

**Volume-III D**  
**Employers Requirements and Technical specification**  
**For Electrical Works**



## 1 Detail scope of work

This scope of work covers confirmatory site survey, Design, Engineering, Manufacture, Testing & Inspection in accordance with agreed QAP and Standards at Manufacturer's/ Vendors' works, Packing, Forwarding and Delivery/ Supply from Manufacturer's Works to Erection site, Unloading, Handling, Assembly, Erection, Testing & Installation, Commissioning and Performance demonstration at site and operation & maintenance for specified period as mentioned in the Terms & condition of this Contract of the equipment and systems listed below for proposed smart of in the Area Based Development (ABD). The lists of proposed roads are provided in the annexure- 2.

- a. Smart Lighting system for the proposed smart roads and junctions
- b. Conversion of overhead transmission lines to underground cabling network
- c. Optimization of Distribution Transformer

### 1.1. Smart LED Lighting

- 1.1.1 Carrying out survey of all the project roads mentioned in annexure-3.0, inspection and measurement of Right of Way (ROW) and length of each road for design of steel lighting system, identifying the prospective locations for mounting of poles and feeder pillars as per the offered rating and technology, identifying bottlenecks for execution along these roads, identifying the source of power for the proposed feeder pillars, carrying out lighting calculation on Dialux-4.12 or AGI32 or equivalent software for roads and junctions for specified lux levels, preparation of detailed BOQ and submission of execution report.
- 1.1.2 Smart street lighting system including outdoor LED lighting fixtures having dimmable and non dimmable drivers; decorative octagonal poles, junction boxes, RCC foundation, mounting brackets, hard wires feeder pillar with, smart lighting controller for group control system, centralized control & monitoring system & other necessary accessories ; web hosting on cloud server with web application LICENSE & server support for five year with hosting on cloud server and integration with ICCCL at Multilevel car parking ABD area Raipur (including O&M), for smart road as mentioned in annexure-3. Replacement of High mast conventional flood lighting with LED flood lighting fixtures & retrofitting of existing smart High mast lighting feeder pillar with smart high mast lighting controller features and equipments. The junctions to be improved high mast are given annexure-5.0.
- 1.1.3 Landscape LED lighting at Vivekanand sarovar from durga devi junction to Nehru nagar junction

- 1.1.4 Connecting power and control cabling through Double walled corrugated (DWC) HDPE pipes and earthing of lighting poles, fixtures and controller panels as per required standard
- 1.1.5 Civil works associated with above works including excavation / trenching / horizontal directional drilling (HDD), back filling and making the surface same as before, fabrication and erection of steel structural support for mounting of feeder pillars, laying of DWC HDPE pipes for cable laying
- 1.1.6 Arranging for GSM connectivity for communication within the entire proposed network
- 1.1.7 Dismantling of existing lighting pole and fixtures and transporting all the dismantled material to employer at Raipur Municipal Corporation store provided by employer are in scope of contractor.

**1.2. Conversion of HT/LT overhead transmission line into underground cabling network**

- 1.2.1. Conducting Survey to ascertain the site conditions, measurements for verification of length and quantities, identification of location for installation of feeder pillars and RMUs; manholes, consumer per DT, per service pole, service cable length from service pole to consumer premises, sanction demand of consumer, optimises cable route length for HT, LT and service cable, preparing survey report and preparing cable schedule etc.
- 1.2.2. Conversion of all 33kV, 11kV and 415V overhead transmission line or Aerial bunch cable (AB cable) into underground cable of equivalent rating as per standard guideline by Chhattisgarh State Power Distribution Company Ltd.(CSPDCL).
- 1.2.3. Details of the network within the ABD area along the project roads are provided in Annexure – 1.0 & 2.0.
- 1.2.4. Design and submission of calculations of cable sizing for different voltage level and network considering the existing and future loading for main feeders and service connections; Earthing system etc. as per the required design criteria.
- 1.2.5. Replacement of feeder boxes of pole/ plinth mounted Distribution transformers with floor mounted outdoor DT box with one incomer and four outgoings. The rating of switchgear and bus shall be as per design criteria.
- 1.2.6. All service poles shall be replaced by service LT pillar (FP).The configuration of FPs shall be provided as per design criteria.
- 1.2.7. Supplying and laying of DWC HDPE pipe for HT, LT and ICT cable along the designated corridor in ROW of the project roads as per section drawing

(Dwg NO: CE.10596A-CV-3054-SI-30161 to TCE.10596A-CV-3054-SI-30196,TCE.10596A-CV-3054-SI-30199,TCE.10596A-CV-3054-SI-30200, Total 39 drawings).HT & LT cable laying in DWC HDPE pipe in all roads mentioned in annexure-2.

- 1.2.8. Design, civil works, provision of manhole cover, approval and execution of HT & LT cable manhole along proposed smart road as per standard guidelines of CSPDCL.
- 1.2.9. Contractor shall provide necessary cut-outs or junction boxes for HT / LT cable wherever required for completion of electrical work if, required.
- 1.2.10. Laying of service cables through DWC HDPE pipe.
- 1.2.11. Dismantling of Existing supply poles, DP structures and transmission lines and shifting them to the CSPDCL store at place directed by RSCL/ CSPDCL.
- 1.2.12. Contractor to provide the RFID Markers a portable marker locator device for HT and LT cable at thirty two (32) junctions of proposed smart road.

### **1.3. Optimisation of Distribution transformers (DTs)**

- 1.3.1. Optimization of existing DTs by combining two or three DTs into 11/0.433kV Compact Substation (CSS) having RMUs, dry type transformer and LT Switch board of equivalent or next higher ratings
- 1.3.2. A list of selected DTs and their optimised CSS ratings have been provided in Annexure 1.0.
- 1.3.3. Conducting confirmatory survey of all DTs as per annexure-1.0 and availability of space for installation of CSS and also for further possible optimization.
- 1.3.4. All civil works for preparation of Foundations for CSS, RMU, design and execution of earthing system.
- 1.4. Contractor shall provide RMU on proposed smart road as per provided in annexure-2.
- 1.5. Liaison with CSPDCL, RMC and Other agencies for shut down and land permits etc.
- 1.6. Contractor shall relocate DT's inside on ROW of proposed smart road and installed at appropriate location. It's contractor's responsibility to identify such DT's and prepare action plan with CSPDCL / RSCL. Contractor shall install such DT's on pole or plinth as per site condition and complete all works to make DT's operational.
- 1.7. Contractor shall provide maintenance free earthing as per IS 3043 for CSS with cu strip. Earthing with 4.5meter GI pipe earthing with GI strip for RMUs, lighting poles, DT boxes and service feeder pillar.

**2 General instruction to contractors**

- 2.1 Contractor shall be solely responsible for any shortages or damages in transit for his supply scope, handling and/ or in storage of any materials and erection of the equipment, supply of erection tools at site. Contractor shall ensure that it will not affect any activity or project schedule. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. Shall be to the account of contractor.
- 2.2 Nothing in this specification shall be constructed to relieve contractor of his/ her responsibilities towards following best engineering practices established in the country.
- 2.3 All - obtaining approval from CSPDCL (Chhattisgarh State Power Company Limited), no objection certificates from CSPDCL / Electrical Inspector, relevant Government Agencies, Statutory Authority, as applicable is included in contractor's scope.
- 2.4 All necessary legal fees required for various applications and approval of drawing, document, and supervision charges from CSPDCL, Electrical Inspector, relevant Government Agencies, and Statutory Authorities shall be paid by contractor.
- 2.5 Even if all components of a system included in this specification are not explicitly identified and/ or listed herein, these shall be supplied under this contract to ensure completeness of the system and facilitate proper operation and easy maintenance of the Electrical system. Any and all other works not indicated above but necessary/ required to complete the job in all aspects, are included in contractor's scope
- 2.6 Submission of equipment/ system Design Calculation Sheets, Detail Engineering Drawings, Data Sheets, equipment Sizing Calculations etc for review and approval by RSCL / CSPDCL before execution/ procurement and manufacturing.
- 2.7 Contractor shall carrying out joint Inspection, Testing, Commissioning and Performance demonstration of the entire street lighting system within the proposed smart Road of Raipur Smart City ABD Area and submission of reports for review & acceptance by RSCL / CSPDCL. Contractor follows all instruction and technical guidance raise by CSPDCL / RSCL during design, detail engineering, GFC, construction, testing & commissioning of all Electrical works.
- 2.8 Contractor shall provide five year joint maintenance contract (AMC) for all electrical work done under this tender and must have maintenance team including one supervisor, one skill and two unskilled working staff & 15-20% spare parts of all critical items, tools (all types) & latest cable fault locator to cater any consequence at its own store establish at Raipur.

- 2.9 The list of critical items shall be provided by contractor before start of AMC to CSPDCL for their approval.
- 2.10 Contractor shall ensure 24x7 maintenance team as per clause 2.8 with required tools, cable fault locator availability at site.
- 2.11 Contractor shall provide AMC directly from OEM for CSS, RMU & FRTU etc.
- 2.12 During AMC period CSPDCL shall supervise and provide work permit, disconnection and restoration of Power circuit. All repair, replacement of cable joints, switches such as MCB, MCCB, ACB, control wires, yearly testing of earth pit shall be in scope of contractor.
- 2.13 Contractor shall submit GFC, calculation sheet, cable schedule to CSPDCL / RSCL for approval and instruction.
- 2.14 Contractor shall not perform electrical work, purchase of material without approval or permission of RSCL / CSPDCL / Consultant.
- 2.15 Contractor shall provide 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.
- 2.16 All SAFETY considerations in design and manufacturing for safe operation & maintenance and safe practices during installation at site shall be in the scope of contractor.
- 2.17 Submission of all "As Built" drawings, Data sheets, Calculations etc. after execution and commissioning of the equipment and systems as specified above.
- 2.18 Submission of relevant documents and drawings to the concerned statutory authorities/ agencies and getting clearance and approval for the supplied and installed equipment under this specification is solely the responsibility of contractor.
- 2.19 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.
- 2.20 The clearance for carrying out dismantling works of existing Light Poles, Light Fittings & Lighting Fixture shall be given only after successful completion of trial testing period of 15 days and approval from RSCL.
- 2.21 Operation and maintenance 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 365 days as per the Service Level Benchmark specified. The same shall also include the following;

- 2.22 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.
- 2.23 After completing life of equipments, the same equipments shall be replaced with new hardware / software of same or better specifications free of cost throughout the Contract period.
- 2.24 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.
- 2.25 Maintaining a status Dashboard on the progress of the project and submission of periodic report on weekly basis to ULB during execution
- 2.26 The detail provided in annexure-1 to annexure-5 is indicative and only for information.

### 3 List of Drawings to be Submitted after Award of Contract

Following drawings, calculations & schedules shall be submitted for approval before procurement, fabrication and Installation of equipments at site. This is minimum list of drawing to be given by contractor for review but shall not limit himself to this list but it is responsibility of Contractor to provide all drawing, design data as instructed by employer.

<b>A)</b>	<b>Drawings</b>
1.0	Plan drawing for Electrical services showing manholes , cable route marker, CSS, RMU, U/G cable along road
2.0	415V Outdoor DT box / service feeder pillars
a.	Complete assembly drawings of distribution board showing plan, elevation and typical sectional views and location of cable boxes and control cable terminal blocks for external wiring connections, etc.
b.	Foundation plan showing the location of channel sills, foundation, anchor bolts and anchors, floor plans and openings.
c.	Schematic power, Feeder operation logic and control wiring diagrams with control, interlocks, relays, instruments, space heaters ratings and bus bar rating with material etc.
d.	Details of breakers / MCCBs, relays and other components as may be incorporated.
e.	Type test certificates not older than last three years
3.0	Cabling system
a.	Construction of main cable inside on proposed smart road
b.	Details of Installation of HT and main LT Cables and service cable in HDPE pipe directly buried etc., on proposed smart road



c.	1.1kV Cable routing layout for road lighting.
d.	Bill of quantities of LT cables, lugs and glands
4.0	Earthing system
a.	Detail calculations of earthing conductor
b.	Earthing notes including detail write up and drawings of earthing conductor layout, equipment & structural earthing, joints, cable earthing, instrument earthing and special earthing.
c.	Details such as material, sizes, etc. of the earth conductor and electrode pits
d.	Earthing layout drawing showing routing of strip with interconnection of equipment earthing to the earth pits
5.0	Lighting System
a.	Road Lighting and vivekand sarovar lighting layout with type of mounting details, Type of fixture details and Circuit diagram showing phase wise load distribution and Detailed lux level calculations.
b.	Street Light pole details with Foundation details.
c.	Flood light pole with foundation details.
6.0	Compact Substation
a.	Detailed Single line diagrams
b.	Detailed General Arrangement showing dimensioned views, cable entry location, foundation details, mounting details and components of every equipment under scope of Supply
c.	Detail Power, Control and Protection wiring drawing with Terminal block diagram with terminal numbers
d.	Inter connection Schedule between the equipments within the CSS as well as inputs required externally
e.	Complete Bill of material listing equipment designation, make, type, model, rating, quantity etc. of the various accessories & components used for the above equipment
7.0	All Civil drawings related to foundation of all the electrical items.
8.0	Drawing for the Fencing of the CSS.
9.0	Civil drawing for HT/LT manhole
10.0	Drawing for location of Smart RFID cable route marker on proposed smart road
<b>B)</b>	<b>Calculations</b>
a.	Compact sizing calculations
b.	Fault level Calculations
c.	LT cable sizing
d.	HT cable sizing
e.	Service cable sizing
f.	Earthing Sizing Calculations
g.	External Lighting Calculations as per Lux level given in IS 1944 Part-I.
<b>C)</b>	<b>Schedules</b>
a.	Cable Schedule
b.	Junction Box Schedule
c.	Service Feeder Pillar

All equipment/system sizing calculations/drawings shall be submitted to the client for approval whether specifically mentioned or not.

#### 4 Design Requirements

The design criteria, given below has to be followed by contractor for designing/ sizing of electrical equipment covered under Contractor's battery limits; However it is to be noted by contractor that, following this design criteria does not relieve contractor from adherence to the standards, regulatory requirements & best engineering practices.

##### 4.1 System Description

4.1.1 The distribution network comprises of 33kV, 11kV and 415 V overhead lines along the road of ABD area.

4.1.2 The grid substations are inside the ABD area is given below:

1x5MVA 33/11kV Nagar Nigam Substation

2x5MVA 33/11kV Sports complex

1x10MVA, 2x5MVA 33/11kV Medical college substation

2x5MVA, 33/11kV Nutan Rice mill substation

1x5MVA 33/11kV Rajbhandha Substation

2xMVA 33/11kV Mantralay Substation

The pole mounted distribution transformer is distributed (DT) through 11kV overhead line and further 415V supply from DT are supplied to consumers through 415V service line.

##### 4.2 General Design Criteria

4.2.1 The proposed power distribution system shall be designed in accordance with this specification, taking into account all possible factors affecting the choice of the system to be adopted; such as required continuity of supply, flexibility of operation, Operational costs, reliability of supply from available power sources, total load and the concentration of individual loads.

4.2.2 The proposed power distribution system shall be designed to restrict voltage drop from DT terminal to farthest consumer below 5% or as per CSPDCL norms.

4.2.3 In accordance with this specification, taking into account all possible factors affecting the choice of the system to be adopted; such as required continuity of supply, flexibility of operation, Operational costs, reliability of supply from available power sources, total load and the concentration of individual loads.

4.2.4 All the components of the electrical system shall be sized to suit the maximum load under the most severe operating conditions. Accordingly, the maximum simultaneous consumption of power, required by continuously operating loads shall be considered and an additional margin shall be taken into account for intermittent service loads, if

any. The amount of electrical power consumed by each area shall be calculated for its operation at the design capacity.

#### 4.3 **Sizing of 11kV /433V Compact substation (CSS):**

For sizing of Compact substation following points shall be considered.

- 4.3.1 Equivalent size of single Distribution Transformer (DT) or by combining two or three to equivalent size of one Compact substation. The preferred sizes of CSS are 315kVA, 500kVA and 630kVA.
- 4.3.2 APFC size shall be equivalent to 30% size of CSS.
- 4.3.3 Surge arrestor of 9kV, 10kA at HT terminal of Transformer
- 4.3.4 Cast resin Dry type Transformer
- 4.3.5 N-1 contingency (In case of failure of CSS, load of CSS shall transfer to another DT of equivalent rating or CSS nearest to failed CSS)
- 4.3.6 Maximum loading on CSS shall not exceed 50%.
- 4.3.7 Maximum losses @75deg C consider for Dry Type transformer shall be as mentioned in table below:

kVA rating	No load losses in kW	Full load losses in kW	Total Losses in kW
315	0.8	2.6	3.4
500	1.1	4.2	5.3
630	1.3	6.1	7.4

- 4.3.8 LV outgoing of CSS shall consist of six (6) MCCB, each of 250A with microprocessor release and SCADA, GSM / GPRS compatible.
- 4.3.9 CSPDCL DT metering shall be installed in side CSS. DT meter shall be provided as per CSPDCL norms and standard operating procedure & approval.
- 4.4 **Sizing of 11kV Gas based RMU:**
- 4.4.1 3Way RMU shall consist of two load break switch and one VCB and 4way RMU shall consist of three load break and on VCB.
- 4.4.2 The Load break switch shall be rated for the ring capacity irrespective of its location/ sequence in the loop i.e. while feeding from one end of the Loop, the switch shall be capable to withstand the entire load current of the Loop.
- 4.4.3 The protection relay shall be communicable as per the SCADA, GSM/ GPRS requirement.

- 4.4.4 Specific requirements shall be as per enclosed specification
- 4.4.5 Sizing of Outdoor DT box:
- 4.4.6 The system shall be 3P +N, 4 wire solidly grounded system.
- 4.4.7 The main bus shall be designed based on the load rating as well as the actual fault level at the location of the board with 10% tolerance.
- 4.4.8 The current density of the bus bar shall be 1.3 A per sqmm for Aluminum bus and 1.6 for Copper bus.
- 4.4.9 Earth bus of the panel shall be sized suitable for the above fault level.
- 4.4.10 Incomer breaker shall be considered ACBs for switchgear ratings above 630A and MCCB shall be considered up to 630A.
- 4.4.11 All ACBs and MCCBs shall be rated for Bus fault level with  $I_{cs}=I_{cu}=I_{cw}=100\%$  for ACB and  $I_{cs}=I_{cw}=100\%$  for MCCBs.
- 4.4.12 25% spare capacity shall be considered on each bus/ panel for future.
- 4.4.13 1No ACB of rating 800A shall considered for Incomer & 4nos MCCB's outgoings shall be considered MCCBs of 250A for 500kVA DT.
- 4.4.14 1No MCCB of rating 630A shall considered for incomer and 4no's outgoing shall be considered MCCB's of rating 250A for DT's between 315kVA to 400kVA rating.
- 4.4.15 1No MCCB of rating 400A shall considered for incomer and 4no's outgoing shall be considered MCCB's of rating 250A for 200kVA DT.
- 4.4.16 1No MCCB of rating 250A shall considered for incomer and 4no's outgoing shall be considered MCCB's of rating 160A for DT's 63kVA to 100kVA rating.
- 4.4.17 The MCCB's shall be microprocessor OL/SC/EF release and SCADA compatible.
- 4.4.18 Specific requirements shall be as per enclosed specification
- 4.5 **25kVA DT shall be provided with outdoor service feeder pillar with 250A MCCB and MCB's in outgoing.**
- 4.6 **Sizing of Outdoor Service feeder pillar**
- 4.6.1 The system shall be 3Phase+N, 4 wire solidly grounded system.
- 4.6.2 The main bus shall be designed based on the load rating as well as the actual fault level at the location of the board with 10% tolerance.
- 4.6.3 The current density of the bus bar shall be 1.3 A per sqmm for Aluminium bus and 1.6 for Copper bus.
- 4.6.4 Earth bus of the panel shall be sized suitable for the above fault level.

- 4.6.5 ACBs shall be considered for switchgear ratings above 630A and MCCB shall be considered up to 630A.
- 4.6.6 All ACBs and MCCBs shall be rated for Bus fault level with  $I_{cs}=I_{cu}=I_{cw}=100\%$  for ACB and  $I_{cs}=I_{cw}=100\%$  for MCCBs.
- 4.6.7 20% spare capacity shall be considered on each bus/ panel for future.
- 4.6.8 Outgoing shall be consider 32A, DP, 10kA/1sec, MCB for single phase consumer and 63-100A, FP, 10kA/1sec MCB for three phase consumer
- 4.6.9 Specific requirements shall be as per enclosed specification
- 4.7 Sizing of cables:**
- 4.7.1 Contractor shall ensure that cable associated with the power distribution systems in all the installations throughout the Works are adequately rated for their use.
- 4.7.2 The following main aspects shall also be considered while deciding the final size of the cables-
- 4.7.3 Supply voltage and frequency
- a) All cables shall be selected to carry the corresponding full load current under site conditions.
  - b) Route length and disposition of cables
  - c) Maximum allowable temperature rise under normal full load condition based on the material of cable insulation (XLPE/ PVC).
  - d) Maximum short circuit current duration (fault clearing time) and final temperature of cable during short circuit current flowing through the cable.
- 4.7.4 For Cables emerging from ACB outgoing, fault clearing time shall be considered as 0.16 second.
- 4.7.5 For Cables emerging from MCCB outgoing, fault clearing time shall be considered as 0.1 second
- 4.7.6 For the HT incomer cables minimum fault clearing time shall be considered as 1 sec.
- 4.7.7 Appropriate de-rating factors as per cable manufacturer's catalogue and enlisted below shall be considered for sizing the cable:
- a) Ambient Air Temperature (minimum 45 degree C).
  - b) Ambient ground temperature (minimum 40 degree C to be considered)
  - c) Laid in Air / ducts/ directly in ground etc.
  - d) Depth of cable burial (minimum 700 mm for ICT, LT and 1050 mm, / 1500mm for 11kV, 2000 for 33KV HT)
  - e) Thermal Resistivity of Soil (minimum 150 degree C Cm/ W to be considered)

- f) No. of cables in a group-touching each other or separated by a distance
  - g) No. of cable trays in tier
  - h) Any other de-rating factors as applicable & as per Manufacturer's catalogue.
- 4.7.8 In running condition, cumulative voltage drop (at 100% rated load) shall not exceed 5% (measured at any consumer premises) for the LV loads.
- 4.7.9 In case of high voltage the voltage drop limited to CSPDCL supply code.
- 4.7.10 Standardization of cable sizes shall be preferred.
- 4.7.11 All the 33kV cables shall be un-earthed (UE) grade, multi-stranded Al conductor, XLPE insulated, inner/outer extruded PVC sheath ST2, galvanized steel flat strip armoured cables.
- 4.7.12 All the 11kV cables shall be un-earthed (UE) grade, multi-stranded Al conductor, XLPE insulated, inner/outer extruded PVC sheath ST2, galvanized steel flat strip armoured cables.
- 4.7.13 The 415V cables shall be 1.1 kV grade, multi-stranded Copper/ Al conductor, XLPE insulated, colour coded, inner and outer extruded PVC sheathed, galvanized steel round wire/ flat strip armoured cables.
- 4.7.14 Cables up to & including 4.0 sq.mm shall be Cu multi-stranded conductor with galvanized steel round wire armoured & balance cables shall be Al multi-stranded conductor with galvanized steel round wire/ flat strip armoured.
- 4.7.15 Min. Size of cable 33kV- 3Cx400sqmm Al, XLPE, armoured, UE grade, 11kV- 3Cx240Sqmm, Al, XLPE, armoured, UE grade, 415V- 3.5Cx300Sqmm Al, XLPE, armoured.
- 4.7.16 Min size of service cable shall be service cable shall be 3Cx6Sqmm, Al, Armoured, PVC.

