building.

The Contractor shall visit the site during the tender stage for purpose of ascertaining ground condition regarding main/ auxiliary earths and no extra will be entertained after the contract is awarded.

The exact location of earth conductors (tape / PVC wire), earth electrodes and earthing points on the equipment/ panels/ DB's shall be determined at the site by the Contractor in consultation with the Consultant and the same shall be indicated in as built drawings.

10 Examination of Work

No work shall be covered by backfilling or otherwise put out of view without the approval of the Consultant/ Engineer-in-charge. The Contractor shall give due notice to the Consultant/ Engineer-in-charge whenever any such work is ready for examination and the Consultant/Engineer-in-charge shall without unreasonable delay, unless be considers it unnecessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such work.

11 Field Tests

Each electrode shall be tested for earth resistance by means of standard DIGITAL EARTH TEST METER. The tests shall be carried out preferably after a protracted dry spell. The distance between two electrodes shall not be less than twice the length of electrode.

No earth Electrode shall have a greater ohmic resistance than 1-2 Ohm or as per relevant IS as measured by a DIGITAL earth testing apparatus.

12. Measurement

Earthing stations shall be enumerated and earthing tapes/ PVC insulated copper wires shall be measured by length.

13 Earthing Tapes

Earthing tapes shall be GI, Copper or Copper wires with PVC insulation as specified in BOQ.

14 Jointing

All tapes shall be jointed to ensure earth continuity. GI tapes shall be jointed by welding and painting the same with zinc rich paint.

All copper tapes shall be tinned and riveted at the joints. Minimum two rivets for 25mm wide tapes and four rivets for 32m wide and above tapes.

LIST OF APPROVED MAKE

Sr. No	Equipment/ Accessories	Make
1	Led Luminaire	Philips, Bajaj, Wipro ,CGL, Schreader
2	GI Octagonal Pole	Bajaj, Crompton, Valmount, Paruthi
3	Smart Feeder Pillar	Philips, Bajaj, Wipro ,CGL,Schreader
4	1.1 kV Grade Armoured/ Unarmoured Cable	HAVELL'S/KEI/PARAMOUNT/ FINOLEX/UNIVERSAL/POLYC AB
5	Cable Termination Kit/ Cable Joining Kit	CABSEAL/RACHEM/COMPAQ
6	Cable Lugs (Tinned Copper)	Dowells, Commet, Connectwell
7	Connectors / Terminals	Wago Controls / Elmex / Connectwell
8	MCB, ELCB Distribution Board	Legrand Schneider Siemens ABB
9	MCCB	ABB Schneider Siemens L & T
10	Time Switch	Schneider Siemens L&T Legrand
11	MFM	Schneider Siemens AE Socomec
12	Energy meter	L&T ,Secure, Enercon, Schneider

13	Contactor	ABB Schneider Siemens L&T
14	Junction Box	Hensel, Sintex or equivalent
15	LED / Driver	Cree, Nichia, Philips ,Osram
16	Lighting Pole terminal & control terminal	Elmex, Connect well, wago, Phoenix or equivalent

Note:-

1) Only one of the above makes of the materials will be acceptable. The Contractor has to comply with the approved makes given in the tender document.

2) The Bidder shall offer the equipment of makes mentioned above and reputed make as per DHBVN/UHBVN approved make list shall also be acceptable. All materials are subjected to Client/ DHBVN/UHBVN/Nagar Nigam approval before procurement.

3) The items manufactured in India shall be permitted only if the items are ISI marked (any other definition of compliance to BIS shall not be acceptable).

4) Samples from all the approved makes shall be offered for selection.

5) For standardization, inventory, electrical system coordination, the Employer/ Employer's Representative can insist on any one make from the makes indicated above.

The items shall meet specifications. Mere mention of a make as approved make in the above list does not qualify for acceptance of an item.