#### 4.8 Sizing of Grounding System

- 4.8.1 The safety earthing system will be designed on the basis of IEEE 80-2000 and IS3043-1987.
- 4.8.2 Measurement of soil resistivity at site by Wenner's four electrode method as per IS: 3043 – 1987 shall be carried out.
- 4.8.3 The maximum values of earth fault current for the design of the earthing system will be considered based on system requirement as follows:

33kV System	: 25kA for 3sec
11 kV System	: 20 kA for 1 sec

415 V System : (will be decided as per actual fault level calculation)

- 4.8.4 The neutral point of the 11/0.433kV transformers secondary windings shall be solidly earthed.
- 4.8.5 For, Transformer neutral (compact substation) maintenance free earthing as per IS-3043 with copper strip for earthing conductors shall be used.
- 4.8.6 For RMU, Lighting pole, DT box and service feeder pillar earthing, 4.5 meters GI Pipe earthing with GI strip shall be used.
- 4.8.7 Materials used for earth electrodes shall be designed to suit the ground conditions and shall be galvanised steel. Preferably the earth conductors buried in the soil are of MS material designed taking into consideration corrosion tolerance.
- 4.8.8 Earth Grid Conductors sizing
- a. The main earth grid conductor sizing shall be calculated based on the maximum fault current that the conductor has to withstand in a given time for a specific system. Following factors will be considered for sizing the earthing conductor:

a)	Design Ambient Temperature	45°C
b)	Allowable temperature rise for steel welded joints	500°C
c)	Fault clearing time	1 seconds
d)	Overall earthing resistance for other Substation	less than 1 ohm

#### 4.9 Smart LED Lighting System

##### 4.9.1 Incoming Power Supply arrangement for Street Lighting system

- (i) The 415V supply shall be tapped from nearest DT box / feeder pillar provided at proposed smart road or as per tapping point provided by RSCL/ CSPDCL within range of 100mtr of lighting Feeder pillar.
- (ii) The smart lighting controller provided for a group of maximum 25 lights to be controlled.
- (iii) The size of incoming cable from supply point to smart lighting controller shall be 3.5Cx35Sqmm, Al, XLPE, Armoured.
- (iv) The outgoing looping loop in and loop out cable shall be 4Cx10Sqmm, Al, XLPE, Armoured.



- 4.9.2 The list of identified roads is provided in the Annexure 3. The roads vary in width along its entire length. Maximum ROW width is being provided in the Annexure. The width of ROW to be considered for the design shall be inclusive of the shoulder width on either side or Carriage way.
- 4.9.3 Contractor shall design the system for each road keeping the following in view;
- a) The level and type of lighting adopted for a street shall be based on its traffic importance, both vehicular and pedestrian. However, the system of lighting to be provided should take into account all the relevant factors, such as the presence of factories, market, or places of public resort, the character of the street like trees, landscape etc.
  - b) Public lighting should permit users of the road at night to move about with the greatest possible safety and comfort so that the traffic capacity of the road at night is as much equal to that planned for the daytime as possible.
  - c) The driver should be able to see distinctly without the use of dipped or driving headlights and locate with certainty and in time all significant details notably the alignment of the road ( its direction and its surrounds)
  - d) The glare due to luminaries should be controlled at a value which keeps the visual discomfort to which the driver is subjected below an acceptable level as per the latest standard.
  - e) The pedestrian should be able to see distinctly the edges of the footways, vehicles and obstacles; dark patches should not occur.
  - f) The above aim shall be achieved with due respect to the aesthetic appearance of the lighted road within acceptable limits of cost of installation and maintenance.
- 4.9.4 All the required Design Factors shall be considered as per the latest version of IS 1944 and National Lighting Code 2010
- 4.9.5 Lighting design shall be performed using latest version of DiaLux Software (Version 4.12 or higher)/AGI-32/ Original Equipment Manufacturer (OEM) validated software. The Validation Report validated from Accredited Authority shall be submitted along with the BID.
- 4.9.6 Maximum power output of each Feeder Pillar for calculating the incoming cable size shall be considered not less than 10 kVA. The voltage drop at the terminals of the

farthest pole shall not exceed more than 3% from the Feeder Pillar. Cumulative voltage drop from HT to the farthest Point for one feeder Pillar group shall not exceed 5%.

4.9.7 The following criteria shall be followed for designing the lighting control system for the Identified roads;

- a) Only Group ON-OFF shall be provided for the roads having lights below 90W.
- b) Group ON-OFF Plus Dimming shall be provided for the roads having Lights equal to or above 90W.
- c) Dimming shall be possible up to 100% of the rated output.
- d) Dimmable driver shall be considered for only for Luminaires which are rated equal to or above 90W.
- e) Only Step-less Dimming shall be provided for the Luminaires where applicable

4.9.8 Lighting Design

Following factors shall be considered while arriving at the utilisation factor to determine the number of fixtures for each area.

- a) Maintenance Factor : 0.8
- b) Uniformity factor : 0.4.
- c) Road lighting will be designed to maintain
  - avg. 15lux on carriage way,
  - avg. 8-10lux on footpath.
- d) High Mast lighting at junctions will be designed to maintain 30lux avg.
- e) The lighting controller shall control maximum 25nos fixtures in group.

4.10 **Civil design**

4.10.1 All the civil foundation design shall be suitable for the Seismic requirement of Raipur as per latest IS.

4.10.2 The design shall also consider the maximum wind speed of min 150 kmph as per IS 875.

4.10.3 Grade of concrete to be used shall be M20 (1:1.5:3) and grade of reinforcement steel shall be Fe 500 or Fe415.

4.11 **Civil design of Manhole**

4.11.1 Min. size of manhole shall be 2mx2mx1.5m.

4.11.2 Grade of concrete to be used shall be M20 (1:1.5:3) and grade of reinforcement steel shall be Fe 500 or Fe415.

4.11.3 RCC Precast covers on Manhole.

4.11.4 HT manhole shall be provided at every min 90meters or maximum 100meters and LT manhole shall be provided at every 25meter of intervals.

#### 4.12 Lighting Pole foundation

The detail of pole foundation base plate and foundation shall be as per mentioned in table below:

Pole Height in meter	Foundation detail
5m	base plate size 200x200x12mm, foundation bolts 600mm long
6m	base plate size 220x220x12mm, foundation bolts 600mm long
7m	base plate size 220x220x12mm, foundation bolts 700mm long
9m	base plate size 260x260x16mm, foundation bolts 750mm long

#### 4.13 Sizing selection of DWC HDPE pipe

4.13.1 DWC HDPE pipe shall confirm to IS 14930 with ISI marked on all accessories like socket, bend, couplers etc.

4.13.2 Size DWC HDPE pipe for HT and LT main cable shall be 160mm dia. Min. no's of lay along road as per section drawings provided with tender.

4.13.3 DWC HDPE pipe of 63mm dia shall consider for ICT cable. 8nos pipe per side per road.

4.13.4 Service cable shall be lay in 63mm dia. DWC HDPE pipe as per site condition

#### 4.14 Sizing selection of Hume pipe for road crossing

150mm dia Size of RCC Hume pipe class NP-2 (in standard length of 2 metre).

#### 4.15 GI pipe

150mm dia G.I. pipe along with wall or pole/ support with 2 Nos MS clamps for support of cable for DT's.

#### 4.16 Cable route marker

a) cable route marker with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size ) of size 60 cm X 60 cm at the

bottom and 50 cm X 50 cm at the top with a thickness of 10cm shall be provided at every 50m of interval along road.

- b) RFID cable markers are provided at Junctions (32nos) for each cable on proposed smart road. The size of RFID cable marker 22.5cms dia, 1.5m depth, 134.0 kHz frequency.
- c) RFID marker locator- 8000 marker records, built in GPS module, 1.5m depth, range- 4x20 digit LCD.

#### 4.17 Confirmatory Survey

Contractor shall carry confirmatory survey of proposed smart road , inspect, measure and identify lighting pole and current situation of lighting system, Distribution Transformer, pole, Overhead lines, road crossing by overhead lines, service pole & service cable / line length, consumer per DT per service pole, consumer name , BP no, sanctioned load etc.

Confirmatory survey of DT (as per annexure-1) identify for conversion in CSS, space / location for installation & commissioning of CSS.

Mapping of all electrical equipments under this tender into Google map or any specified software design & developed by Contractor without any cost to employer.

#### 4.18 The System technical parameters for Different voltage level;

- a) 33kV System

Nominal System Voltage kV	33
Maximum system voltage kV	36
Rated impulse voltage withstand (peak) kV	170
Rated one-minute power-frequency withstand voltage (rms) kV	70
Rated short-time current (3 sec rms) kA	26.3
Rated Peak short-circuit current (peak value) kA	66
System earthing	Solidly earthed

- b) 11kV System

Nominal System Voltage kV	11
Maximum system voltage kV	12
Rated impulse voltage withstand (peak) kV	70
Rated one-minute power-frequency withstand voltage (rms) kV	28
Rated short-time current (3sec rms) kA	20
Rated Peak short-circuit current (peak value) kA	62.5

System earthing	Solidly earthed
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## c) LV System

Nominal System Voltage V	415
Maximum system voltage V	1100
Rated impulse voltage withstand (peak) kV	-
Rated one-minute power-frequency withstand voltage (rms) kV	3
Rated short-time current (1 sec rms) kA	20
Rated Peak short-circuit current (peak value) kA	62.5
System earthing	Solidly earthed

## d) AC Control, Lighting and Space Heating

Voltage	:	240 V
Phases	:	1
Frequency	:	50 Hz
Connection	:	2 wire (Phase & Neutral)

## 5 EQUIPMENT SPECIFICATION

The technical specification, given below has to be followed by contractor for designing / sizing of electrical equipment covered under Contractor's battery limits; However it is to be noted by contractor that, following this specification does not relieve contractor from adherence to the standards, regulatory requirements & best engineering practices.

### 5.1 Compact Substation

#### 5.1.1 Scope

This specification covers the design, construction, manufacture, inspection and testing at manufacturer works, delivery to site and commissioning and site testing, storage at site of Compact substation rated at 315kVA, 500kVA and 630kVA.

#### 5.1.2 Code & Standards

5.1.2.1 All equipment and material shall be designed manufactured and tested in accordance with the latest applicable Indian Standard / IEC standard.

5.1.2.2 The Compact Sub-station offered shall in general comply with the latest IS/ International standard including amendments of the following standards but not restricted to it.

Title	Indian & IEC Standards
High Voltage Low Voltage Pre-Fabricated Substation	IEC:61330 / 62271-202
Metal enclosed High Voltage Switchgear	IS: 13118, IS: 3427, IEC:60298 /62271-200
High Voltage Switches	IS:9920, IEC:60265
High Voltage Switchgear	IEC: 60694
Code of practice for selection, installation and maintenance of Switchgear	IS:10118
Distribution Transformer	IEC:60076
Low Voltage Switchgear and Control gear	IEC 60439

#### 5.1.3 General criteria for Compact Substation

5.1.3.1 The Compact Sub-station shall consist of 11KV SF6 Insulated Compact HV Switchgear / Ring Main Unit (consists of two Load Break Switch and one VCB), Dry type Transformer, L.T. Switchgear, APFC and FRTU with all connection accessories, fitting & auxiliary equipment in a pre-fabricated Enclosure to supply

Low-voltage energy from high-voltage system as detailed in this specification. The complete unit shall be installed on a substation plinth (base) as Outdoor substation. 11kV Load Break Cable Switches controls incoming-outgoing feeder cables of the 11kV ring distribution system. The SF6 / Vacuum Circuit Breaker shall be used to control and isolate the 11kV/433V Distribution Transformer. The transformer's L.T. side shall be connected to L.T. switchgear by means of Aluminium bus bar. The LV outgoing cables to service feeder pillar shall be taken out from the L.T. switchgear.

5.1.3.2 The pre-fabricated unitized substation shall be designed for:

- a) Compactness,
- b) Fast installation,
- c) Maintenance free operation,
- d) Safety for worker/operator & public.

5.1.3.3 The Switchgear and component thereof shall be capable of withstanding the mechanical and thermal stresses of short circuit listed in ratings and requirements clause without any damage or deterioration of the materials.

5.1.3.4 For continues operation at specified ratings temperature rise of the various switchgear components shall be limited to permissible values stipulated in the relevant standard and / or this specification.

5.1.4 Service Conditions:

5.1.4.1 The equipment offered shall be suitable for continuous satisfactory operation in tropical area of Installation.

5.1.4.2 The Enclosure consisting of High Voltage switchgear-control gear, Low Voltage switchgear-control gear & Transformer of the Unitized substation shall be designed to be used under normal outdoor service condition. The enclosure should take minimum space for the installation including the space required for approaching various doors & equipment inside. The enclosure construction shall be such that it fully protects ingress of rain water, dust & rusting.

5.1.4.3 The Compact Substation shall be suitable for continuous operation under the basic service condition indicated below:

Ambient Temperature	:	50 Deg C
Relative Humidity	:	upto 95%
Altitude of Installation	:	upto 1000m

5.1.5 Specific Requirement

The main components of a prefabricated-unitized substation are Transformer, High-voltage switchgear-control gear, Low-voltage switchgear-control gear, corresponding interconnections (cable, Flexibles, bus bars) & auxiliary equipment. The components shall be enclosed, by either common enclosure or by an assembly of enclosure. All the components shall comply with their relevant IS/IEC standards.

#### 5.1.6 Ratings:

Description	Unit	Value
Rated Voltage / Operating Voltage	kV rms	11
Rated frequency & Number of phases	Hz & nos.	50 & 3
Rated maximum power of substation	kVA	315/500/630
Rated Ingress protection class of Enclosure	IP	IP-23 for Transformer Compartment and IP-54 for LT and HT Switchgear Compartment
Rated temp Class of Transformer Compartment		
Transformer Losses@ 75deg	As per design basis	
HV Insulation Level		
Rated withstand Voltage at Power frequency of 50Hz	kVrms	28
Rated Impulse withstand Voltage	kV peak	75
HV Network & Bus bar		
Rated Current	Amp	630A
Rated short time withstand current	kA rms/3sec	21kA
Making capacity for switch dis-connector and earthing switches	kA peak	50kA
Breaking Load break switch (rated Current)	A	630A
LV Switchgear & Bus bars		
Bus bar rating	Amp	As per requirements
ACB	Amp /Pole	As per requirements
MCCB	Amp/Pole	As per requirements

#### 5.1.7 Outdoor Enclosure



- 5.1.7.1 The enclosure shall be made of 2.0 mm thickness Galvanized Sheet Steel tropicalised to meet local / Indian weather conditions including all the partition sheets & doors.
- 5.1.7.2 The structure of the substation shall be capable of supporting the gross weight of all the equipment & the roof of the substation compartment shall be designed to support adequate loads. In case of relocation of the Compact Substation, the entire substation should be capable of getting lifted and placed as a Single Unit without dismantling of any of the major equipment's inside. The lifting arrangement should be from the bottom of the enclosure & not from the top.
- 5.1.7.3 There shall be proper / adequate ventilation inside the enclosure so that hot air inside enclosure is directed out by help of duct. Louvers apertures shall be provided so that there is circulation of natural air inside the enclosure. The Compact Substation should be designed & engineering to have natural cooling & ventilation instead of forced cooling / ventilation as the same would derate the Transformer further and shall be an additional load on the Transformer.
- 5.1.7.4 The complete design shall be compartmentalized. The design of CSS should enclose all the equipment's in one single continuous enclosure. No equipment shall be placed outside the CSS enclosure.
- 5.1.7.5 The protection degree of the enclosure shall not be less than IP54 for HT & LT switchgear compartment and IP23 for Transformer Compartment.
- 5.1.7.6 **Interconnection:** The interconnection of HT switchgear to Transformer shall be with the help of 1Cx3X95mm<sup>2</sup> or suitable size of un-armoured Aluminium cables and from Transformer to LT switchgear with the help of suitable size of Aluminium bus bars.
- 5.1.7.7 **Internal Fault:** Failure within the Compact substation due either to a defect, an exceptional service condition or mal-operation may initiate an internal arc. Such an event may lead to the risk of injury if persons are present. It is desirable that the highest practicable degree of protection shall be provided and unit shall be tested for Internal Arc fault test adhering to as per latest IEC 61330 / 62271-202.
- 5.1.7.8 The compact substation shall be type tested for internal arc test AB for 20kA for 1sec (A-Operator, B-Pedestrian)
- 5.1.7.9 **Covers & Doors:** Covers & doors are part of the enclosure. When they are closed, they shall provide the degree of protection specified for the enclosure. All covers, doors or roof shall be provided with locking facility or it shall not be possible to open or remove them before doors used for normal operation have been opened. The

doors shall open outward at an angle of at least 90degrees & be equipped with a device able to maintain them in an open position. Proper padlocking facility shall be provided for doors of each compartment. Transformer compartment doors must be open from both the sides & should not have access from outside.

5.1.7.10 **Earthing:** All metallic components shall be earthed to a common earthing point. It shall be terminated by an adequate terminal intended for connection to the earth system of the installation, by way of flexible jumpers/strips & Lug arrangement. The continuity of the earth system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry. The components to be connected to the earth system shall include:

- a) The enclosure of Unitized / prefabricated substation,
- b) The enclosure of High voltage switchgear & control gear from the terminal provided for the purpose.
- c) The metal screen & the high voltage cable earth conductor,
- d) The transformer tank or metal frame of transformer,
- e) The frame &/or enclosure of low voltage switchgear

5.1.7.11 **Internal Illumination:** There shall be arrangement for internal lighting activated by associated switch on doors for HV & LV compartments separately.

5.1.7.12 **Labels:** Labels for warning, manufacturer's operating instructions etc. & those according to local standards & regulations shall be pasted / provided inside and shall be durable & clearly legible.

5.1.7.13 Painting and Fabrication process

- a) The paints shall be carefully selected to withstand tropical heat rain. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. For this purpose, powder coating shall be used.
- b) Special care shall be taken by the manufacturer to ensure against rusting of nuts, bolts and fittings during operation. All bushings and current carrying parts shall be cleaned properly after final painting.
- c) The fabrication process shall ensure that there are no sharp edges on the GI sheets used.

5.1.8 Test On Compact Substation

5.1.8.1 Type test:

The Compact substation shall be type tested as per IEC 61330/62271-202. The following type test shall be carried out on CSS;

- Test to verify Degree of protection

- Arcing due to internal fault
- Temperature rise test of Transformer
- Test to verify the withstand of the enclosure of the prefabricated substation against mechanical stress
- Short circuit test and rated short time withstand current

#### 5.1.8.2 Routine Test

The following routine test shall be conducted on CSS;

- Voltage test on auxiliary
- Function test
- Verification of complete wiring

## 5.2 Technical Specification of 11kV SF6 Metal Enclosed, Indoor Ring Main Unit (RMU)

The RMU should be complete with all components necessary for its effective and trouble free operation along with associated equipment etc. such components should be deemed to be within the scope of supplier's supply. The RMU should be fixed type SF-6 insulated, vacuum circuit breakers with O/C & E/F relay for the protection of the transformer. It should be maintenance free equipment, having stainless steel robotically welded IP67 enclosure.

### 5.2.1 Codes And Standards

5.2.1.1 The Ring Main Unit (RMU) should be designed, manufactured and tested according to the latest version of:

Common Specifications for High Voltage Switchgear and control gear standards	IEC60694
Ac metal enclosed switchgear and control gear for rated voltages above 1kV and up to and including 72kV	IEC62271-200 , IEC60298
Alternating current disconnections (Isolator) and earthing switches	IEC 60129 /62271-102
Classification of degrees of protection provided by enclosures	IEC 60529
Switches part-1: switches for rated voltage above 1kV and less than 52kV	IEC 60265
Circuit breakers	IEC 60056
High Voltage alternating current switch fuse combinations	IEC 60420

Current Transformers	IEC 60185
Voltage Transformer	IEC 60186
Electrical relays	IEC 60255

5.2.1.2 Any other codes recognized in the country of origin of equipment might be considered provided that they fully comply with IEC standards.

5.2.1.3 The design of the switchgear should be based on safety to personnel and equipment during operation and maintenance, reliability of service, ease of maintenance, mechanical protection of equipment, interchange ability of equipment and ready addition of future loads.

5.2.2 The RMU shall be suitable for continuous operation under the basic service condition indicated below:

Ambient Temperature	:	50 Deg C
Relative Humidity	:	upto 95%
Altitude of Installation	:	upto 1000m

5.2.3 Technical features of RMU

5.2.3.1 Non-extensible SF6 Insulated Compact Switchgear shall consist of following items:

- a) Load Break Cable Switch with integral earth switch having full making capacity shall be used for Incoming cables.
- b) SF6 / Vacuum Circuit Breaker shall be used for distribution network of HT switchgear. Circuit Breaker complete with operating mechanism, O/C, E/F protection relay with associated Current Transformers shall be used for control and protection of Transformer. An integral cable earthing switch with full making capacity shall be provided.
- c) The Load Break Cable Switch, Vacuum circuit breaker, Bus bars should be mounted inside a sealed for life, cast resin / stainless steel tank. The operating mechanism of the switches and breakers shall be outside the SF6 tank and accessible from front. The tank should be filled with SF6 gas at an adequate pressure. The degree of protection for gas tank should be IP67. There shall be provision for filling the SF6 gas at site. Moreover, the Cast Resin / Stainless Steel Gas Tank shall confirm to the sealed pressure system as per IEC and ensure the gas leakage to 0.1 % per year as per IEC.

5.2.3.2 General Finish

The panel shall be totally enclosed, metal enclosed, vermin and dust proof suitable for tropical climate use as detailed in the specification.

#### 5.2.3.3 Ratings

The bus bars shall have continuous rating of 630 Amps. The isolator shall have a continuous rating of 630 Amps. SF6 Circuit Breaker or Vacuum Circuit Breaker shall have a continuous rating of 630 Amps. in accordance with relevant IS / IEC standard

#### 5.2.3.4 Breaking & Making Capacity

The Load Break Cable Switches shall be capable for breaking rated full load current. The same along with its earthing switch shall also be suitable for full making capacity of the system as specified. The complete switchgear shall be suitable for breaking capacity of 21kA symmetrical at 11000 volts three phase for 11kV system for 1 sec.

#### 5.2.3.5 Bus bar

Switchgear shall be complete with all connection, bus-bars etc. Copper busbars continuous rating shall be 630 Amps. The busbars should be fully encapsulated by SF6 gas inside the tank.

#### 5.2.3.6 Remote Operation

All isolator & Breakers shall be there for remote operation of the switchgear's Isolator & Breaker shall be possible using Motors fitted to the operating mechanism.

#### 5.2.3.7 Protection

The circuit breaker shall be fitted with static type self-powered relay inside the front cover to avoid any tampering. The same shall be used in conjunction with suitable CT's and Tripping Coil for fault tripping of the Circuit Breakers. CT's shall be mounted on bushing of breaker. CT's mounted on cable inside cable compartment are also acceptable.

#### 5.2.3.8 Cable Termination

Each Cable compartment shall be provided with three bushings of adequate sizes to terminate the incoming outgoing 11kV, 1X3Cx300Sqmm cables as the case may be. There shall be enough height from the base of the mounted switchgear so that the cables can be bent and taken vertically up to the bushings. The Cable termination shall be done by Heat shrinkable Termination method so that adequate clearances shall be maintained between phases for Termination. Cable Termination boots shall be supplied by the switchgear manufacturer. Cable boxes shall be arc proof and interlocked with respective earthing switches.

#### 5.2.3.9 Earthing of the main circuit

The moving contacts of the earthing switch shall be visible in the closed position through transparent covers.

#### 5.2.3.10 Locking Arrangement

Suitable padlocking arrangements shall be provided as stated below:

- a) Circuit Breaker motorized operating handle in the “OFF” position.
- b) Each feeder Panel operating handle in ‘Closed’ ‘Open” or ‘Earth’ position.
- c) Each isolator operating handle in ‘Closed’, ‘Open’, or ‘Earth’ position.

#### 5.2.3.11 Fault passage Indicators (FPI)

Fault Passage Indicators (FPI) shall be provided to facilitate quick detection of faulty section of line.

- a) The fault indication may be on the basis of monitoring fault current flow through the device.
- b) The unit should be self-contained requiring no auxiliary power supply.
- c) FPI shall be integral part of RMU to avoid thefts. The FPI shall have clear display, automatic reset facility and shall be SCADA compatible.

#### 5.2.3.12 Ratings:

The Switchgear shall be Non –extendible Compact Switchgear with Ring main unit and Vacuum Circuit breaker in SF6

The technical data of Switchgear is shown below:

Description	Rating
• <b>Switchgear data</b>	
Voltage rating	12kV
Service	Indoor
Type	Metal clad
Number of Phases	3
Rated Frequency	50 Hz
Rated Current	630 Amp (isolator)
Short circuit rating	
Breaking	21kA rms for Breaker
Short time withstand for 3sec	21 kA rms
Making capacity	52.5 kA peak for Breaker
Rated insulation level kVrms	28 kV
Rated level kV impulse	75 kV

System earthing	Solidly earthed at substation
• <b>Circuit Breaker</b>	
Type	SF6 / Vacuum Breaker in SF6 tank
Rated voltage	12kV
Breaking current	
i) Load breaking	21 KArms.
Making current	52.5 KA peak
Rated current	630 Amps.
Operating mechanism.	Trip free & free handle type with mechanically operated indication & pad locking.
○ Isolators	
Type	Load breaking and fault making in SF6 tank
Rated current	630 Amps.
Rated breaking capacity	630 Amps.
Fault making capacity	52.5 KA peak
No. of poles	3
Operating mechanism	Operating handle with ON, OFF, Earth positions with arrangement for padlocking in each position.
○ Busbars	
Material	Copper
Type	SF6 insulated
Rated Current	630 Amps

#### 5.2.3.13 General data, enclosure and dimensions

- Standard to which Switchgear complies : IEC
- Type of Ring Main Unit Metal Enclosed, Panel type, Compact Module.
- Number of phases :3
- Whether RMU is type tested :Yes
- Whether facility is provided with pressure relief: Yes
- Insulating gas :SF6
- Nominal operating gas pressure :1.4 bar abs. 20° C
- Gas leakage rate / annum % : 0.1% per annum
- Expected operating lifetime : 30 years
- Whether facilities provided for gas: Yes, temperature compensated manometer Monitoring can be delivered
- Material used in tank construction Stainless steel sheet

#### 5.2.3.14 No Operations, degree of protection and colours

Rated operating sequence of Circuit Breaker: O –3min-CO-3min-CO

Total opening time of Circuit Breaker: Approx. 40-50ms

Closing time of Circuit Breaker : approx. 30-45ms

Mechanical operations of switch CO 1000

Mechanical operations of CO earthing switch: 1000

Mechanical operations of circuit breaker: CO 2000

Principle switch / earth switch : 3position combined switch

5.2.3.15 Degree of protection:

High Voltage live parts,	SF6 tank IP 67
Front cover mechanism	IP 2X for Indoor
Cable covers	IP 3X for Indoor

5.2.3.16 Colours:

Front cover	7035
cable cover	7035

5.2.3.17 Load Break Switch:

The Load Break Switch offered shall conform to IS: 4710/9920 as amended to date. The LBS shall be triple pole, spring assisted, hand operated, and non-automatic type with quick break contacts. The operating handle shall have three positions 'ON', 'OFF' and 'EARTH' which shall be clearly marked with suitable arrangement to padlock in any position. A safety arrangement for locking shall be provided by which the isolator operation shall be prevented from 'ON' position to 'EARTH' position or vice versa.

5.2.3.18 Switchgear:

The switchgear will have sealed for life, the enclosure shall meet the "sealed pressure system" criteria in accordance with latest IEC: 298 (a system for which no handling of gas is required throughout service life of approximate 30 years.) There shall be no requirement to 'top up' the SF6 gas. In addition, manufacturer shall confirm that maximum leakage rate is lower than 0.1% per year. It shall provide full insulation, making the switchgear insensitive to the environment. Thus assembled, the active parts of the switchgear unit shall be maintenance free.

The switchgear shall be designed so that the position of different devices is visible to the operator on the front of the switchboard & operations are visible as well. The switchboard shall be designed so as



to prevent access to all live parts during operation without the use of tools.

**RMU should be tested for internal arc fault test.**

**5.2.3.19 Circuit Breaker:**

The unit shall consist of SF6 / VCB, with integral fault making / dead breaking earth switch. These shall be triple pole single throw and suitable for local /remote operation. The function shall be naturally interlocked to prevent the main & earth switch from being switched 'ON' at the same time & the circuit breaker not allowed to trip in 'Earth On' position. The selection of the main/earth switch lever on the panel, which is allowed to move only if the main or earth switches in the off position. The lever shall be able to pad locked in either the main or earth position.

Circuit Breaker shall be provided with the following accessories, unless otherwise specified:

- Mechanical ON/OFF/EARTH Indication
- Mechanical charge/discharge indicator
- Auxiliary contacts 2NO and 2NC
- Tripped on fault indicator
- "Live Cable" LED Indicators through Capacitor Voltage Dividers mounted on the bushings.

**5.2.3.20 Protection:**

Protection Relays: The Circuit breaker shall be fitted with static type self-powered relay inside the front cover to avoid any tampering.

**5.3 TECHNICAL REQUIREMENTS OF FRTU**

**5.3.1 General**

The Feeder Remote Terminal Unit (FRTU) shall be installed in Ring Main Units (RMUs). FRTU shall be used for control of switching devices such as breaker, isolator inside RMU.

**5.3.2 Design Standards**

The FRTUs shall be designed in accordance with applicable International Electro-technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply.

### 5.3.3 FRTU Functions

As a minimum, the FRTU shall be capable of performing the following functions unless otherwise specified:

Load break switch status (ON/ OFF)

- Load Break switch Local/ remote control
- FPI operated
- Earth switch status (ON/ OFF)
- Breaker status (ON/ OFF)
- Breaker auto trip
- Breaker Local/ Remote control
- Equipment healthiness: Gas pressure, Trip Circuit healthy, Number of operations
- Transformer healthiness
- Energy consumption data
- Protection data (setting / events / fault-history)

5.3.4 FRTU shall perform the following operations through SCADA/ DMS from remote, unless otherwise specified:

- Load Break switch OPEN/ CLOSE
- Load Break switch Local/ remote control
- FPI reset
- Circuit Breaker OPEN/ CLOSE
- If only the local control & monitoring is proposed for CSS as a minimum the provision shall be there for remote operation of the Load Break Switch & Breaker if so required at a site at a later date. Remote operation shall be possible using Motors fitted to the operating mechanism at site as and when required.

## 5.4 Technical Specification of Distribution Transformer (Cast Resin Dry Type Transformer)

### 5.4.1 Scope:

This specification covers the requirements of design, manufacture, testing and supply of cast resin dry type transformers complete with all the accessories and fittings for efficient and trouble-free operation.

#### 5.4.2 Codes & Standards

The equipment covered by this specification shall, unless otherwise stated to be designed, constructed and tested in accordance with latest revisions of relevant Indian standards / IEC publications.

IS 1271	-	Classification of Insulating Materials.
IS 2026	-	Power transformers (part I - V)
IS 2099	-	Bushing for alternating voltages above 1000 V
IS 2705	-	Current transformers
IS 3202	-	Code of practice for climate proofing
IS 3639	-	Power transformer fittings and accessories
IS 4257	-	Porcelain bushings for transformers
IS 11171	-	Dry type Transformer
IS 8478	-	Application guide for tap-changers
IS 10028	-	Code of practice for selection, installation and Maintenance of transformers.

#### 5.4.3 General Design Features

- 5.4.3.1 All transformers shall be of the latest design, dry type Cast Resin only.
- 5.4.3.2 The type of cooling shall be Natural Air cooled (AN) and the corresponding ratings for each transformer shall be as indicated in the specific requirements.
- 5.4.3.3 Each transformer shall be suitable for operation at full rated power on all tapings without exceeding the applicable temperature rise.
- 5.4.3.4 It shall be possible to operate the transformer satisfactorily, with the loading guide Specified in IS-6600. There shall be no limitations imposed by bushings, tap changers, Auxiliary equipment to meet this requirement.
- 5.4.3.5 The transformers shall be designed to be capable of with-standing, without injury, the thermal and mechanical effects of short-circuits between phases or between phase and earth at the terminals of any winding with full voltage applied across the other winding for periods given in relevant standards. There shall be no limitations imposed by any part/component of the transformer/off load tap links to meet the short circuit level Specified.
- 5.4.3.6 Each transformer shall be designed for minimum no-load and load losses within the economic limit and shall be able to have minimum loss at the rated load condition.
  - a) All electrical connections and contacts shall be of ample cross sections for carrying the rated current without excessive heating.
  - b) The transformer shall be capable of continuous operation at full load rating

under the following conditions.

Voltage variation =  $\pm 10\%$

Frequency variation =  $\pm 5\%$

Combined voltage and frequency variation (Absolute sum) = 10%

#### 5.4.4 Construction

- 5.4.4.1 The transformer shall be dry type, AN cooled suitable for Compact substation application.
- 5.4.4.2 The core-clamping frame shall be provided with lifting eyes having ample strength to lift the complete core and winding assembly.
- 5.4.4.3 Off circuit tapings shall be provided on the HV windings. Tap changing is done by means of off-circuit links accessible through openings provided.
- 5.4.4.4 The lifting lugs and rollers shall be provided. A winding temp. Scanner shall be provided and is actuated by means of resistance temperature detectors embedded in LV windings of all three phases. It should have alarm and trip contacts at a specified temperature.
- 5.4.4.5 The transformer shall be of IP00 protection class and will be installed in the transformer compartment of compact substation having IP23 protection class.

#### 5.4.5 Windings

- 5.4.5.1 The winding insulation shall be of Class 'H' and temperature rise limit to 90 deg. C
- 5.4.5.2 Windings shall be of electrolytic copper conductors (circular in shape) of high conductivity and 99.9% purity.
- 5.4.5.3 Windings shall be designed to withstand the specified thermal and dynamic short circuit stresses.
- 5.4.5.4 The windings shall be duly sectionalized. Accessible joints brazed or welded and finished smooth shall connect similar sections. No corona discharge shall result on the winding upon testing the transformer for induced voltage test as specified in IS.
- 5.4.5.5 The end turns of the high voltage windings shall have reinforced insulation to take care of the voltage surges likely to occur during switching or any other abnormal condition.
- 5.4.5.6 The high voltage and low voltage winding are shall be made of copper Conductors. HV winding will be always being resin casted under vacuum while LV winding can either be casted or pre-impregnated with resin.

#### 5.4.6 CORE

- 5.4.6.1 The double wound Core shall be constructed from non-ageing cold rolled Grain oriented steel sheets. The built core shall be painted with high temperature

resistant paint to prevent corrosion at the edges of core plates and to withstand high temperatures. By using different core material optimisation of core losses shall be achieved. The yokes shall be firmly clamped between yoke channels or plates. The top & bottom yoke frames shall be secured to each other by means of tie-rods, which help in securing the winding in place.

5.4.6.2 The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and the production of flux component at right angles to the planes of laminations which may cause local heating.

#### 5.4.7 OFF-CIRCUIT TAP Changing links

- Off circuit tapings are provided on HV windings. Tap changing is done by means off circuit links. Use of tap changing links eliminates any moving parts as against a manually operated tap changer.

#### 5.4.8 Terminal Arrangement

- HV side and LV side of transformer will have the top busbar arrangement for connection of HT side by means of cable and LT side by means of busbar.

#### 5.4.9 Technical particulars of dry type transformer

SR. NO.	DESCRIPTION	PARTICULARS
01	Type	Three Phase, 50 Hz, Core Type, Two Winding, Cast Resin Dry Type Transformer
02	Rating ( kVA )	315 / 500 / 630
03	Winding material	Copper
04	No load voltage ratio	11 / 0.433 kV
05	Connection a) HV b) LV	Delta Star with neutral
06	Vector group	Dyn11
07	Insulation level (kVp/ kVrms) a) HV b) LV	75 / 28 - / 03
09	Type of Tap Changer for giving voltage variation to HV	Off circuit tap links
10	Tapping range	+5 % to -5 % in step of 2.5%
11	Temperature rise winding over ambient temperature	90 °C
12	Class of Insulation	Class 'H'
13	Enclosure	IP 00 ( Without Enclosure )
14	Method of Cooling	AN (Air Natural)
15	No load losses at rated voltage & frequency (IS Tol.)	
16	Full load loss at principle tap at 75 °C (IS Tol.)	As per design basis

17	Termination HV LV	Busbar Busbar
18	Fittings for Dry type	2 Numbers Earthing Terminals, Rating and Diagram Plate, Bi-Directional Rollers, Lifting Lugs, Winding Temp Scanner.
19	Paint	Enamel-RAL 7032 (Siemens Grey)
20	Guaranteed losses at 75°C and at normal tap position as per IS tol.	315KVA 500KVA 630KVA
20.1	No Load loss (KW)	0.8 1.1 1.3
20.2	Full Load loss (KW)	2.6 4.2 6.1
20.3	Total loss (KW)	3.4 5.3 7.4

#### 5.4.10 Painting

5.4.10.1 All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents as required to produce a smooth surface free of scale, grease and rust.

5.4.10.2 The external surface, after cleaning, shall be given a coat of high quality red oxide or yellow quoted primer, followed by filler coats.

#### 5.4.11 Tests And Test Certificates

The transformer shall be subjected to all the routine, type and special tests as per IS-11171 and 2026 / IEC 60076/ IEC62271-202.

##### 5.4.11.1 Routine Test

All Routine Tests in accordance with IEC 60076 / IS 2026 shall be carried out on each transformer.

The following shall constitute the routine tests:

- Measurement of winding resistance
- Measurement of voltage ratio and check of voltage vector relationship
- Measurement of impedance voltage (principal tapping), short circuit impedance and load losses
- Measurement of no-load losses and current
- Separate source voltage withstand test
- Induced over-voltage withstand test

##### 5.4.11.2 Type test

The following shall constitute the type tests:

- Lightning impulse test

- Temperature rise test

#### 5.4.11.3 Special Tests

The following tests may be carried out:

- Short circuit withstand test
- Measurement of acoustic sound level
- Partial discharge measurement
- Mechanical tests: IP test on enclosure

### 5.5 Technical Specification of Low Voltage Switchgear

#### 5.5.1 Code & standards

IEC-439-1, 1992	Low voltage Switch gear and Control gear assemblies Part-I, type tested and partially type tested assemblies.
IEC-947-1, 1998	Low voltage Switch gear and Control gear Part-I general rules.
IEC-1180-1, 1992	High voltage test techniques for low voltage equipment Part-I definition test and Procedure requirement
IEC-529, 1989	Degree of protection provided by enclosures (IP code)

#### 5.5.2 System

- Declared voltage** :– 3 Phase, 433V ( $\pm 5\%$ ) 50 Hz,
- Neutral**: – Solidly earthed at substation.
- Busbar** – Aluminum

5.5.3 General finish:- Tropical, totally enclosed, metal-clad, weather-proof, vermin and dust proof.

#### 5.5.4 LT Circuit Ways:

- **Incomer**
  - 315 KVA – 630A 4P MCCB
  - 500 KVA - 800A 4P ACB
  - 630 KVA - 1000A 4P ACB
- **Outgoing**
  - 315 KVA – 250A 4P MCCB of 6no's
  - 500 KVA - 250A 4P MCCB of 6no's
  - 630 kVA - 250A 4P MCCB of 6no's

#### 5.5.5 General Characteristics of ACB

##### 5.5.5.1 Conformity with Standards

The air circuit-breakers used in low voltage installations are constructed and tested

in accordance with the IEC 947/IS 947 Standards and respect the following EC directives:

- a) "Low voltage Directive" (LVD) No. 73/23 EEC
- b) "Electromagnetic compatibility Directive" (EMC) No.89/336 EEC

#### 5.5.5.2 Functional characteristics

- a) The circuit-breakers must have a rated service voltage of 690 V AC and a rated insulation voltage of 1000 V.
- b) The circuit-breakers must have a rated impulse withstand voltage of 12 kV.
- c) The rated uninterrupted current must be between 800 and 6300 A with the possibility of selection of ratings from 400 A.
- d) Different versions shall be available with rated ultimate short circuit breaking capacity (Icu) from 50kA at 415V and shall have rated short circuit service breaking capacity (Ics) equals to Icu.
- e) Different versions of circuit-breakers shall be available with rated short-time withstand current (Icw -1 sec) for 50kA for 1sec in category B.
- f) It must be possible to supply the circuit-breakers both from the top and bottom terminals without derating their performances and without jeopardising their functionality.
- g) The mechanical life must be at least 12000 operations, without the need for maintenance of the contacts and arcing chambers.

#### 5.5.5.3 Environmental characteristics

- a) Operating temperature: -25 °C...+70 °C
- b) Storage temperature: -40 °C...+70 °C
- c) Altitude: 1000m
- d) Suitability for use in a hot-humid environment. With regard to this, the circuit-breakers must undergo a tropicalisation process which makes them suitable for use in a hot-humid environment, as established by the prescriptions of the main shipping registers and in accordance with the international IEC 60068-2-30 Standards.

#### 5.5.5.4 Construction characteristics

- i) The circuit-breaker structure must be made of steel sheet.
- ii) There must be total segregation between power and front shield, using double insulation where suitable so as to guarantee maximum operator safety.
- iii) Total segregation between the phases must be guaranteed for safety reasons.
- iv) The main contacts must be separate from the arcing contacts in cat. B circuit-breakers only.



- v) It must be possible to inspect easily the arcing chambers easily and to check main contact wear with the circuit-breaker racked-out, by removing the arcing chambers.
- vi) All the circuit-breakers in the range have the same height and depth with the aim of standardising the supporting structures of the switchgear and the switchgear itself as far as possible.
- vii) The circuit-breakers must indicate the precise position of the main contacts and the condition of springs charged/discharged on the front, by means of certain and reliable signals.
- viii) The operating mechanism must be of the stored energy type with operation by means of precharged springs fitted with antipumping device. The springs are charged manually by activating the front lever, or by means of a geared motor, supplied on request.
- ix) The whole range of air circuit-breakers must be fitted with electronic protection releases. It must be allowed the interchangeability of protection releases from skilled personnel.
- x) ACBs shall have minimum watt losses in order to restrict temperature rise inside the breaker.

#### 5.5.6 RELEASES

##### 5.5.6.1 Release (Protection functions)

- a) The release must not require auxiliary power supplies since the power is taken from the current transformers.
- b) The signals supplied by the release must not operate with power supply supplied by internal batteries. The basic version of the release must provide:
  - c) protection against overload with trip with inverse long time delay (L)
  - d) protection against instantaneous short-circuit (I)
  - e) Selective short-circuit (S)
  - f) Earth fault (G)
- g) The setting ranges shall be:
  - i. Protection against overload (L)
    - Characteristic  $t=k/I^2$
    - Trip threshold  $I_1=(0.4...1) \times I_n$  with timing adjustable from 3 to 144 sec. (value referred to a current equal to  $3 \times I_1$ )
  - ii. Protection against selective short-circuit (S)

- Characteristics  $t=k$  and  $t=k/I_2$
- Trip threshold  $I_2=(1...10) \times I_n$  with timing adjustable from 0.1 to 0.8 sec. (value referred to a current equal to  $10 \times I_n$  for curves at  $t=k/I_2$  and referred to currents  $>I_2$  for curves at  $t=K$ )
- iii. Protection against instantaneous short-circuit (I)  
Trip threshold  $I_3=(1,5...15) \times I_n$
- iv. Protection against earth fault (G)  
Characteristics  $t=k$  and  $t=k/I_2$   
Trip threshold  $I_4=(0.2...1) \times I_n$  with timing adjustable from 0.1 to 0.8 sec. (value referred to a current equal to  $4 \times I_4$ )
- v. Neutral protection level:  
50% - 100% - 200% - excluded  
All the protection functions except protection against overload must be excludable
- h) User interface and signalling LEDs
  - i. The release shall allow parameterisation of the trip thresholds and timing by means of dipswitches.
  - ii. Alarm and trip signaling for all the protection functions by means of LEDs located on the release shall be available. No batteries or external power supplies shall be necessary for powering these indicators. The indication shall be available for not less than 48 hours after the trip, even with the circuit-breaker open.
  - iii. An alarm shall indicate by means of LEDs located on the release the disconnection of opening solenoid and current transformers. A trip shall also occur, after a short time delay, when the disconnection is detected.
  - iv. It shall be possible, with the aid of external devices, to read currents, and information on last 10 trips (currents, protection tripped) occurred to the unit.

### 5.5.7 MCCB with Thermal Base release

#### 5.5.7.1 Standards conformity

Moulded case circuit-breakers (MCCB) installed in the low voltage plant must be designed, manufactured and tested according with the international standards IEC 60947-1, IEC 60947-2, IEC 60947-3, IEC 60947-4-1, IEC 61000 or with the corresponding harmonized national standards, the CE "Low Voltage Directives" (LVD) n° 73/23 EEC and "Electromagnetic Compatibility Directive" (EMC) n° 89/336 EEC.

#### 5.5.7.2 Moulded case circuit breakers functional features

- i. Rated insulation voltage ( $U_i$ ) for MCCB shall be 800 V AC or more.
- ii. Rated Impulse withstands voltage ( $U_{imp}$ ) for MCCB's shall be 8kV.
- iii. Rated service voltage( $U_e$ ) for the moulded case circuit breaker shall be standard as 690V, however performance on short circuit level shall be consider based on system operating voltage.
- iv. Rated uninterrupted current between varying from 160 and 800 A with trip units settings starting from 1 A
- v. Rated short circuit breaking capacity shall be considered as per bill of material and the rated service short circuit breaking capacity ( $I_{cs}$ ) shall be in 50-100% of rated ultimate short circuit breaking capacity ( $I_{cu}$ ).
- vi. According to IEC 60947-2 starting from 400 A the circuit breakers must be category B, however other small rating category A shall be confirmed.
- vii. MCCBs must be available with different ultimate short breaking capacities between 16kA and 20kA @ 380/415 V AC.
- viii. Both line up and line down supplying must be possible without decreasing MCCBs performances or functionality.
- ix. MCCB shall confirm to current limiting type and this feature shall ensure less amount of let through energy at the time of opening on fault. The MCCB shall have opening time less then 10msec for current rating upto 800A.
- x. A test bottom for the correct functionality checking (moving contacts opening) must be place in front of the breaker.

#### 5.5.7.3 Ambient characteristics

- Operating temperature: -25 °C .. +70 °C
- Storage temperature: -40 °C .. +70 °C
- Reference temperature for setting the thermal element of the thermo magnetic trip unit: +40 °C
- Maximum relative humidity: 98%
- Altitude: 1000 m Suitability for being used in hot-humid places.

#### 5.5.7.4 Construction characteristics

- a) By means of the double insulation technique, moulded case circuit-breakers must guarantee complete separation between the power circuits and the auxiliary circuits.
- b) Moulded case circuit-breakers must have an operating lever which always indicates the exact position of the circuit-breaker contacts (positive operation), by means of safe and reliable signals (I= closed, O= open, yellow-green line= open due to trip unit).

- c) Moulded case circuit-breakers must be suitable for isolation in compliance with § 7.2.7 of the IEC 60947-2 Standard. This indication must be clearly and indelibly marked on the circuit-breaker (in accordance with IEC 60947-2) and in a position where it is visible with the circuit-breaker installed.
- d) Moulded case circuit-breakers with rated uninterrupted current up to 250 A shall have a 45 mm high face which makes them suitable for installation on modular panels.
- e) For the front parts of the circuit-breakers the degree of protection of at least IP20 (excluding the terminals) must be guaranteed.

#### 5.5.8 Protection trip units

##### 5.5.8.1 Thermo magnetic over current trip units

- i. Thermo-magnetic trip units shall be fitted with protection threshold against overload (whose thermal element must consist of a bimetal) and with protection threshold against short circuit.
- ii. The protection threshold against overload must be continuously adjustable starting from 0.7 times the rated current of the trip unit and up to its rated value.
- iii. The reference temperature for setting the thermal element of the protection trip unit is 40°C. The temperature performance of the trip unit must be indicated as the temperature varies.
- iv. The protection threshold against short-circuit can be either the fixed or adjustable type with continuity from 5 and up to 10 times the rated current of the trip unit. For current rating upto 250Amps, magnetic threshold be minimum of 10 times of rated current.

##### 5.5.8.2 Magnetic only over current trip units

- The over current trip units with magnetic only threshold shall be suitable for protection against short-circuit.
- The adjustable magnetic only trip units (suitable for motor protection) shall only be available in the three-pole version, whereas those with fixed threshold shall also be available in the four-pole version.
- The adjustable magnetic only trip units must be available for circuit-breakers up to 250 A with an upper magnetic threshold equal to  $I_m = 3200$

#### 5.5.9 MCCB with microprocessor based release

##### 5.5.9.1 Standards conformity

Moulded case circuit-breakers (MCCB) installed in the low voltage plant must be designed, manufactured and tested according with the international standards IEC 60947-1, IEC 60947-2, IEC 60947-3, IEC 60947-4-1, IEC 61000 or with the

corresponding harmonized national standards, the CE “Low Voltage Directives” (LVD) n° 73/23 EEC and “Electromagnetic Compatibility Directive” (EMC) n° 89/336 EEC.

#### 5.5.9.2 Moulded case circuit breakers functional features

- b. Rated insulation voltage ( $U_i$ ) for MCCB shall be 800 VAC or more.
- c. Rated Impulse withstand voltage ( $U_{imp}$ ) for mccb's shall be 8kV.
- d. Rated service voltage ( $U_e$ ) for the moulded case circuit breaker shall be standard as 690V, however performance on short circuit level shall be consider based on system operating voltage.
- e. Rated uninterrupted current between varying from 160 and 3200 A with trip units settings starting from 10A
- f. Rated short circuit breaking capacity shall be considered as per bill of material and the rated service short circuit breaking capacity ( $I_{cs}$ ) shall be in 100% of rated ultimate short circuit breaking capacity ( $I_{cu}$ ). ( $I_{cs}=I_{cu}$ )
- g. According to IEC 60947-2 starting from 400 A the circuit breakers must be category B, however other small rating category A shall be confirmed.
- h. MCCBs must be available with different ultimate short breaking capacities between 16kA and 20kA @ 380/415 V AC.
- i. Both line up and line down supplying must be possible without decreasing MCCBs performances or functionality
- j. MCCB shall confirm to current limiting type and this feature shall ensure less amount of let through energy at the time of opening on fault. The MCCB shall have opening time less then 10msec for current rating upto 630A, and less them 15msec for current rating upto 1600Amps.
- k. A test bottom for the correct functionality checking (moving contacts opening) must be place in front of the breaker.

#### 5.5.9.3 Ambient characteristics

- a. Operating temperature: -25 °C .. +70 °C
- b. Storage temperature: -40 °C .. +70 °C
- c. Maximum relative humidity: 98%
- d. altitude: 1000 m sea level
- e. Suitability for being used in hot-humid places.
- f. Circuit-breakers fitted with electronic trip units must comply with the prescriptions of the International Standards on electromagnetic compatibility.

#### 5.5.9.4 Construction characteristics

- i) The range of moulded case circuit-breakers must cover a range of rated uninterrupted currents from 160 to 3200 A.
- ii) By means of the double insulation technique, moulded case circuit-breakers must guarantee complete separation between the power circuits and the auxiliary circuits.
- iii) Moulded case circuit-breakers must have an operating lever which always indicates the exact position of the circuit-breaker contacts (positive operation), by means of safe and reliable signals (I= closed, O= open, yellow-green line= open due to trip unit).
- iv) Moulded case circuit-breakers must be suitable for isolation in compliance with IEC 60947-2 Standard. This indication must be clearly and indelibly marked on the circuit-breaker (in accordance with IEC 60947-2) and in a position where it is visible with the circuit-breaker installed.
- v) Moulded case circuit-breakers with rated uninterrupted current up to 250 A shall have a 45 mm high face which makes them suitable for installation on modular panels.
- vi) The same depth must be guaranteed from 320 A up to 1000 A, in order to standardize both switchboards and their supports.
- vii) All the installation positions must be possible without jeopardizing the function of the apparatus. Starting from 630 A up to 1600 A the withdrawable version shall be mounted and operated horizontally.
- viii) For the front parts of the circuit-breakers the degree of protection of at least IP20 (excluding the terminals) must be guaranteed.

#### 5.5.9.5 Protection trip units

- a) From the 250 A size circuit-breakers, the trip unit must be interchangeable.
- b) Electronic over current releases
- c) The electronic over current trip units must be self-supplied and must be able to guarantee correct operation of the protection functions even in the presence of a single phase supplied with a current value equal to 20% of the phase current.
- d) They must be unaffected by electromagnetic interference in compliance with the EMC directive on the matter.
- e) The basic version shall be fitted with protection functions against overload (function L) and against short-circuit. The latter function can either be of the instantaneous type (function I) or, alternatively, with intentional delay (function S). The function of protection against short circuit must be excludable. A basic

version shall also be provided with only the protection threshold against instantaneous short-circuit which cannot be excluded.

- f) The minimum performances of the protection functions of the electronic protection trip unit for distribution, where present, must be:
- Function L: adjustable trip threshold  $I_{L1} = (0.4 \dots 1) \times I_n$ , trip curves for the basic version with times from 3 to 12 seconds – 2 different trip curves - (at 6 times the set threshold). Cannot be excluded.
  - Function S: adjustable trip threshold  $I_{L2} = (1 \dots 10) \times I_n$ , trip curves for the basic version with times from 0.1 to 0.25 seconds – 2 different trip curves – (at 8 times the rated current of the trip unit. Can be excluded.
  - Function I: adjustable trip threshold  $I_{L3} = (1 \dots 10) \times I_n$  for the basic version (instantaneous trip). Can be excluded.
- g) All the protection functions must be characterized by threshold and time tolerances according to the International Standards.
- h) The size of the current sensors must be a minimum of 10 A to a maximum of 3200 A so as to cover the widest possible current range.

#### 5.5.10 Automatic Power factor Control (APFC)

5.5.10.1 Automatic Power Factor Control (APFC) unit shall be provided on LT side to maintain improve power factor of the system.

5.5.10.2 The capacitor bank shall be provided with sequencing devices, timer and relays for automatic sequential switching of the capacitors in and out of circuit.

5.5.10.3 APFC shall be complete with all the required accessories.

5.5.10.4 The Capacitor shall be MPP type with inbuilt discharging resistor.

### 5.6 Technical specification for 33kV, 3C, UE, XLPE Cable

#### 5.6.1 Scope

This specification covers design manufacture, testing & commissioning and inspection at manufacturers works packing and delivery of 33kV cable for Raipur smart city project site.

#### 5.6.2 Codes & Standards

The cables shall confirm to the latest applicable standards for U/G cable for UE grade specified below. In case of conflict between standards and this specification, this specification shall govern.

PVC insulation and sheath of electric cables	IS: 5831
Recommended current ratings for cables of PVC insulated and PVC sheathed heavy duty cable	IS: 3961 (part 2)
Conductors for insulated electric cables	IS: 8130
Electric cables	IS: 1885
Mild Steel wire, formed wires and tapes for armouring of cables	IS: 3975
Cross linked polyethylene insulated	IS: 7098
Specification for cross- linked polyethylene insulated PVC sheathed cables for working voltages from 3.3kV to & including 33kV	IS 7098 (part II)
Cable drums for Electric cables	IS: 10418
Method of tests for cables	IS 10810: 1984

#### 5.6.3 System Voltage:

- Voltage (kV) of cable: 33/33kV
- Service voltage: 33kV
- Highest Voltage: 36kV
- Earthing System: solidly earthed
- BIL : 170kV
- Fault level: 25kA for 1sec
- Frequency : 50Hz

#### 5.6.4 Environmental Condition

Ambient Temperature: 45 deg C

Relative humidity: 95%

Altitude: 1000m

#### 5.6.5 Electrical Characteristics & performance

##### 5.6.5.1 Description of Cable:

Electrolytic grade aluminum conductor shall be of H4 grade of class 2 or Untinned annealed copper of class 2 as per IS 8130/1984 and any latest amendments to it. The shape of conductor shall be compacted, stranded, and circular, shielded with



conductor screen of black extruded semi-conducting XLPE compound , XLPE insulation, shielded with insulation screen of black extruded semi-conducting compound, black semi-conducting tape and metallic screen of copper tape, Inner sheath extruded PVC type ST2, Single layer of strip / round steel or round hard drawn aluminium wire armoured as per IS:7098 (part-II) and black extruded FR PVC (Type ST-2) overall sheathed, conforming generally to IS:7098 (part-II).

5.6.5.2 Voltage Grade: 33KV /33KV (For 33 KV System)

5.6.5.3 Size of Cable: As per site requirement

5.6.5.4 Maxm. Conductor temp. : 90 degree C at maxm. Continuous current.

5.6.5.5 Maxm. Permissible short-circuit Temperature: 250 degree C for one second

5.6.5.6 Approx. length of Cable in a Drum - 500Metres + 5% (for 1 Core)

5.6.5.7 End Sealing: H.S. Caps (Heat Shrinkable)

5.6.6 Construction Features

5.6.6.1 **Conductor:** Material to IS: 8130/1984, plain Aluminium H4 grade Class 2, stranded compacted circular Or Copper conductor: Untinned annealed copper of class 2 as per IS 8130/1984 and any latest amendments to it.

5.6.6.2 **Conductor Screening:** A semi-conducting cross-linked polyethylene (XLPE) screening shall be extruded over the conductor to act as an electrical shield which together with the elimination of the so called “Strand Effect” prevents to a great extent air ionisation on the surface of the conductor. Thickness as per IS 7098 part II.

5.6.6.3 **Insulation:** The main insulation of the Cable shall be extruded unfilled, chemically cross-linked polyethylene (XLPE) inert gas cured satisfying the requirement of IS: 7098(Part-II). Insulation thickness should not be less than 9.5 mm(Nominal).

5.6.6.4 **Insulating Screen:** Combination of black extruded semi-conducting compound & semi- conducting tape as the non-metallic part and annealed copper tape lapping as metallic part metal screen eliminates tangential stress of rotating electrostatic field surrounding the conductor and uniform electrical stress in the insulation. Metal copper screen should be able to carry a short circuit current of 1KA for 1sec.

The semi-conducting polyethylene (XLPE) screen shall be extruded over the main polyethylene insulating wall to prevent partial discharge at the surface of the insulation. The copper tape shall be wrapped over the semi conducting tape or extrusion as mentioned earlier for 3 core cables. The metal screen so formed around the cores shall be in contact with one another as the cores are laid up at triangular configuration. For single core cable, Aluminium wire armouring shall constitute the metallic part of insulation screen. Conductor screening, insulation and insulation

screening shall be extruded in triple extrusion process as to obtain continuously smooth interface.

The mechanical and chemical properties of the materials for semi conducting screens are much more important than their electrical properties, but for obtaining the high overall degree of electrical properties of an H.V. cable, the inner and outer semi conducting screens and the main polyethylene insulation between the screens shall be simultaneously extruded during the manufacturing process known as “triple extrusion”.

**5.6.6.5 Inner Sheath:** The cable core shall be supplied with bedding of PVC (inner sheath) in the form of extruded PVC Type ST-2 compound for 33 KV. For single core cable inner sheath is not required.

**5.6.6.6 Armour :** Galvanized round steel wires or galvanized formed wires for 3 core cable as per IS 7098 part II. Single layer of round hard drawn aluminium wire for 1 core cable as per IS 7098 part II to ensure an adequate return path for the flow of fault current and also to provide suitable mechanical protection. For 1 core aluminium Wires of required size in requisite number shall be laid closely in the spiral formation to protect the circumference of the cable fully and to provide adequate cross sectional area for flow of maximum fault current within limits of specified temperature rise and duration of fault. The direction of the lay of the armour shall be opposite to that of the cable cores.

**5.6.6.7 Outer Sheath:** Black extruded FR PVC Type ST-2 compound to IS: 5831 and thickness shall be as per IS 7098 part II.

A reliable serving shall be necessary for maintaining conductivity of the armour particularly under corrosive condition in the form of jacket. The cable shall therefore be finished with an extruded PVC over sheath of thickness as per IS 7098 part-II.

The quality of PVC over sheath (Jacket) shall be ensured for service reliability against moisture intrusion and shall conform to type ST-2 of IS: 5831.

The sheaths shall be protected against white ants, vermin and termites by suitable, reliable and durable measures.

The supplier shall suggest suitable materials for use, in the event of damage to over sheath to prevent passage of moisture along the cable.

#### 5.6.7 Cable Identification

The following shall be embossed on the outer sheath for the identification.

- Manufacturer's Name
- Voltage Grade.

- Nominal section & Material of conductor and numbers of core.
- Year of manufacture.
- Inscription for length of cables at 1.0 meter interval.
- Name of the purchaser : CSPDCL
- Marking “Electric Cable under smart city project” shall be embossed throughout the length of the cable at 10meter spacing.
- Type of Insulation: XLPE

5.6.8 Sealing of Cable Ends: The cable ends of cable in the wooden drum for delivery shall be sealed with heat shrinkable caps.

5.6.9 Wooden drums

The Cable shall be packed in non-returnable wooden drums.

The following information shall be marked on each drum.

- a) Drum identification No
- b) Manufacturer's Name, Trade Name/Trade Mark, if any.
- c) Nominal sectional area of the conductor of the cable.
- d) No. of Cores.
- e) Type of Cable and Voltage Grade with Cable Code.
- f) Length of the Cable in Cable Drum.
- g) Direction of rotation of Drum (by means of an arrow)
- h) Approximate Weight : Tare : Gross
- i) Year and Country of Manufacture.
- j) Purchase Order No.
- k) Date of Delivery.
- l) Name of the Purchaser : RSCL

Drums shall be proofed against attack by white ants or termite conforming to IS: 10418.

The Drums may also be marked with ISI Certificate Mark, if applicable. Safe Pulling Force: --- N/mm<sup>2</sup> (for Conductor) shall be mentioned on drum.

5.6.10 Test at manufacturing works and Certificates

5.6.10.1 Each type and size of cable shall comply with the requirements of routine test as per relevant Indian Standard.

5.6.10.2 All routine and Acceptance tests shall be carried out at the manufacturer's works on every lot of offered different type and sizes of cables as per relevant Indian Standards. Selection of samples for acceptance test as well as rejection and

retesting shall be guided by relevant IS. The entire cost of acceptance and routine tests that are to be carried out as per relevant IS shall be treated as included in quoted price of control and power cable. Three (3) copies of test reports shall be submitted for approval and distribution to site. Contractor shall give at least 15 (fifteen) days advance notice intimating the actual date of inspection and details of all tests that are to be carried out.

#### 5.6.11 Routine Tests

The routine test shall be carried out on all cables manufactured in accordance with this specification. The following routine tests shall be made on cable length as specified in the IS.

- a) Conductor resistance test.
- b) Partial discharge test on full drum length.
- c) High voltage test

#### 5.6.12 Acceptance test

The following shall constitute Acceptance Tests:

- a) Tensile test (for aluminium)
- b) Wrapping test (for aluminium)
- c) Conductor resistance test.
- d) Test for thickness of insulation and sheath.
- e) Hot set test for insulation.
- f) Tensile strength and elongation at break test for insulation and outer sheath.
- g) P.D.test (for screened cables) only on full drum length.
- h) High Voltage test
- i) Insulation resistance (Volume Resistivity) Test
- j) Test of cross linking for extruded semi conducting screen.
- k) Oxygen Index (Test on FR)
- l) Flammability test (Test on FR)

### 5.7 Technical specification for 11kV, XLPE, 3Core, UE cable

#### 5.7.1 Scope:

This specification covers design manufacturing, testing and inspection at manufacturer's works packing and delivery of 11kV, XLPE, three core (3C) un-earth grade cables for Raipur smart city project.

#### 5.7.2 Codes & Standards

The cables shall confirm to the latest applicable standards for U/G cable for UE grade specified below. In case of conflict between standards and this specification, this specification shall govern.

Cross linked polyethylene insulated	IS: 7098 (Part-II)
Conductor for insulated electrical cables and cords	IS: 8130
Methods of test for cables	IS: 10810
Mild Steel wire, formed wires and tapes for armouring of cables	IS : 3975
Specification for PVC insulation sheath for electric cables	IS: 5831
Polyethylene insulation and sheath for Electric cable	IS: 5831

### 5.7.3 System Voltage

- Voltage (kV) of cable: 1.1kV
- Service voltage: 0.433kV
- Highest Voltage: 1.1kV
- Earthing System: solidly earthed
- BIL : 28kV
- Frequency : 50Hz

### 5.7.4 Environmental Condition & service condition

- Ambient Temperature: 45 deg C
- Relative humidity: 95%
- Altitude: 1000m

### 5.7.5 Constructional features

5.7.5.1 **Conductor:** The cable shall be made from H2 grade aluminium to form compacted stranded circular conductor having resistance within the limits specified in IS-8130/1984.

**5.7.5.2 Conductor Screen:** The conductor screen shall be extruded semiconductor XLPE, extruded by triple extrusion method in the same operation as along with the insulation and insulation screen; The IS-7098 part-2. The semiconductor shall be suitable for operating temperature of the cable and shall be compatible with the insulation.

**5.7.5.3 Insulation:** The insulation shall be Cross Linked Polyethylene (XLPE) insulation applied by extrusion method.

- a) The insulation should be suitable for specified system voltage. The extrusion should be a true triple extrusion with thickness and concentricity control of all the three layers.
- b) The curing process of XLPE insulation should be dry cured and dry cooled. The manufacturing process shall ensure that insulations shall be free from voids. Minimum degree of cross linking shall be 75%.
- c) The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions.
- d) The extrusion method should give very smooth interface between semi-conducting screen and insulation.
- e) The insulation of the cable shall be compatible with the continuous conductor temperature of 90°C, short time overload temperature of 130°C & short circuit temperature of 250°C.
- f) The average thickness of the insulation shall not be less than as specified in IS: 7098-II. The insulation shall be so applied that it fits closely on conductor screening and it shall be possible to remove it without damaging the conductor.
- g) The eccentricity of the insulation shall be less than 10% and ovality shall be less than 5%.

**5.7.5.4 Insulation Screen:** To confine electrical field to the insulation, semi-conducting XLPE shield shall be put over the insulation. The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by triple extrusion and shall be as IS: 7098 Part 2, Copper Tape of 10% Overlap, water blocking tape shall be applied over the semiconducting compound.

**5.7.5.5 Inner Sheath:** The sheath shall be extruded PVC Type ST2, suitable to withstand the site conditions and the desired temperature. It should be of adequate thickness as specified in IS: 7098-II, consistent quality and free from all defects.

**5.7.5.6 Armour:** Armouring shall be applied over the inner sheath with single galvanized steel flat strips / GI Wires complying with the requirements of IS: 3975/1979 for 3-Core Cables. Minimum armour coverage shall be 90%. A joint in any wire shall be at least 300 mm from the nearest joint in any other armour wire in the complete cable and shall be as per IS: 7098 Part 2, IS: 3975, IEC:60502 Part – 2, BS: 6622, BS: 7835.

**5.7.5.7 Outer Sheath:** The outer sheath shall be applied over armouring with suitable additives to prevent attack by rodents and termites. Outer sheathing shall be designed to offer high degree of mechanical protection and shall also be heat, oils, chemicals, abrasion and weather resistant. Common acids, alkalis, saline solutions etc. shall not have adverse effects on the sheathing materials used.

The underground cables shall be manufactured to the highest quality, best workmanship with scientific material management and quality control. The manufacturer shall furnish the quality plan, giving in detail the quality control procedure/ management system.

The cable shall be suitable for laying in covered trenches, duct and/or buried underground to meet the outdoor application purposes.

**5.7.6 Inner Sheath (Common Covering Only For 3-Core Cables):**

**5.7.6.1** The laid-up cores shall be provided with PVC ST 2 inner sheath applied by extrusion. It shall be ensured that the shape is as circular as possible. 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.

**5.7.6.2** The thickness of the inner sheath (common covering) shall be as per IS 10462 (Part 1)

**5.7.6.3** When one or more layers of binder tapes are applied over the laid-up cores, the thickness of such tapes shall not be construed as a part of inner sheath.

**5.7.7 Armouring:**

Armouring shall be applied over the inner sheath with galvanised steel flat strip /GI wire complying with the requirements of IS: 3975/1979 for 3-Core cables. The dimensions of the galvanized steel flat strips/GI wire shall be as specified in the IS: 7098/Part-II/1985

**5.7.8 Outer Sheath:**

The outer sheath shall be applied by extrusion. It shall be applied over the armouring and shall consist of FR PVC ST2. The minimum thickness of the sheath shall be as per IS 10462 (Part 1).

5.7.9 Cable Identification:

The contractor shall follow clause: 5.6.7

5.7.10 Cable Drums:

5.7.10.1 Cables shall be supplied in non-returnable wooden drums. The wood used for construction of the drum shall be properly seasoned and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with a suitable rust preventive coating to avoid rusting during transit or storage.

5.7.10.2 Before winding the cables on drums, contractor shall obtain Purchaser's approval for the drum lengths. Cable ends shall be sealed by non-hygroscopic sealing caps.

5.7.10.3 Contractor has to ensure reference of an arrow and suitable accompanying wording which shall be stencilled on the sides of the drums indicating which way it should be rolled. The number on each drum shall be either branded at the end of the drum or stamped on the metal attached to an end of the drum. The cable shall be placed on the drum in such a manner that it will be protected from injury during transit. Each end of the cable shall be firmly and properly secured to the drum. The drum shall be securely blocked in position so that the cable will not be displaced during transit. Cable ends shall be sealed by non-hygroscopic sealing caps.

5.7.10.4 It shall be contractor's responsibility to prepare the drum cutting schedule so that cable wastage is minimum while cutting.

5.7.10.5 Contractor shall obtain Purchaser's approval for the drum lengths.

5.7.10.6 The following information shall be marked on each drum.

The contractor shall follow clause: 5.6.9

5.7.11 Tests and Certificates:

Contractor shall submit routine, type and acceptance test for approval to employer before dispatch of Cable.

The contractor shall follow clause: 5.6.10

5.7.11.1 Type test

- Flammability test

5.7.11.2 Acceptance test



- Conductor resistance test
- Test for thickness of insulation
- Test for thickness of inner and outer sheath
- Hot-set test for insulation
- Tensile strength and elongation at break test for insulation and outer sheath
- Partial discharge test (on full drum length) - (shall be less than 2PC)
- High voltage test
- Insulation resistance (volume resistivity) test
- Void & Contamination Test
- Wafer Boil Test
- Degree of Cross linking of XLPE
- Oxygen and Temperature Index for FR PVC ST 2
- Abrasion Resistance Test for PE ST 7
- Carbon Black content for PE ST 7
- Water penetration test as per IEC 60502-2

#### 5.7.11.3 Routine test

Following routine test shall perform on cable:

- Conductor resistance test
- Partial discharge test on full drum length
- High voltage test

#### 5.7.11.4 Site Test

Following test shall perform at site:

- Physical inspection test to verify physical damage
- IR measurement before High Voltage test
- High Voltage test
- IR measurement after High Voltage test

### 5.8 Technical Specifications for LT up to (1100V) XLPE / PVC Insulated Cable

#### 5.8.1 Scope:

This specification covers design manufacturing, testing and inspection at manufacturers works packing and delivery of 1100V, XLPE / PVC cable for Raipur smart city project.

#### 5.8.2 Codes & Standards

The cables shall confirm to the latest applicable standards for cable specified below. In case of conflict between standards and this specification, this specification shall govern.

PVC insulated cables	:	IS: 694
(For voltage up to 1100 V)		
HRPVC & PVC insulated cables	:	IS: 1554
Heavy duty		
Cross linked polyethylene insulated	:	IS: 7098
PVC insulation and sheath	:	IEC-189-2
PVC insulation and sheath of electric	:	IS: 5831
Cables		
Polyethylene insulation and sheath for	:	IS: 6474
Electric cables		
Conductors for insulated electric cables	:	IS: 8130
Methods of test for cables	:	IS: 10810
Specification for drums of electric cables	:	IS: 10418
Specification for PVC insulated cables	:	BS: 6346
For electricity supply		

#### 5.8.3 System Voltage

- Voltage (kV) of cable: 1.1kV
- Earthing System: solidly earthed
- Frequency : 50Hz

#### 5.8.4 Environmental Condition & service condition

- Ambient Temperature: 45 deg C
- Relative humidity: 95%
- Altitude: 1000m
- The cables shall be layed in duct directly buried in ground.

#### 5.8.5 Construction features of 1.1kV XLPE Cable

5.8.5.1 **Conductor:** The cable shall be made of electrolytic copper / Aluminium conductor, stranded circular, compacted circular and shaped as per IS 8130, IEC 60228 & BS EN 60228.

#### 5.8.5.2 **Insulation:**

- a) The insulation shall be Cross Linked Polyethylene (XLPE) insulation as per IS 7098-1 applied by extrusion method.

- b) The insulation should be suitable for specified system voltage.
- c) The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions.
- d) The extrusion method should give very smooth interface between semi-conducting screen and insulation.
- e) The insulation of the cable shall be compatible with the continuous conductor temperature of 90°C, short time overload temperature of 130°C & short circuit temperature of 250°C.

#### 5.8.5.3 Inner Sheath:

- a) The sheath shall be extruded PVC Type ST2, suitable to withstand the site conditions and the desired temperature. It should be of adequate thickness as specified in IS: 7098-II, consistent quality and free from all defects.
- b) The underground cables shall be manufactured to the highest quality, best workmanship with scientific material management and quality control. The manufacturer shall furnish the quality plan, giving in detail the quality control procedure/ management system.
- c) The cable shall be suitable for laying in covered trenches, duct and/or buried underground to meet the outdoor application purposes.

#### 5.8.5.4 Armour: Galvanized steel round wire/ flat strip as per IS 3975, IEC 60502-1.

#### 5.8.5.5 Outer Sheath:

The LV Power cables shall be 1.1kV grade, 4/ 3.5/ 3 Core, multi-stranded, Al/ Cu conductor, XLPE insulated, extruded inner & outer PVC sheath compound type ST2 and galvanized wire (up to 6 sq mm) / steel strip (>6 sq mm) armoured cables. All single phase, lighting cables shall have 100% Neutral.

#### 5.8.6 Cable Colours:

5.8.6.1 All cable cores shall be colour coded throughout their length and shall be so connected between switchboard, distribution board, Distribution Transformer and accessories, that the correct sequence or phase colours are preserved throughout the system.

5.8.6.2 The colour coding should be as follows:

- |      |                           |                                       |
|------|---------------------------|---------------------------------------|
| i.   | 3 phase                   | Red, Yellow and Blue                  |
| ii.  | single phase or dc supply | Red and Black                         |
| iii. | earth                     | Green/Green with Yellow coloured band |
| iv.  | control                   | Gray (DC)                             |

#### 5.8.7 Cable Identification:

The contractor shall follow clause: 5.6.7

#### 5.8.8 Cable Terminations:

##### 5.8.8.1 Cable Lugs

- i. Cable lugs shall be of tinned copper, solder less crimping type for Cu cables & AL lugs for the AL cables.
- ii. The current rating of the lugs shall be same as that of the respective cable conductors.
- iii. Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.
- iv. Double holes extended neck (long barrel neck) type lugs shall be used in case of cables above 185 sq. mm.
- v. Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs. This shall especially be ensured for Al cable terminations & bimetallic terminations shall be used wherever required.
- vi. If termination is done with crimping tool employing crimping die then forming dies shall be used to make the sector shaped conductor into a round conductor before crimping the lugs on the conductor. The lug must not be crimped directly on the sector conductor. Before crimping the lug, the conductor shall be thoroughly cleaned and special jelly applied over it to prevent further oxidation.

##### 5.8.8.2 Cable Glands

- i. Glands shall generally be of the double compression hexagonal type brass glands. Earth continuity of brass glands shall be assured.
- ii. Double compression type cable glands shall be used. Cable glands shall be brass casting, machine finished and Nickel-plated to avoid corrosion and oxidation. Rubber components used in cable gland shall be of neoprene.
- iii. For single core cables, gland shall be with brass ring.
- iv. Glands for single core cables shall be constructed from non-magnetic materials.
- v. Cable glands shall be with metric threads.
- vi. Where holes for cable entries are not provided it shall be the responsibility of contractor to mark out and drill such holes. Burrs and swarf shall be removed, care being taken to ensure that swarf and filings, etc do not enter the equipment.
- vii. For non-hazardous areas cable glands in situations where moisture may be present shall be double seal weatherproof type, gland shrouds shall be used and entry shall be sealed.
- viii. For dry indoor situations, standard industrial glands with shrouds are acceptable.

- ix. For hazardous areas, glands conforming to EEE standard shall be used with double seal and shroud.

5.8.9 Cable Drums:

5.8.9.1 Cables shall be supplied in non-returnable wooden drums. The wood used for construction of the drum shall be properly seasoned and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with a suitable rust preventive coating to avoid rusting during transit or storage.

5.8.9.2 Before winding the cables on drums, contractor shall obtain Purchaser's approval for the drum lengths. Cable ends shall be sealed by non-hygroscopic sealing caps.

5.8.9.3 Contractor has to ensure reference of an arrow and suitable accompanying wording which shall be stencilled on the sides of the drums indicating which way it should be rolled. The number on each drum shall be either branded at the end of the drum or stamped on the metal attached to an end of the drum. The cable shall be placed on the drum in such a manner that it will be protected from injury during transit. Each end of the cable shall be firmly and properly secured to the drum. The drum shall be securely blocked in position so that the cable will not be displaced during transit. Cable ends shall be sealed by non-hygroscopic sealing caps.

5.8.9.4 It shall be contractor's responsibility to prepare the drum cutting schedule so that cable wastage is minimum while cutting.

5.8.9.5 The following information shall be marked on each drum.

Contractor shall follow clause: 5.6.9

5.8.9.6 Contractor shall obtain Purchaser's approval for the drum lengths.

5.8.10 Tests & Certificates:

Contractor shall follow clause: 5.6.10

5.8.10.1 Acceptance test

- Conductor resistance test
- Test for thickness of insulation
- Test for thickness of inner and outer sheath
- Tensile strength and elongation at break test for insulation and outer sheath
- High voltage test
- Insulation resistance (volume resistivity) test
- Void & Contamination Test
- Degree of Cross linking of XLPE
- Oxygen and Temperature Index for FR PVC ST 2

5.8.10.2 Routine Test:

Following routine test shall perform on cable:

- Conductor resistance test
- High voltage test

#### 5.8.10.3 Site Test

Following test shall perform at site:

Physical inspection test to verify physical damage

- IR measurement

### 5.9 LT Feeder Pillar

#### 5.9.1 Scope

This specification covers design manufacture, testing & commissioning and inspection at manufacturer's works packing and delivery of 3Phase ,440V,50Hz, ,1ways,2/3way LT feeder pillars and mini pillar and Outdoor DT box to Raipur smart city Ltd project site.

#### 5.9.2 Codes and Standards

All components used in the manufacture of the feeder Pillars shall confirm to the relevant National/ International standards as mentioned below:

IS: 5082/1998	Electrolytic Grade Aluminum sections for Electrical purpose
IS: 4237/1982	General arrangement for switch gear and control Gear for voltage not exceeding 1000 V with enclosure Box
IS: 12063/1987	Degrees of Protection provided by enclosures of electrical Equipment's
IS: 6005/1998	Code of practice for phosphating iron and steel
IS: 5/2004	Colour for ready mixed paints and enamel
IS: 732/1989	Code of Practice for Electrical Wiring Installations
IS: 5039/1983	Distribution pillars for voltage not exceeding 1000 V

#### 5.9.3 Technical parameters for Service Feeder Pillar:

Rated Supply Voltage	3Phase,440V,50Hz
Insulation Level	Continuous -1100VAC, 50Hz
Rated current	250A
Rated short Circuit current	10kA,1sec
Temperature Rise	Shall not exceed operating temperature of

	components conforming to relevant standards limited to 50Deg C above ambient
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#### 5.9.4 General requirement

- 5.9.4.1 All outdoor feeder pillars (DT box and service feeder pillar) shall be as per CSPDCL standard norms and specifications.
- 5.9.4.2 All OFP shall be Wall/ Column/ Steel Support mounting, double door, single front, non-compartmentalised enclosure with locking facilities or as per CSPDCL requirements.
- 5.9.4.3 The OFP shall be of sheet steel enclosed and shall be fully dust and vermin proof, providing as degree of protection of IP 55 with rain hood / canopy. The sheet steel used shall be cold rolled and 2 mm thick. The gland plate shall be 3mm thick.
- 5.9.4.4 The fabricated enclosure shall not have any welds or bolt heads apparent from outside. All fabrication work like cutting, drilling, punching, shearing & welding etc. related to the enclosure shall be complete before proceeding to 7 tank process. The fabricated body shall be thoroughly cleaned and treated by chemical agents as required to produce a smooth surface free of scales, grease and rust.
- 5.9.4.5 All interiors and exteriors of the enclosure shall be finished and painted to prevent rusting and corrosion. The paint should be carefully selected to withstand tropical heat, rain and environmental effects. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. Thickness of all painting shall be minimum 80 - 100 microns DFT.
- 5.9.4.6 The gasket shall be of neoprene rubber suitable to withstand all weathers for long tenure of service. All hardware shall be HD Galvanized or stainless steel. Door shall be with concealed type hinges & captive screws.
- 5.9.4.7 All the doors shall have panel type lock with keys in duplicate as per the requirements of the CSPDCL.
- 5.9.4.8 A danger notice board written in English or Hindi shall be made as per CSPDCL norms and shall be provided on the front door of the Outdoor DT box / service feeder pillar.
- 5.9.4.9 The details of connected load in KW, service No. area for feeder pillar / DT box service ,name of the agency and year of erection shall be labelled using radium sticker / radium paint.
- 5.9.4.10 The feeder pillar shall consist of switchgears as per design criteria.
- 5.9.4.11 The feeder pillar shall have cable entry at the bottom suitable for terminating double compression glands for 2Rx3.5Cx 240 sqmm Aluminium conductors, XLPE

insulated armoured cable at the incoming terminal and outgoing cable shall be as per consumer connected from that feeder pillar.

5.9.4.12 All MCCBs shall be comply with the relevant IS and IEC standards.

5.9.4.13 An Aluminium / GI Earth bus shall be run at the bottom of the Feeder Pillar which shall be connected to the earth leads at the two extreme ends for connecting the GI earthing strip from the electrode.

5.9.4.14 Contractor shall take approval from CSPDCL for specification, GA, GTP, Single line diagram and internal wiring diagram of Feeder Pillar (Outdoor DT box & service feeder pillar).

#### 5.9.5 Air Circuit breaker (ACB)

5.1.1.1 All the incomers & bus coupler ACBs shall be FP EDO type. All other ACBs shall be TPN EDO type.

5.9.5.1 All the ACBs shall have  $I_{cs}=I_{cu}=I_{cw}=100\%$

5.9.5.2 Up to and including 630 A, Fixed Type FP/ TPN MCCB shall be considered, while above 630A FP/ TPN fully draw out type ACB shall be considered in line with the electrical Single Line Diagram requirements.

5.9.5.3 All ACBs shall be provided with additional 6 NO + 6 NC contacts, exclusively for Purchaser's use.

5.9.5.4 All the ACBs (except for APFC panel) shall be provided with microprocessor based O/L+ S/C + inbuilt E/F protections.

5.9.5.5 ACBs/ MCCBs for APFC panel shall be provided with thermal magnetic based O/L+ S/C + E/F protections.

5.9.5.6 Each ACB shall be provided with – On, Off, Trip, Spring Charged, Trip Coil Healthy, Service & Test Position indication lamps.

5.9.5.7 For incomer feeders R, Y & B Phase indication lamps shall be provided.

5.9.5.8 All ACBs shall be Schneider make 'Masterpact NW' / Siemens '3WL' / L&T 'C Power' or Equivalent from the approved make list.

5.9.5.9 Circuit breaker shall be horizontal withdrawal type, comprising three/ four identical poles operated through a common shaft.

5.9.5.10 It shall be suitable for switching duty of transformer and motors and other devices.

5.9.5.11 It shall be possible to push in and withdraw the breaker easily and without much effort. Insulating plugs and sockets for power as well as for control circuits shall be of robust design and fully self-aligning. Plugs and sockets for power circuits shall be silver faced, insulated with PVC or other insulating material.



5.9.5.12 The breaker shall have three distinct positions namely services, test and fully withdrawn positions. In test position, it shall be possible to operate the circuit breaker without energizing the power circuits. Separate limit switches each having a minimum of 4 No contacts shall be provided for both service and test position of the circuit breaker. These contactors shall be rated for 10 Amp, 240 volts AC.

5.9.5.13 Operating mechanism

- a) The EDO type ACB shall be power operated by a motor charged spring operated mechanism & MDO type shall be manual type spring operated mechanism.
- b) The operating mechanism shall have anti-pumping features under every method of closing. The operating mechanism shall normally be operated by LOCAL/ remote electrical control, when the breaker is in service position. Shunt trip coils shall perform electrical tripping.
- c) The main poles of the breaker shall operate simultaneously. Also there shall not be any objectionable rebound of the moving contact in the fixed contacts.
- d) The mechanism shall be such that any failure of auxiliary spring shall not prevent tripping. When the breaker is in closed position, failure of any auxiliary spring shall not cause damage to the CB or danger the operation.
- e) A mechanical indicator shall be provided on the breaker operating mechanism to indicate open and closed position of the breaker. This shall be visible to a man standing in front of the cubical with the door closed.
- f) It shall be possible to operate the breaker mechanically. This shall be possible only after opening the cubical door. Provision shall be made for local electrical control also when the breaker is in the test position by a control switch on the cubical doors.
- g) All working parts of the mechanism shall be of corrosion resistance material. All split pins; bolts, nuts and other parts shall be properly pinned and locked to prevent loosening with repeated operation of the breakers.
- h) Auxiliary switch containing 6 No. +6 NC potential free contacts rated for 10 Amp 240 V AC (Inductive breaking).

5.9.5.14 Spring charged Mechanism

- a) Spring operated mechanism shall be complete with motor, opening spring, closing spring with limit switch for automatic charging and all necessary accessories to make the mechanism a complete operating unit.

- b) The breaker operation shall be independent of the motor, which shall be used only for tensioning/ compressing of the spring.
- c) The closing operation shall automatically charge the tripping spring. The closing, opening shall get charged immediately after a closing operation is performed.
- d) Motor used shall be preferably universal type operated on AC supply. The Motor shall operate satisfactory at all values "between" 85% to 110% of rated voltage.

#### 5.9.6 Moulded Case Circuit Breakers (MCCB):

- a) The MCCBs shall conform to IEC 947 & the latest applicable standards.
- b) All MCCBs shall be of fixed type unless otherwise specified in the specifications elsewhere.
- c) MCCBs shall be of four pole/ triple pole with neutral construction arranged for simultaneous four/ three-pole manual closing and opening and for automatic instantaneous tripping on short circuit.
- d) All the incomer & bus coupler MCCBs for Main LT PMCC panels shall be FP type with microprocessor based O/L +S/C + inbuilt E/F release & all outgoings MCCBs shall be TPN with thermal magnetic based O/L +S/C + E/F releases.
- e) All MCCB's shall be Schneider make Compact NSX/ Siemens -Sentron 3VL OR equivalent from the approved make list.
- f) For achieving the Earth Fault protection in thermal magnetic (TM) based MCCBs, external CBCT, Earth Fault relay & shunt trip provision shall be considered as part of complete TM based MCCB.
- g) The ON, OFF and TRIP positions of the MCCB shall be clearly indicated by using LED indications.
- h) MCCBs shall be with ICS = ICU = 100%
- i) MCCB shall be capable of withstanding the thermal stresses caused by overloads and locked rotor currents of values associated with protective relay settings of the motor starting equipment and the mechanical stresses caused by the peak short circuit current of value associated with the switch gear rating.
- j) All the MCCBs shall be of current limiting type and shall provide a cut off in 4-8 milli seconds for prospective currents during faults.
- k) All the MCCBs shall be provided with rotary operating handle with door interlock.

- l) MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.
- m) All MCCBs shall be provided with additional 2 NO + 2 NC contacts, exclusively for Purchaser's use.
- n) All the switchgear selection for motor feeders shall be Type-2 co-ordinated.

#### 5.9.7 Miniature Circuit Breaker (MCB)

- a) MCB shall be hand operated, air break, quick make, quick break type.
- b) Operating mechanisms shall be mechanically trip-free from the operating knob to prevent the contacts being held closed under overload or short-circuit conditions.
- c) Each pole shall be fitted with a bi-metallic element for overload protection and a magnetic element for short-circuit protection. Multiple pole MCBs shall be mechanically linked such that tripping of one pole simultaneously trips all the other poles. The magnetic element tripping current classification shall be of the type suitable for the characteristics of the connected load. Where this is not specified, it shall be Type C.
- d) The short circuit rating shall be not less than that of the system to which they are connected.

#### 5.9.8 Indicating Lamps: Indicating lamps shall be:

- a. Clustered LED type and of low watt consumption.
- b. Provided with series resistors.
- c. Provided with translucent lamp covers of colors 'Red', 'Green' and Amber' etc. as required.
- d. Indicating lamp shall be of the double contact, bayonet cap type rated for operation at either 110 V AC or at the specified AC/ DC system voltage as applicable.

#### 5.9.9 Cable Entry:

- 5.9.9.1 The panel shall have provisions of cable entry from bottom. The removable cable gland plate shall be provided to make entry dust and vermin proof.
- 5.9.9.2 The panel shall have provisions for fixing the multi-core cable glands.
- 5.9.9.3 The cable glands support plates shall be 3 mm thick.
- 5.9.9.4 Cable entries to the panel shall be from the bottom unless otherwise specified. Cable gland shall be double compression screwed type and made of brass.

- 5.9.9.5 Drawings/ Documents Required: After award of contract Contactor has to submit drawings/ documents for Purchaser's approval as mentioned below but not limited to:
- 5.9.9.6 General arrangement diagram showing dimensions of enclosure, length, widths and depth of enclosure and bill of quantity indicating the rating, make of each components and quantity.
- 5.9.9.7 Complete assembly drawings of the switchboard/ distribution board/ MCC showing plan, elevation and typical sectional views and location of cable boxes and control cable terminal blocks for external wiring connections, etc.
- 5.9.9.8 Foundation plan showing the location of channel sills, foundation, anchor bolts and anchors, floor plans and openings.
- 5.9.9.9 Schematic power and control wiring diagrams with bus bar rating with material, instrument & control transformers, switchgear rating, control interlocks, relays, instruments, space heaters details etc.
- 5.9.10 Tests
- 5.9.10.1 Type Test
- a. Temperature rise test as per IS8623-1993
  - b. High Voltage test as per IS8623-1993
  - c. Short Time Withstand Current test as per IS 8623 or equivalent
  - d. Degree of protection IP-54 as per IS 13947/1993
- 5.9.10.2 Acceptance test
- a. All routine tests on each Feeder Pillar and Temperature rise test on one sample of each rating.
- 5.9.10.3 Routine tests
- a. Overall dimension Check
  - b. Insulation Resistance test
  - c. High Voltage test at 2.5kV, 50HZ AC for one min.

### 5.10 Technical Specification of Octagonal pole

- 5.10.1 The Product should be designed for the specific climatic and environmental conditions of the region to ensure full durability and safety throughout its designed life.
- 5.10.2 All the Poles shall be designed to withstand the maximum wind speed of 150km/hr as per IS 875. The top loading .i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of EN 8.
- 5.10.3 The pole shall also be designed to with stand the Earthquake as per the provisions of the relevant BIS/other standards related to the urban location in the State of Chhattisgarh.
- 5.10.4 All pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations .i.e. from inside and outside.
- 5.10.5 The welding of pole shaft shall be done by Submerged Arc Welding (SAW) or using high end MIG/TIG Welding process. The welding shall be carried out conforming to approved procedures. The welding shall be done as per qualified MMAW process approved by Third Party Inspection agency.
- 5.10.6 The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.
- 5.10.7 Aesthetic appearance - All the grooves and carvings of the pole unit shall be free from any kind of distortion for a pleasing aesthetic appearance.
- 5.10.8 The Octagonal/conical Poles shall be bolted on a pre-cast foundation with a set of foundation bolts for greater rigidity.
- 5.10.9 Top Mountings -The galvanized mounting bracket shall be supplied along with the Poles for Installation of the luminaires.
- 5.10.10 The materials of the pole as follows:
- a. Pole confirming to grade S355J0
  - b. Base Plate: Fe 410 conforming to IS 226 / IS 2062
  - c. Foundation bolts: 6.8gr as per IS 1367
  - d. Pole sections: The octagonal poles shall be in single piece with single longitudinal welding joint
  - e. **Galvanization:** - The poles shall be hot dip galvanized as per IS 2629 / IS 2633 / IS 4759 standards with average coating thickness of 65 micron. The

galvanizing shall be done in single dipping. The zinc Ingot raw material shall be 99.99% pure and procured from reliable sources with Quality Test Certificates.

- 5.10.11 The pole manufacturing & galvanizing unit shall be ISO 9001: 2000 & ISO 14001 certified to ensure consistent quality & environmental protection.
- 5.10.12 Electrical connections - Four way connectors shall be provided along with Slide lock suitable for connecting 1.1 kV grade, 4 core X16 sqmm Al cable. It shall also inhouse 1 no. 6 amps DP MCB, 2.5 sqmm connectors for looping with 2.5 Sqmm Copper wires for connecting to the luminaire through 1.1 kV grade, 3 core X 2.5 mm<sup>2</sup> PVC insulated copper conductor flexible un-armoured Cable from the terminal block to the fixture within the pole. All the cables laid through the pipe shall be without any joint.
- 5.10.13 The poles shall have integrated Junction box with openable door of adequate size (approximate 600mm length) at the elevation of 750 mm from the base plate. The door shall be hinged type with mechanical interlock, dust proof, weather proof and vandal resistance and shall ensure safety of inside connections and components. The door shall be flush with the exterior surface and shall have suitable locking arrangement. The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.
- 5.10.14 The door of the Junction Box shall permit clear access to the components inside viz., termination strips, connectors, MCBs, cables etc. There shall also be suitable arrangement for the purpose of earthing.
- 5.10.15 Two nos. Earth Boss shall be provided at the bottom of the pole (diagonally opposite) suitable for connecting 25X6 mm GI/ CU earth strip or 6SWG GI wire for earthing of the poles.
- 5.10.16 Two nos. 50 mm NB HDPE Sleeves of suitable length shall be provided through the foundation upto the Junction Box for entry of power cable.
- 5.10.17 Contractor shall carry out all the relevant tests and inspection in the presence of the PURCHASER or Third Party Agency, as may be selected by the PURCHASER, before the dispatch of the poles at no extra cost to the PURCHASER.
- 5.10.18 Contractor shall inform the PURCHASER at least FIFTEEN (15) days in advance, about the manufacturing programme so that arrangement can be made for inspection. PURCHASER reserves the right to waive the inspection at any stage.
- 5.10.19 All the material/equipment/accessories shall be supplied with manufacturer's test certificates.

- 5.10.20 Contractor shall submit the Proposed Product Catalogue, Detail Data sheet, spare parts list and drawing of Pole & Bracket along with the BID for each product quoted.
- 5.10.21 The Lighting paint & overhang shall be painted with two coat of approved colour and shade with synthetic enamel paint after GI coating.
- 5.10.22 M20 concrete foundations shall be provided for all the poles. Approx dimension of the foundation for evaluation purpose is 600X600X1700 mm. However, contractor's shall design as per the stability requirement and Soil bearing Capacity of each location. The Poles shall be bolted on a pre-cast foundation with minimum four foundation bolts for greater rigidity.
- 5.10.23 Earthing of each pole shall be carried out with one dedicated earth electrode. The earth electrode can either be GI pipe type electrode. The GI Pipe electrode shall be 4.5 m deep. The earth electrode shall be connected with two 6SWG sqmm GI wire to the two distinct earth boss on the pole.
- 5.10.24 List of Certificates to be submitted by contractor for Poles:
- Galvanizing test certificate.
  - Steel grade certificate from steel mill.
  - Stability test certificate after installation of pole.
  - Wind Tunnel Test Certificate from reputed laboratory or organization.
  - Manufacturer's authorization for tender bidding from OEM

## 5.11 Technical Specification for Street Lighting

### 5.11.1 LED Luminaries

### 5.11.2 Code & Standards

Title	IS/IEC Code
Testing procedure of photometric testing for LED luminaires	LM 79
Testing procedure on the lifespan of LEDs	LM 80
National Lighting Code	SP72
Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources	IS:16105
Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products	IS:16106
Limits of Harmonic Current Emissions	IS 14700-3-2
DC or AC supplied electronic control gear for LED modules performance requirements	IEC 62384
Lamp control gear: particular requirements for DC or AC supplied electronic control gear for LED modules	IEC 61347-2-13
Environmental Testing: Test Z- AD: composite temperature/ humidity cyclic test	IEC 60068-2-38

Electro Magnetic compatibility (EMC)- Limits for Harmonic current emission-- (equipment input current $\leq$ 16 A per phase)	IEC 61000-3-2
EMC Immunity requirement	IEC 61547
LED modules for general Lighting-Safety requirements	IEC 62031
Classification of degree of protections provided by enclosures (IP Codes)	IEC 60529
Fixed general purpose luminaires	IEC 60598-2-1
General Lighting - LEDs and LED modules – Terms and Definitions	IS:16101 / IEC TS 62504
LED Modules for General Lighting Part 1 Safety Requirements	IS:16103(Part1)
LED Modules for General Lighting Part 2 Performance Requirements	IS:16103(Part2)
Safety of Lamp Control Gear, Part 2 Particular Requirements Section 13 D.C. or A.C. Supplied Electronic Control gear for Led Modules	IS:15885(Part2/Sec13)

#### 5.11.3 Environmental Condition

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

Maximum ambient air temperature: 50° C

Minimum ambient air temperature: 10° C

Max. Relative humidity: 90%

Atmosphere: Dusty and Heavy chemical smoke at times in certain areas. The equipment shall be suitable to sustain and work in the atmosphere of Raipur.

#### 5.11.4 Luminaire Description

- The Luminaries shall have a sturdy and corrosion resistant high pressure Die cast Aluminium housing with weatherproof gasket for lamp and control gear accessories. The Housing shall be Epoxy coated, without any cracks or thorough holes, made in a single piece of die-cast LM6 aluminium alloy. The luminaries shall be totally enclosed, dust tight and water proof.
- Heat sink used should be aluminium extrusion having high conductivity. The dimensions of luminaries shall be optimum and adequate to permit sufficient heat dissipation, through the body itself, so as to prevent abnormal temperature rise inside the lantern and consequential damage to the cover and gasket materials, LEDs, lenses and electronic drivers. Heat sink must be thermally connected to MCPCB/ LED light source.
- The Luminaire shall employ individual optical lens for the each of the LED to ensure better uniformity of light distribution.



- d. The luminaire must have secondary lens/optics. Though the secondary lens/optics do result in minor loss of lumens, it is nevertheless a must to distribute the light output of the LEDs so as to achieve the desired polar curve characteristics for the luminaire– no exemption shall be permitted on this account. The material of lens should preferably be PMMA.
- e. The Luminaires Housing shall be suitable for termination of Cable with Double Compression Cable Glands.
- f. Housing protection: IP-66. If the LEDs and LED Driver are in different compartments, then the two compartments must be individually IP-66. For achieving IP-66, proper gaskets should be provided. Test certificate of NABL accredited laboratory is to be submitted for the luminaire model/rating offered.
- g. Luminaires' should conform to the photometric Distribution / requirements of Cut-Off / Semi Cut – off light distribution and optics as classified in IS 1944.
- h. Suitable number of LED lamps shall be used in the luminaires. The manufacturer shall submit the proof of procurement of LEDs from OEMs at the time of testing
- i. The Luminaires shall be provided with high tensile heat resistant toughened glass of minimum 0.8mm thickness or UV resistant polycarbonate cover fixed with stainless Steel screws.
- j. An extruded silicon loop gasket shall be provided in the lantern body to ensure a weather proof seal between the cover and the metal housing to exclude the entry of dust, water, insects, etc. Luminaires should conform to degree of protection of IP 65 or above. Felt gasket will not be accepted.
- k. Year of Manufacture, Batch No., Serial Number or Identification No. Luminaires Manufacturer's Name / Logo, Wattage and Frequency should be embossed on the housing.
- l. LED luminaires, should conform to the various National / International standards for safety & performance. Manufacturer should provide test reports as per LM 79 & LM80. Lumen maintenance report as per LM 80 guidelines shall be submitted for the LEDs used along with the BID. Selected contractor should submit the test report of luminaires and Driver from NABL accredited laboratory/ equivalent.
- m. Luminaires should conform to the IS standards for Safety & Performance and test certificates as per IS 16107 should be provided by the manufacturer. In case of luminaires are imported, contractor shall conform to test parameters as per UL or equivalent standards.

- n. The electrical component of the LED and LED driver must be suitably enclosed in sealed unit to function in environment conditions mentioned earlier.
- o. All the connecting wires inside the Luminaires shall be low smoke halogen free, fire retardant cable.
- p. Adequate protection against Overloading, Short Circuit, Over Voltage, over temperature, Under Voltage, String Open shall be provided within the Luminaires.
- q. Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.
- r. The equipment should be compliant to IEC 60598-1, IEC 62031 and IEC/ PAS 62612 depending on the type of luminary.
- s. All the material used in the luminaires shall not contain any toxic material/ metal like mercury; shall be halogen free and fire retardant confirming to relevant standards.
- t. The Manufacturer shall have all the relevant testing facilities certified by an accredited laboratory and shall be offered for inspection to the PURCHASER for verification of the required parameters and tests. Contractor shall confirm the same in the BID.
- u. The control gear shall comply with the provisions of IEC 61347-2-13, IEC 62031 and IEC 62384 as appropriate.
- v. The luminaire manufacturer shall submit the photometric test report in respect of the luminaire offered (through DIA Lux (4.12 version), AGI32 or other simulation software).
- w. IES photometric file is also to be supplied in soft copy (i.e. on CD or by uploading/e-mailing the files, as per tender instruction). Firms are warned of serious consequences if they try to submit a tampered/doctored report.
- x. The luminaire shall comply safety requirements laid down in IEC: 6059-1/IS : 10322: Part 1, IEC: 60598-23/IS : 10322: Part 5: Sec 3. Test certificate of NABL accredited laboratory shall be submitted and certificate must cover the luminaire model/rating offered by the firm.
- y. The lighting fixtures offered shall comply with the following requirements

#### 5.11.5 Luminaire Datasheet

Sr. No.	Parameter	Requirement / Value
1	Type	LED Luminaires complete with all accessories for Street Lighting
2	Rated Voltage	230 V

3	Expected Frequency	50 Hz +/- 3%
4	Operating Voltage Range	140 V to 270 V but luminaires shall be tested for 100V to 300 V AC
5	Power Factor	> 0.90
6	Operating Temperature Range	0 Deg C to 50 Deg C
7	Working Humidity	10% - 90% RH
8	Driver Type	Constant Current based Electronic Driver
9	Driver Efficiency	> 85%
10	Driver Life	>20000 hrs.
11	Protection required in Driver module	
12	Short Circuit	Yes
13	Over Voltage	Yes
14	Over Temperature	Yes
15	Under Voltage	Yes
16	String Open Protection	Yes
17	Luminaire IP Protection	IP-66
18	Minimum Surge Protection	>4 KV
19	THD	≤ 15%
20	Rated Minimum LED Life (L70)	50000 Burning Hours
21	CRI	>70
22	Junction temperature rise	< 85 Deg C
23	Solder point temperature	< 70 Deg C
24	Maximum temperature rise for Driver	<30 Deg C at 45 Deg C ambient
25	Operating Hours	Dusk to Dawn (max 12 Hrs.)
26	Efficacy of Luminaries	>100lm/W
27	Colour Temperature	5000K – 6000K
28	Illumination Regulation	<5%
29	Material used for following	
29.1	Housing	Die cast aluminium/ extruded Aluminium body with powder coated finish
29.2	Heat Sink	Aluminium extrusion
29.3	Clip / Fastners	Stainless steel.
29.4	Diffuser	Toughened glass (0.8mm thick)/ UV stabilized Poly carbonate material
30	Maximum temperature of Heat sink	<70 Deg C
31	IK protection of Optic Cover	>IK07
32	Wires used Inside Luminaries	Cu conductor, low smoke halogen free, fire retardant e-beam cable
33	Cable gland IP protection	IP 66

#### 5.11.6 Testing of Luminaire

- a. The Routine test on each of the offered Luminaires shall be carried out by contractor before dispatch. Following tests shall be carried out as Routine tests by contractor for the offered Luminaires;
  - Visual and Dimensional check
  - Checking of documents of purchase of LED

- Insulation resistance test
  - HV test
  - Reverse polarity
- b. The Acceptance test shall be carried out by PURCHASER or PURCHASER's Representative on a sample of the lot offered for Acceptance. The Lot shall be different from the lot from which the Type test samples have been drawn. The cost of the testing shall be borne by contractor. Following tests shall be carried out as Acceptance tests by contractor for the offered Luminaires;
- Visual and Dimensional check
  - Checking of documents of purchase of LED
  - Insulation resistance test
  - HV test
  - Over voltage protection
  - Surge protection
  - Reverse polarity
  - Lux measurement
- c. Following Type tests reports shall be provided by contractor for the offered Luminaires along with the BID;
- Resistance to humidity
  - Insulation resistance test
  - HV test
  - Over voltage protection
  - Surge protection
  - Reverse polarity
  - Temperature rise Test
  - Ra (Colour Rendering Index) measurement test
  - Lux measurement
  - Fire retardant Test
  - Test for IP 66 protection
  - Endurance Test,
  - Life Test
  - Photometric Measurements Test Report (IES LM 79)
  - LED Lumen Maintenance Test Report (IES LM 80)
  - Vibration test as per ANSI
  - Drop Test

#### 5.11.7 Mockup Test Requirements

- a. Tenderer are required to submit 6 nos. light fixtures along with the other accessories of light fixtures / luminaires of specified types as per submitted design and specifications mentioned in the submitted tender documents (by the tenderer) for Mockup
- b. The exact location shall be communicated in due course of time by RSCL.
- c. The mock-up shall be done in 3no's poles for various ROW's on proposed smart road.
- d. Tenderer shall depute representative having complete knowledge to explain their product in detail.
- e. Tenderer shall organize & bear all cost of providing samples material, illumination arrangement, power generator, transport, loading, unloading, security, etc for Mock-up.
- f. Mock-up will be evaluated by a committee, nominated by RSCL. If, required modifications will be suggested and an undertaking to agree to the modifications without any financial implications will be taken from the tenderer. However, in case of major changes, if any in the work or if RSCL feels that some modifications need to be done to create a level playing field, a revision in the price-bid could be allowed only at the discretion of RSCL.
- g. The fixture of selected contractor will be returned only after execution of work and for other will be returned after insurance of LOA of successful contractor.
- h. Those who qualify in Mock-up test as above shall be invited for the opening of financial bid.
- i. The unopened tender of the tenderer who are found unresponsive or who are found not qualified in the technical evaluation and Mock-up evaluation shall be returned unopened to tenderer.

#### 5.11.8 Submittals to be made by the tenderer

The tenderer is mandatorily required to submit the following documents along with his tender:

- a. Model/ make of LED used in the luminaire- datasheet to be furnished.
- b. LM 80/ IS: 16105 report with TM21 extrapolation in support of the L70 reported
- c. Life in respect of the LED used in the offered luminaire
- d. If compliance to IEC 62471/IS: 16108 is not confirmed in the LED datasheet, then submit a test certificate issued by an internationally/ nationally accredited laboratory.
- e. LED Driver's datasheet showing at least the following attributes: make, model/

- f. Rating, THD, Efficiency, Power factor, protections, TC. If the datasheet is not confirming one/ more of the said attributes, then submit the required data/ information from the LED Driver manufacturer.
- g. If available, then submit the Driver manufacturer's detailed in-house test report in respect of the LED Driver offered (but this is not mandatory).
- h. The following EMI/ EMC test certificates from NABL accredited laboratory must be submitted in respect of the LED Driver: CISPR 15/IS: 6573, IEC: 61547 (certificates are required in respect of all the IEC: 61547 pertinent reference standards as are mentioned in this RDSO document), IEC: 6100-3-2/IS:1534 Part 1 & IEC: 61000-3-3/IS 14700: Part 3: Sec 1.
- i. The following test certificates from NABL accredited laboratory must be submitted in respect of the LED Driver model/ rating offered: LED Driver Safety as per IEC: 61347- 2-13/ EN: 61347-2-213/IS: 15885-213 and LED Driver Performance as per IEC: 62384/IS: 16104
- j. Test certificate from NABL accredited laboratory must be submitted in respect of LED luminaire safety compliance as per IEC: 60598-1/ IS: 10322: Part 1, IEC: 60598-2-3/IS: 10322: Part 5: Sec 3. The test certificate should cover the model/ rating of the luminaire offered.
- k. Manufacturer's stated system (LED + Driver) wattage of luminaire
- l. Sketch/drawing indicating the luminaire's mechanical arrangement and key dimensions
- m. LM 79/IS: 16106 report in respect of the luminaire from NABL accredited Laboratory.
- n. Photometric report print-out in respect of the offered luminaire (through Dialux-4.12 / AGI-32 or other simulation software)
- o. Delivered Lumens declaration of Luminaire
- p. IES Photometric file in soft copy (i.e. on CD or by uploading/e-mailing the files, as per tender instructions).
- q. Polar graph print-out
- r. Manufacturer's in-house test report of the luminaire model/ rating offered by the tenderer
- s. Test certificate from NABL accredited laboratory in support of IP-66 protection of luminaire.
- t. Test certificate from NABL accredited laboratory in support of Impact Resistance IK-07
- u. Lighting design report for the mockup test condition indicating the average

- v. Luminance uniformity, maximum & minimum values. Polar curve of the light fitting indicating the light distribution capability of luminaries should also be attached.
- w. Authorization certificate in case contractor is not a manufacture.

## **5.12 Technical Specification of Street Light Feeder Pillar**

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

- provided with a metal flip cover which can be moved up and down for viewing the meter.
- 5.12.8 Both the doors shall have panel type lock with keys in duplicate as per the requirements of the PURCHASER.
- 5.12.9 All the feeder pillars shall be of uniform height and shall be mounted with the bottom of the panel at 500mm above the Finished Ground or Floor level as the case may be.
- 5.12.10 A danger notice board written in English and Hindi shall be made of 2mm thick GI plate and shall be provided on the front door of the feeder pillar.
- 5.12.11 The details of connected load in KW, service No., Meter No., area in which Street-light poles erected name of the agency and year of erection shall be labelled using radium sticker/radium paint.
- 5.12.12 The enclosures shall be manufactured by hand layup process in approved moulds or any other approved process so as to ensure smooth finish on mould side i.e., on external face and reasonable smooth finish on internal face.
- 5.12.13 The feeder pillar shall consist of Incoming Four Pole (FP) RCBO or MCB, 3 Phase Energy Digital Meter, FP Contactor for each outgoing circuit, Astronomical Timer, Outgoing FP MCB apart from all the smart control components like Gateway controller, Power Supply Unit for the Gateway unit, Battery for Back up etc. It shall also consist of FP Isolator for isolating the smart lighting control equipment without discontinuing supply to the light pole during the outage of the smart control system.
- 5.12.14 The feeder pillar shall have cable entry at the bottom suitable for terminating double compression glands for 2 Runs of 3.5Cx 50 sqmm Aluminium conductor, XLPE insulated armoured cable at the incoming terminal and 8 Runs of 4 core 16 sqmm Aluminium conductor, XLPE insulated armoured cable at the outgoing terminal.
- 5.12.15 All MCBs/RCBOs/RCCBs shall be comply with the relevant IS and IEC standards. It shall be current limiting type and shall provide a cut off in, < 10 ms for prospective currents during faults. It shall be provided with fixed thermal overload, short circuit and earth fault release. The breaking capacity of the MCCB shall be 16A for 1 sec and rated for  $I_{cs} = I_{cu} = 100\%$ . The other power and control components are as listed below;
- 5.12.16 All the contactors shall have high rupturing capacity rated for 3 phase, 440 V, 50 Hz, Four Pole, AC 3 duty.



- 5.12.17 Astronomical timer having Single channel and capable of Auto resetting when power resumes, provision of manual over ride, switching ON / OFF the circuit as per the Sun set and Sun rise timings along the year.
- 5.12.18 25X3 Copper bus bar with SMC support insulators shall be provided for power distribution within the feeder pillar. The size of phase and neutral shall be equal.
- 5.12.19 The minimum rating of the incomer shall be 32A, 100mA sensitivity, current limiting four Pole, AC 3 duty.
- 5.12.20 Outgoing FP 16-25A MCB – Current limiting type, Characteristic Curve C, Breaking capacity 10 kA for 1 sec.
- 5.12.21 Terminal connectors suitable for terminating the above mentioned cables. Separate terminals shall be provided for tapping power for the luminaires with 2.5 sqmm Copper conductor PVC insulated Un-armoured cable. Twenty percent spare terminals shall be provided.
- 5.12.22 Under voltage and Over voltage Monitoring Relay for connection and disconnection of the power during off band abnormal voltage within a time band.
- 5.12.23 All connecting power & control wiring shall be carried out with stranded copper conductor PVC insulated LSHF wires. Minimum size of control wiring shall be 1.5 sqmm and power wiring shall be 4 sqmm.
- 5.12.24 Space Heater with MCB and Thermostat and 7W LED Luminaires with lamp shall be provided inside with a door limit switch. The lamp and the heater shall be tapped from the outgoing of the meter with separate DP MCB circuits.
- 5.12.25 Earth Leakage circuit breaker confirming to IS-12640/1988 & BS 4293/1983 with latest amendment having sensitivity 110 mA and breaking capacity of 10 KA for 1 sec and suitable for 3-phase, 4 pole having characteristic of quick acting & tripping with all advance feature with suitable enclosure box/mounting rail.
- 5.12.26 Contractor shall provide provision for connection through SIM, Ethernet, RS 485 and OFC to connect with server through whatever mode is available at site. Presently the communication of the Feeder pillar shall be carried out through GSM network however after the city OFC network is laid the communication shall be carried out through the OFC network.
- 5.12.27 An Aluminium / GI Earth bus shall be run at the bottom of the Feeder Pillar which shall be connected to the earth leads at the two extreme ends for connecting the GI earthing strip from the electrode.
- 5.12.28 Cast Resin CT of appropriate rating (---/5A) shall be provided at the incomer of each phase for measurement of the current.

5.12.29 The data sheet of the 3 Ph energy meter is as follows;

S. No.	Particular	Specifications
1	Type of Meter/Design designation	AS per CSPDCL
2	Standards	IS13779, CBIP-304
3	Class of Accuracy	Class 1.0
4	Rated Current	10-60A (10A basic current)
5	Rated Maximum current as percentage of basic current	600% of Basic Current
6	Rated voltage (volts)	3 X 240 V – Phase to Neutral 3 X 415 V – Phase to Phase
7	Rated frequency (Hz)	50 Hz $\pm$ 3%
8	Specified operating voltage range	0.8 to 1.1 V ref.
9	Limit voltage range of operation	0.7 to 1.2 V ref.
10	Temperature range of operation a) Specified operation range b) Limit range of operation c) Limit range for storage and transport	AS per IS13779
11	Relative humidity a) Annual mean b) For 30 days these days being spread in a natural manner over the years. c) Occasionally on other days	AS per IS13779
12	Power consumption at rated current a. Active b. Apparent b) Power consumption	1 W 4VA 1 VA
13	Percentage minimum current which shall start the meter and continue to run thereafter at rated voltage and unit power factor of basic current (% of basic current)	0.2% of basic current
14	Tamper & Fraud Protection details	As per IS 13779

5.12.30 Two nos. Pipe Earthing electrode shall be provided for each Feeder pillar and connected with 25X6 mm GI earth strip. The pipe electrode shall be as per the latest version of IS 3043.

5.12.31 HDPE pipe of suitable for conveniently accommodating the above incoming and outgoing cables shall be laid upto the feeder pillar for carrying the buried cables upto the feeder pillar for termination. The GI strip for earthing shall also be laid through the same pipes.

5.12.32 The feeder pillar shall be mounted on prefabricated Galvanised Steel Support structure duly fastened with a concrete foundation with M20 concrete.

5.12.33 All the material/equipment/accessories must confirm to the relevant IS with its latest amendments. All the material/equipment/accessories shall be supplied with manufacturer's test certificates.

5.12.34 Insulation resistance between live parts and earth terminal shall be 5 MΩ minimum. All power equipment shall be able to withstand high voltage (HV) test at 1.5 kV for 1 minute between live parts (current carrying parts) and earth terminal without breakdown of insulation.

5.12.35 Following documents needs to be submit for approval

- a. General arrangement drawing
- b. Support & foundation drawings
- c. Wiring diagram
- d. QAP (Quality assurance plan)
- e. Data sheet for each component

5.12.36 Routine test shall be conducted as per relevant IS/IEC and shall be carried out at manufacturer place and same shall be witnessed by RSCL/RSCL's representative. Following shall be minimum check

- a. Visual inspection Check
- b. Bill of material.
- c. Electrical Continuity check.
- d. Functional Check.
- e. HV insulation check.
- f. Type Test certificate shall be submitted for review.

### **5.13 Technical specification of Centralized Control & Monitoring System (CCMS)**

5.13.1 Scope of Works for Smart Street Lighting shall include design, supply, and installation, testing at site, commissioning, Operation and maintenance of lighting controls through Centralized Control & Monitoring System – (CCMS) for LED streetlights installed under the scope of this RFP. Operation and Maintenance of CCMS shall be as per the terms and conditions of the RFP.

- i. The CCMS system shall be provided for the total no. of lights that is offered based on the design by contractor and shall be Scalable upto two times as many numbers of lamp within short period.
- ii. The CCMS System shall consist of the following components;
- iii. In the Field enclosed within the Feeder Pillar (FP)
- iv. Controller
- v. Communication Module/ Gateway

- vi. Antenna
- vii. Battery Bank for 12 Hrs Back up
- viii. Server for storage of data - preferably dedicated server set-up or cloud based arrangement to ensure 100% guarantee of the data transmission, and real time data storage and archived data for the contract period.
- ix. Web Based Application Software
- x. Concept of Smart Street Lighting to be implemented at ABD area of Raipur smart city Ltd.
- xi. CCMS shall consist of Street Light Controllers and its accessories installed within each Feeder Pillar with a gateway to communicate with Server.
- xii. The Maximum quantity of luminaries controlled by each Controller shall be decided by CONTRACTOR however, it shall not be less than 25 lamps per Controller.
- xiii. All the LED Luminaires shall be Remotely/ Automatically/ Manually Switched ON-OFF in GROUP through Web Based Applications based on
- xiv. Sunrise/ sunset timing depending on geographical locations of the Switching Point / Feeder Pillar based on preprogrammed/ scheduled timings
- xv. All the LED Luminaires which are rated equal to and above 90W shall be Dimmable where as the rest of the lights shall be non Dimmable.
- xvi. Dimming should be possible from 10 to 100% however, dimming shall be carried out in steps as follows;
  - From 10 PM to 1AM – 25%
  - From 1 AM till 3 AM – 50%
  - From 3 AM till Dawn – 75%
- xvii. The setting shall be adjustable / programmable at site as per the Sun rise time.
- xviii. Moreover, the dimmable Luminaires shall be switched ON and switched Off in steps and in synch with the natural light during Sun rise and Sun Set time.

5.13.2 The CCMS shall provide the following features;

- b. Offer Web-based solution for Remote management on Real Time basis of the Outdoor Lighting System through wired or wireless GPRS/ 3G/ 4G/ Fibre/ LAN/ Wifi communication networks securely.
- c. Capturing and monitoring the all the data from the Smart Energy meter to check the status of all the electrical parameters available at the FP

- d. Monitoring of ON and OFF period; Provide On/Off control based on Sunrise and Sunset timings for burn hour optimization, Energy optimization and simplify maintenance.
- e. Shall facilitate easy and remote configuration/ programming of the system from a web based interface that can be changed as per requirement.
- f. Shall facilitate Fault Monitoring and Automatic Fault detection; Event Logging and Report generation.
- g. Alarm Generation and Alert Notifications through emails & SMSs to desired number of users.
- h. The system shall be modular and easily scalable. Presently the system shall be designed for 15000 luminaires or 350 Switching Points and should be expandable upto 2500 switching points as and when required in steps.
- i. Battery Backup for Minimum 6 Hrs shall be provided for the controller to store the data in case of power failure
- j. Emergency Override - Locally & Remotely.
- k. Facilitate Asset mapping through GPS coordinates of each FP on existing maps
- l. The controller shall have inbuilt memory storage in each controller to store data in case of Communication network failure and transfer it as soon as the link is resumed
- m. Shall have protection logic to operate the hardware to automatically isolate the system during abnormal conditions and restart the system as soon as the system normalizes
- n. Server uptime should be minimum 99.99% with disaster backup and sufficient storage capacity and processing power to ensure stable operation of CCMS throughout the contract period
- o. Minimum 60 Days data shall be stored in the CLOUD. Data Older than 60 days shall be backed up on Editable tapes/ Discs
- p. Should be easy to integrate with city control command centre (ICCC).
- q. CCMS shall ensure Data authenticity, Cyber security, safe database management, data retrieval and trouble free operation of software and allied systems. It shall have a self diagnostic and self healing feature to identify fault and resume the system by isolating it within shortest possible time.

#### 5.13.3 Features of Controller

- a) The Controller shall consist of CPU with minimum 32 bit processor, shall have inbuilt three phase power inputs, interface ports – USB, GPRS & Ethernet; internal health monitoring and logging facility; inbuilt flash memory for data storage; and shall support minimum 2 Analogue and 2 Digital inputs.
- b) Controller shall have the provision to store last 30 days data at one hour interval. All these data is accessible for reading, recording by downloading through HHT (Hand Held Unit) through optical port or USB/Bluetooth given on controller front. For HHT, a smart phone-based solution for collecting /accessing data is also acceptable
- c) The controller shall have a built-in calendar and a local Real Time Clock (RTC) having an accuracy of +/- 1 minute per year or better, synchronized with remote time server, to enable functionality even in case of communication network failure. A separate internal Lithium battery back-up shall be provided for continuous operation of controller RTC for at least two years under controller un-powered conditions.
- d) Controller shall be able to carry out switching operations based on Astronomical calendar of the location.
- e) Controller shall facilitate local operation in case of emergency or during maintenance with proper security verification.
- f) Controller shall be able to detect switch weld condition and generate alarm.
- g) Controller shall be able to log minimum last 25 scheduled and unscheduled events including scheduled switching events, faults, abnormal power conditions and maintenance.
- h) Controller shall additionally be able to log minimum last 25 the power availability events.
- i) The controller shall have protection logic to monitor the abnormal conditions like overload & over voltage conditions, against the benchmark/ threshold limits configured in it and carry out auto switching to disconnect the system if the abnormal condition prevails over predefined period. The controller shall reconnect after the normal system conditions are resumed. All such unscheduled switching activities shall be logged in the system.
- j) Controller shall be provided with a 6 digit LCD to display the controller parameters/ data. Proper universal interface port (USB, Optical etc.) or device shall be provided to access all the stored data within the controller as well as to configure the controller locally either by a Hand Held Unit or by connecting

to a laptop in a secured manner. Configuration allows user to set operating modes, ON/OFF timings, RTC configuration, Updating GPS locations, Astronomical Clock etc.

- k) The CPU of the controller shall be well protected against overvoltage and surges upto 10 kV as per EN 61000-4-5; Burst pulses up to 4 kV as per EN 61000-4-4.
- l) All the controllers shall be traceable when mapped through GPS coordinate.
- m) The controller shall support digital and analogue measurements.
- n) Controller shall have following constructional specifications
  - o) Controller case and terminal blocks shall be made of fire resistant material
  - p) Sealing arrangement - As per IS 13779 and CEA Metering regulations 2006
  - q) Insulation shall withstand an insulation test of 4 KV and impulse test at 6 KV
  - r) Latching Relay/Bi-Stable Switch/Isolation device should conform to IEC - 61036/ 61037

#### 5.13.4 Communication Module of the Controller in the FP

- a. The module shall operate on 240 V AC single phase power supply
- b. Ability to communicate with remote central server/ CLOUD securely via cellular networks (GSM / GPRS) and/ or RF networks. All data shall be secured by encrypting them by 128 bit encryption.
- c. Communication network between CCMS unit and central server should be GSM/GPRS: Quad band 850/900/1800/1900 MHz4G, and communication method shall be TCP – IP via GPRS / 3G and/ or RF SMS
- d. The module shall be a Two-way communicator
- e. The Module shall be able to send data regarding energy usage, ON/OFF status etc. from controller as well as give commands from a central server/ CLOUD for switching ON/OFF scheduling etc.
- f. Ability to remotely upgrade the CCMS device firmware from central server

#### **g. Battery Module**

- The Controller (CPU), Communication module etc. shall be provided with battery backup for 12 Hrs to function during failure of grid power.
- The battery shall help CPU to store all the data and send a main power failure alarm to the remote server/ Cloud before it shuts down safely.

#### **h. Software Application Features**

- i. The web application shall be offered through the RSCL web site or as may be decided by the RSCL at the time of execution.

- ii. The application shall enable receipt & storage of all the field data with a time stamp in Cloud or in-house local server.
- iii. The application shall facilitate to communicate, control and configure the each Switching point FP controllers remotely. The application shall be suitable to manage the data traffic from the field to the Cloud or Server.
- iv. Operation Time - It should be able to record LED luminaires glowing and non-glowing hours of a particular FP (Group).
- v. The System should be suitable for third party integration if required.
- vi. Report Generation – shall enable Users to generate various reports related to the system performance parameters such as energy consumed report, lamp and system failure report, actual hours of operation, uptime (%), etc. as well as based on historical data on daily, monthly, quarterly or annually basis as the case may be from the data/readings received from the units. The reports shall be generated in Xcel as well as Graphical format.
- vii. The application should facilitate Roles and Permissions requirements at different level of user hierarchy. It should manage system access for different levels with multiple privileges for different purpose, including Administrator access to configure, work flow access for operations, and public access for viewing and uploading status.
- viii. Web application shall ensure system security and safety for users at different levels with security password for various users.
- ix. It should be possible to configure Switching point remotely through web application. Remote configuration includes setting new ON/OFF timings, setting RTC time, viewing the Real time data of each switching point, Energy meter parameters, Resetting of the any unit, time synchronization of controller with that of Server and GPS clock etc.
- x. The minimum interval for the update of data should be 15 minute but programmable up to 1 minute.
- i. Asset Management –
- j. Application shall provide a map application that gives an overview of all Feeder Pillars on a street map or GIS map or a satellite image.
- k. Web application software shall offer asset management feature and allow user to locate SPC through GPS coordinates. It also enables user to identify each SPC with unique/Asset ID with additional information like Wattage, Make, Installation date, replacement date, Replacement defect tracking. It is also possible to link details of every street light with reference to particular switching point.



- l. Dashboard – Web application shall provide a comprehensive dashboard with real time status of switching point, real time faults of various switching points, system uptime %, power consumption, power consumption, graphical representation of cumulative data etc.
- m. The application software should be flexible to cater to customized requirement which are not foreseen at this point of time but are deemed necessary during the execution and O&M. Separate tabs shall lead to details regarding monitoring & control parameters like, Alerts, Maps, Configuration, Reports, uptime, fault penalty, history, energy savings, power failure, operational hour, lamp failure etc.
- n. Each Switching Point FP shall be represented by a separate Tab on the dashboard to show the switch point summary indicating the FP details, rating, location, meter parameters, history of alerts, active alerts, link to the map page, etc.
- o. The application shall generate alarm and alerts through SMSs for any type of abnormal system conditions and faults as listed below to designated users which should not be less than six in numbers.
- p. It should describe the abnormality or fault in short as well as highlight the same with different colours to indicate the status with respect to time – within 12 hrs, in next 12 hrs, beyond a day etc. It shall provide monthly reports on the faults through email. Penalty as indicated in the Service Benchmark for contractor shall be calculated based on these reports.
- q. Application should be able to track the failure of lamps in a particular switching point by triggering alarm due to significant drop in power consumption. The application should display the no. of faulty lights for each phase separately instead of giving a total figure of faulty lights for all the 3 phases together.
- r. Application shall protect and report Jamming/ hacking attempts and maintain status-quo in cases of such attempts i.e. if lights are ON, they should remain ON till the default OFF time recorded in the system. In case lights are OFF at the time of Jamming / hacking attempt, lights should remain OFF till default ON time recorded in the system
- s. Software to have complaint handling system for light failures, with citizen interface and means of communicating repair update to complaining citizen through SMS.
- t. Ability to remotely upgrade the CCMS device firmware from central server.
- u. The system shall display the following minimum faults in alarms :
  - Phase-wise currents on crossing threshold values

- Phase-wise voltages on crossing threshold values - Under/over voltage detection
  - Main breaker error
  - Contactor fault
  - Circuit breaker off
  - Circuit phase errors (fuse, breaker, etc.)
  - Main power failure
  - Leakage to ground
  - Manual switch activated
  - Control cabinet door open
  - Low Power Factor
  - Communication failure with server
  - Theft Alert
  - Group failure of Lights
- v. The software shall enable to divide the city lights in certain zones as per RSCL requirement and assign access to the concern authorities for control and monitoring from their mobile or laptop.
- w. All alarms shall be notified in near real-time via SMS and email to responsible maintenance team.
- x. The system shall support auto switching of street light according to light sensor input.
- y. The system shall support auto switching of street light according to input. Graphical view of the electrical consumption readings shall be available online for monitoring of the hourly, daily and monthly electricity consumption
- z. All Software's License shall be in the name of RSCL. All costs shall be perpetual cost or onetime cost. Contractor shall provide all the upgrades to the system software and system security during the contract period without any additional cost.
- aa. The Software Application shall be supported for five year by contractor.
- bb. In case of CLOUD server, the CLOUD registration shall be done in the name of Client/ Owner. Only Administrative rights shall be provided to contractor during the contract period. The CLOUD services shall be intact upon renewal every year after the contract period. The CLOUD shall not be OEM specific and shall be independent of OEM so that after the completion of contract period there should be no dependence on OEM for cloud services. The cloud hosting service provider shall have minimum Tier 2 certification.

#### 5.13.5 Cable & Cable Termination

The contractor shall follow clause: 5.8

### 5.14 Quality Control Plans

5.14.1 The Quality Control Plan shall list and define in sequential order all process control activities, inspection and tests proposed to be performed on the equipment/ material starting from component procurement and from testing stages to product dispatch. The Quality Control Plan shall indicate and identify the applicable standards, detailed description with diagram the procedure, acceptance criteria, extent of check and record to be generated.

5.14.2 Contractor shall within Fifteen (15) days of placement of order submit the following information to the RSCL.

5.14.3 Descriptive list of the raw material as well as bought out accessories and the names of sub suppliers selected from those furnished along with the Specification.

5.14.4 Type test certificates of the raw material and bought out accessories.

5.14.5 Quality Assurance Plan (QAP) with hold points for RSCL'S inspection. The QAP and hold points shall be discussed between the RSCL and contractor before the QAP is finalized.

### 5.15 Inspection

5.15.1 The inspection may be carried out by the RSCL or his representative at any stage of manufacturing. The successful contractor shall grant free access to the RSCL/ its representative/s at a reasonable notice when the work is in progress. Inspection and acceptance of any equipment under this specification by the RSCL shall not relieve contractor of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

5.15.2 Contractor shall keep the RSCL informed in advance regarding the time of starting and progress of manufacture of all the equipment in its various stages so that arrangements could be made for stage inspection, if desired by RSCL.

5.15.3 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested and approved by RSCL.

5.15.4 Contractor shall, during inspection/ at any stage as sought by RSCL, will furnish test certificates for all equipment including bought out items as included in this BID. However, the RSCL reserves the right to insist for witnessing the acceptance/routine testing of bought out items.

- 5.15.5 Contractor shall communicate to the RSCL the details of all testing programme at least Three (3) weeks in advance. RSCL reserves the right to waive the inspection at any stage.
- 5.15.6 Contractor shall keep all his testing instruments duly calibrated against Standard Meters at designated Accredited Laboratory not earlier than 6 months from the date of test of the equipment, covered under this specification. Calibration certificates shall be made available during inspection. The calibrating instruments used as standard shall be traceable to National/ International standards.
- 5.15.7 A joint inspection of RSCL Authority; Technical Officer, Project Manager and team of contractor shall be carried out before commencing for operation.
- 5.15.8 Following Field Test shall be carried out on the system
- 5.15.9 Visual Inspection of quality of work,
- 5.15.10 Insulation resistance of the system including cable
- 5.15.11 Power consumption of individual Luminaire, each feeder pillar System for a particular road.
- 5.15.12 Lux level available with and without the other façade and vehicular lights. The lux level shall be tested in accordance with NLC.
- 5.15.13 Operational demonstration with CCMS
- 5.15.14 Earth resistance of each pole and feeder pillar

## **5.16 Capacity Building**

- 5.16.1 Contractor needs to provide training to RSCL employees and other stakeholders as directed by RSCL for capacity building;
- 5.16.2 Contractor shall prepare all the requisite audio/visual training aids that are required for successful completion of the training for all stakeholders. These include the following for all the stakeholders:
- a) Training manuals for RSCL employees / stakeholder departments;
  - b) Computer based training modules;
  - c) Presentations;
  - d) User manuals;
  - e) Operational and maintenance manuals for Smart Components implemented;
  - f) And Regular updates to the training aids prepared under this project.
- 5.16.3 Contractor shall maintain a copy of all the training material on the portal and the access will be provided to relevant stakeholders depending on their need and role.

The access to training on the portal would be finalized with RSCL. Contractor has to ensure the following points:

- a) For each training session, contractor has to provide the relevant training material copies to all the attendees.
- b) The contents developed shall be the property of RSCL with all rights.
- c) Contractor has to ensure that the training sessions held are effective and that the attendees would be able to carry on with their work efficiently. For this purpose, it is necessary that the effectiveness of training sessions is measured. Contractor will prepare a comprehensive feedback form that will capture necessary parameters on measuring effectiveness of the training sessions. This form will be discussed and finalized with RSCL.
- d) After each training session, feedback will be sought from each of the attendees on either printed feedback forms or through a link available on the web portal. One member of the stakeholder group would be involved in the feedback process and he/she has to vet the feedback process. The feedback received would be reported to RSCL for each training session.

#### **5.17 Hand-Over of the System during Exit Period**

- 5.17.1 Contractor shall hand over to the RSCL the following before the expiry of the contract or in the case of termination of Contract by RSCL with Justifiable reason as specified elsewhere in the RFP:
- 5.17.2 A complete list of Hard and Soft Assets with its records over the past period.
- 5.17.3 All the assets in good working condition as per tech specification or its upgraded version. In case any asset is not in working condition, CONTRACTOR shall ensure that the same is made good as per required standard and performance and handed over within the Exit period.
- 5.17.4 All software along with the confidential information related to it like user name and passwords and hardware keys if any. It shall also hand over all the rate contract if any signed with the software company for continuity of services.
- 5.17.5 Information relating to the current services rendered and technology and technical data relating to the performance of the services; Entire documentation relating to various components of the Project, any other data and confidential information related to the Project;
- 5.17.6 All other information (including but not limited to documents, records and agreements) relating to the products & services related to the project to enable RSCL and its nominated agencies, or its replacing contractor to carry out due

diligence in order to transition the provision of the Project Services to RSCL or its nominated agencies, or its replacing contractor (as the case may be).

- 5.17.7 The duration of 60 working days after completion of the contract period shall be considered as Handover/ Exit period during which contractor shall give full access to its premises, records, data base and assets related to this project.
- 5.17.8 All the information as indicated above which is handed over to RSCL should not be copied, sold or reused by contractor under any circumstances without any written approval from RSCL.
- 5.17.9 In case this handover happens within DL period, contractor shall ensure that the technology provider shall continue to support the assets and systems till the end of the DL Period.
- 5.17.10 Contractor shall not retain any data, security codes, and other confidential documents including any type of customer survey data with them.
- 5.17.11 During the Exit period contractor shall not reduce any manpower or replace any Manpower wilfully as available on the day of issue of Notice. In case contractor reduce the manpower then RSCL shall charge Rs. 1000/- Per person per day as penalty for the remaining duration of the Exit period.

#### **5.18 Documents Required To Submit By Contractor during Technical Bid**

- 5.18.1 Offered Solution for Smart Lighting with details of the technology
- 5.18.2 Typical Design report highlighting the solution & calculations for the each category of road as specified in the RFP above
- 5.18.3 Summary statement of Road, Road width, Height of pole, Mounting arrangement, Wattage of LED Luminaire offered, Calculated Lux level
- 5.18.4 LED Data sheet and Type test reports as specified above
- 5.18.5 Guaranteed Energy consumption for each Luminaire and its system including the losses.
- 5.18.6 Luminaire Data sheet mentioned in the BOQ and their respective type test reports as specified above.
- 5.18.7 Detail Write up on the CCMS including proposed system, features offered, technology and components offered, System Architecture, data sheets of the components.
- 5.18.8 Approach methodology for replacement of High mast fixtures and replacement of High mast controller.
- 5.18.9 Type test certificates, technical data sheet of compact substation and RMU offered

- 5.18.10 Type test certificates & technical data sheet HT and LT cable, DWC HDPE pipe specification type test certificates
- 5.18.11 Typical calculation sheet indicating voltage drop from grid substation to consumer considering one 11kV feeder, DT and consumer.
- 5.18.12 Technical data sheet, typical GA and wiring diagram for Outdoor DT box, service feeder Pillar along proposed smart road
- 5.18.13 Approach methodology for carrying out the scope of work for Project implementation and Operation and Maintenance phases
- 5.18.14 Earthing and Surge suppression solutions offered
- 5.18.15 Sustainability of the System offered
- 5.18.16 Makes of component and systems offered
- 5.18.17 Exit management plan

#### **5.19 Documents Required To Submit By Successful Contractor**

- 5.19.1 Confirmatory Field Survey Report along with findings with maps
- 5.19.2 Detailed Project report with proposed solution as found in the Site Survey report including the following;
  - a. Road details – Total ROW width, Width of carriage way/ foot path/ drains, road length etc.
  - b. Design calculations for each road
  - c. Summary of Road, road width as above, Design lux, Pole height, calculated lux level, no. of FP, Luminaire wattage
  - d. Lists of DT's along the road, Grid substation, 11kV circuit and load on 11kV feeder and consumer per feeder along the smart road, Service pole, consumer per service pole & per DT in spread sheet. The report shall consists of consumer sanctioned demand, service cable length etc.
  - e. Location, site plan for installation of CSS
  - f. Type, Quantity, GA and Technical data sheet for Outdoor DT box, Service feeder Pillar.
  - g. Design calculation sheet for Cable, cable schedule, voltage drop 33kV, 11kV and consumer road wise.

#### **5.20 Guaranteed Energy consumption for each FP including the losses.**

- a) Identified source of power, single line diagram and space provisions for switching points for each road

- b) Location drawings for poles, Switching points and cable laying corridor
- c) Offered systems, components, their technical data sheets and type test reports;
- d) System Architecture drawing
- e) Details regarding Cloud Server and Lighting management Software
- f) Communication Protocol
- g) O&M SOP – Procedure, description of works to be carried out, Regular Inspection Plan, regular Quality Control Plan, regular maintenance plan for Predictive & Preventive maintenance.
- h) Office / Storage space General arrangement layout
- i) Resource Deployment plan for manpower and tools
- j) Details of Call centre & Complain management system – system and component technical details
- k) Organization structure and team CVs
- l) Detailed execution micro schedule to meet the target dates with milestones & deadlines – Order of roads for installation
- m) BOQ
- n) Make offered
- o) Execution drawing with coordinates of each pole and Switching point for each road
- p) Civil foundation drawings with Calculations for each height of pole
- q) Equipment Manuals: Original Manuals from OEMs
- r) Installation Manual: For all the application systems
- s) User Manuals: For all the application software modules, required for operationalization of the system.
- t) System Manual: For all the application software modules, covering detail information required for its administration.
- u) Control schematic diagram and interconnection diagrams for switching points
- v) Test reports of bought out components
- w) Inspection reports of the components, luminaires and system
- x) All drawings shall carry RSCL's name, purchase order no. with date, project title, consulting engineer's name and adequate space for drawing approval.



- y) Training Material: Training Material will include the presentations used for trainings and also the required relevant documents for the topics being covered. Training registers should be submitted for same.
- z) Standard Operational Procedure (SOP) Manuals: The draft process (SOP) document for O&M and all other services shall be formally signed off by RSCL before completion of Final Acceptance Test. This SOP manual will be finalized by contractor within 2 months of operationalization, in consultation with the RSCL and formally signed off by the RSCL.
- aa) Contractor shall ensure upkeep & update all documentation and manuals during the Contract period. The ownership of all documents, supplied by contractor, will be with RSCL. Documents shall be submitted in two copies each in printed (duly hard bound) & in softcopy formats

## **5.21 Smart RFID based cable route marker**

### **5.21.1 Scope:**

The RFID Markers and locating system required is based on RFID cable markers and a portable marker locator device with software database designed for localization and identification of both analog and smart RFID markers. The RFID Marker Locator should be able to find a marker and define the place and depth of marker imposition. In addition, the RFID Marker Locator should have capability to save record number (RFID serial number) of marker being installed On Site during installation - with an inbuilt GPS module that should allow the RFID Marker Locator with GPS module to assign to each marker (selected point) GPS coordinates and therefore allow navigation back to the RFID marker that is buried.

### **5.21.2 RFID Cable marker**

- Type : Passive with RFID
- Output / Operating Frequency: Output frequency: 134 kHz (Power cables)
- RFID : The marker should have unique fixed 10 digit ID in hexadecimal mode
- Construction : high impact polystyrene plastic casing sealed to IP65
- Size : Minimum 220mm diameter x minimum 25mm thickness
- Weight :  $\geq 250$ grams
- Power Source: self generated. No batteries required for signal transmission
- Working : Unit should have capability to receive signal and transmit back
- Depth Range : 1.5 meters
- Working Life :  $\geq 40$  Years

### **5.21.3 RFID Marker Locator**

- 5.21.3.1 **Controls:** Should be based on push button controls, separate, for each of the following functions: Locate; Memory; GPS module; Navigate. Controls should allow menu based navigation.
- 5.21.3.2 **RFID Marker Data Acquisition:** RFID Marker locator should be in a position to acquire and save the marker ID for RFID markers even after installation in trench and at depth up to 1.5m. RFID Marker Locator should have capability to save optional text information about each marker during marker installation in the field. Minimum length of the text information is 20 characters.
- 5.21.3.3 **GPS & Navigation:** RFID marker locator should have built in GPS module for logging GPS coordinates of marker during installation. Locator should provide audio guidance function to allow Operator to navigate to location of marker.
- 5.21.3.4 **Visual Indications:** Large, easy to read liquid crystal display. 4 x 20 digit display with backlight.
- 5.21.3.5 **Memory:** RFID marker locator should have ability to store 8000 marker records.
- 5.21.3.6 **Frequency:** should be in a position to transmit and receive frequency of 101.4 kHz.
- 5.21.3.7 **Power Source:** 10 x 1.5V "C" Batteries. Battery life: Appox 45 hours intermittent use.
- 5.21.3.8 **Depth Measurement:** Marker locator should be able to measure depth of buried marker.
- 5.21.3.9 **Accuracy of Depth :** +/- 10% of depth or better
- 5.21.3.10 **Output & Software :** Marker locator should contain USB to allow data output to computer to marker database software allowing report generation in the form of database including RFID marker 10 digit unique ID, text description of marker for attribute definition e.g. connection point, corner, manhole, cable turning towards road And GPS coordinates for marker installed. Software: should be provided with database management software providing capability to see data output in both database format and google maps. The software should allow the facility to share data on the internet cloud for different users to access marker database based on user name and password.
- 5.21.3.11 **Marker Database mobile phone app:** The marker database should be further viewable directly on any android mobile Smartphone using marker database app downloadable from Google play store which should allow user to view markers installed directly on Smartphone as overlay on google maps. The mobile phone app should have user name and password access control for security.
- 5.21.4 Test certificates & Training

- 5.21.4.1 Test certificate on RFID marker as per manufacture SOP or national and International standard.
- 5.21.4.2 Operating manual of RFID marker
- 5.21.4.3 Free of cost transport of material to Raipur project site.
- 5.21.4.4 Training to RSCL/CSPDCL engineer on operating the equipments, tagging for location on Google map.

## **5.22 EARTHING SYSTEM:**

### **5.22.1 Scope:**

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

### **5.22.2 Applicable Standards: The earthing and lightning protection system shall conform to the CEA guidelines and the latest applicable standards indicated below:**

Code of Practice for Earthing	:	IS: 3043
Code of Practice for the Protection of	:	IS/IEC 62305
Building and allied structure against Lightning.		
Hot dip galvanizing	:	IS: 2629, 2633, 4759
Structural steel	:	IS: 2062 & 808
Welding	:	IS: 816

### **5.22.3 Earthing system:**

- 5.22.3.1 The design basis for designing earthing conductor is indicated under design criteria for electrical system. Earthing system shall be provided all electrical equipments as per the latest edition including all official amendments and revisions of IS-3043 and CEA guidelines.
- 5.22.3.2 All materials and fittings used in the earthing installation shall conform to the relevant Indian Standards or shall be approved by the Engineer's representative & CEIG.
- 5.22.3.3 Contractor has to carry out soil resistivity test at, at least 4 locations for which locations shall be provided by Purchaser's representative. Testing to be done at each site.
- 5.22.3.4 Soil resistivity shall be carried out by Wenner four electrode method as described in IS 3043. Contractor has to carry out the test in presence of Purchaser's representative & test shall be carried out keeping electrode spacing as 1, 2, 4, 6, 8, 10, 15, 25 M (each, along all 8 directions) as per normal practice and report has

to be submitted. Polar curves shall be used for measurement of mean soil resistivity, which shall be used in finding earthing resistance at a particular location. Mean soil resistivity values shall be approved by Purchaser's representative.

- 5.22.3.5 The contractor shall base his earthing calculations on actual measurement carried out by him in the presence of Purchaser/ Purchaser's Representative.
- 5.22.3.6 Galvanized Iron flat / wire or Cu strip shall be used as earthing conductor.
- 5.22.3.7 Contractor to note that, the sizes indicated are minimum required & earthing conductor sizes shall be approved by the Purchaser/ Purchaser's representative on the basis of adequacy calculations submitted by Contractor.
- 5.22.3.8 The underground joints in the system shall be properly welded or brazed and the bolted type connection shall be made with structures/ equipments. Petroleum jelly shall be applied to contact surface of the bolted joints, which will be covered with bituminous compounded and tapes.
- 5.22.3.9 Earthing conductor shall be protected against mechanical damages considering the installation conditions.
- 5.22.3.10 For equipment earthing, two earthing leads will be used if rated voltage of the equipment is 250 volts & above and one earthing lead will be provided for equipment rated below 250 volts.
- 5.22.3.11 The earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm below FGL.
- 5.22.3.12 For each RMU, Feeder Pillar, Street lighting pole & Compact substation, minimum 2 nos. of GI pipe type earthing electrodes shall be provided. The earth pipe shall be buried in specifically prepared earth pit- 4.5 mtr. below ground with alternate layers of charcoal and salt, 40 NB GI pipe with funnel with a wire mesh for watering and bricks masonry block and CI Cover complete as per IS 3043 with necessary length of double GI earth flat 25x6 mm bolted with lug to the plate complete connected to the required point of CSS & RMU with end socket as per direction and duly tested by earth tester conforming to IS.
- 5.22.3.13 For each transformer neutral (for compact substation only), minimum 2 nos. of maintenance free earthing with 3meter long GI pipe including making bore pit of minimum 150mm dia, providing and laying approved make Earthing Electrode of Pipe-in-Pipe technology as per IS 3043-1987 made of corrosion free G.I. Pipes having outer pipe of 80mm dia and inner pipe of 50mm dia and filling with 50kg highly conductive compound around pipe and above that with soft soil in bore pit

complete and providing masonry enclosure with cover plate having locking arrangement and watering pipe etc. as required:

- 5.22.3.14 Each earth electrode pipe shall be welded at the top to a mild steel plate to which the earthing strips shall be connected. These connections shall each be housed in individual inspection chamber set which shall project 100 mm above the finished ground level and shall allow disconnection for testing of individual electrodes. The chamber shall be permanently marked 'Electrical Earth'.
- 5.22.3.15 All materials used for the earth electrode installation shall be purpose made for the application and site conditions and shall be approved by the Purchaser's Representative.
- 5.22.3.16 All civil works, such as excavation, boring, provision of charcoal & salt in adequate quantity, backfilling for the installation of the earth electrodes and the earth pit/ inspection pit shall be in the scope of Contractor.
- 5.22.3.17 After the earth installation has been completed the Contractor shall demonstrate to the Purchaser/ Purchaser's Representative that the resistance of the electrodes to earth and the continuity of the earth network are within the limits specified. Any additional earth electrodes and test instruments required for the tests shall be provided by the Contractor.
- 5.22.4 Important Instructions for Earthing:
  - 5.22.4.1 Each pole of lightning arrestors shall be earthed with separate earth pit.
  - 5.22.4.2 Two-earth conductor shall connect outdoor CT secondary winding to earth grid.
  - 5.22.4.3 The CSS fencing and gate shall be earthed earthed with flexible GI wire.
  - 5.22.4.4 All the earthing material with laying etc. shall be included in the scope.
  - 5.22.4.5 The earth pits may require boring & drilling in the soil & the same shall be considered in contractor's scope.
  - 5.22.4.6 Earth electrode with disconnecting facility shall be provided so that the resistance of the independent earth electrode may be measured.
  - 5.22.4.7 Galvanized conductors shall be touched up with zinc-rich paint where holes are drilled at site for bolting to equipment/structure.
  - 5.22.4.8 Metallic conduits and pipes shall be connected to the earthing system unless specified otherwise.
- 5.22.5 Earthing Pits
  - a) Adequate number of earthing pits shall be provided in conjunction with earthing grid for the earthing system. The minimum spacing between two

adjacent earthing pits shall not be less than length of the electrode (minimum 3 m) and shall be kept 1500 mm away from footings of the structure.

- b) Earthing pits shall be located in ground, which has a reasonable chance of remaining moist. Arrangement comprising of GI pipe with top funnel with wire mesh shall be made to facilitate pouring of water to keep earthing pit wet.
- c) Earthing chamber shall be of RCC / brick chamber of 600 mm x 600 mm, with removable 6 mm thick MS chequered plates. The covers shall have holes for handling. Earthing pits (chambers) shall be painted Green and the earth-pit number shall be marked on it.
- d) Earthing cables crossing other metallic structures such as conduits pipelines etc shall be minimum 300 mm away from such structures.
- e) Earthing conductors shall be protected against mechanical damage.
- f) All earth lead connections shall be as short and direct as possible and shall be without kink.
- g) The main earth loop in plant area shall be generally routed along cables. When equipments are located away from main earth loops, suitable sub-loops shall be run up to them for deriving connections for individual equipment. The entire earthing system shall fully comply with the CEA guidelines and requirements.
- h) Contractor shall have to carry out any changes as desired by the Electrical inspector or the Engineer in charge, in order to make installation conforming to the CEA guidelines 2010.
- i) Contractor shall measure earth resistance of every pit. The earth pit cover shall be black colour painted. The following information shall be mentioned on top of cover (letter shall be written by white paint)
  - Earth Pit No.: ----
  - Earth resistance
  - Date of testing
  - Next date of testing

## 5.23 Technical Specification of laying & Installation of 33kV/11kV and LT underground cables

### 5.23.1 Scope

The scope covers specification for laying of cable at Raipur smart Ltd project site.

### 5.23.2 Code and Standard

Applicable Standards: The installation & commissioning of underground cable shall conform to the CEA guidelines and the latest applicable standards indicated below:

Code of practice for installation & commissioning of Power cable upto and including 33kV rating	IS1255:1983
Standard operating procedure and supply code	CSDPCL

### 5.23.3 Selection of Route

Following guideline shall be followed for selecting route as mentioned below:

- a) The route shall be selected in such a way that it involves minimum obstacles such as roadway crossing, railway crossing etc.
- b) The cable shall be laid along the footpath rather than carriage way.
- c) The cable route shall not involve sharp bends.

### 5.23.4 Method of cable laying

- a) The cable shall be lay in DWC HDPE pipe along ROW of proposed smart road.
- b) The DWC HDPE pipe shall be directly buried in ground after manual digging of ROW.
- c) The cable shall be lay in RCC Hume pipe (NP-2 or NP-3) at railway or road crossing.

### 5.23.5 Installation procedure

5.23.5.1 While laying direct in ground, the DWC HDPE pipe shall be laid on bedding of min. 75mm riddled soil / sand / moorum.

5.23.5.2 The min. depth of laying from the ground surface to the top of the cable is as follows;

- a) Service cable from feeder pillar to consumer –max. 90cm
- b) 33kV cable -2000mm
- c) 11kV cable-1200mm
- d) 415V cable- 900mm
- e) ICT – 750mm
- f) Cable at railway level crossing -1000mm (measured from the bottom of sleepers to the top of Pipe)

The depth may vary as per site conditions for which contractor will take approval from RSCL/CSPDCL.

5.23.5.3 The minimum clearances are as follows:

- a) Power cable to control cable-0.2mtr
- b) Power cable to communication cable-0.3mtr
- c) Power cable to Gas/water main-0.3mtr
- d) Power cable to Power cable- clearance not necessary

5.23.5.4 The precaution to be taken while laying in ducts by taking care against abrasions during pulling proper alignment of duct; precautions against damage to cable at duct entry positions etc.

5.23.6 Cable installation Plan

Cable installation plan should be prepared in accordance with IS 1255 which should contain the details of installation such as –type of cables, cross section area, rated voltage, cable number and drum number; year and month of laying; actual length between joint-to-joint or ends; location of cables and joints in relation to certain fixed reference points; date of making the joint; results of original

5.23.7 Work area fencing

The work of laying the underground cable require a lot of digging along the roadside pavements, therefore it is mandatory that the dug up work area is temporarily fenced with proper warning indications for day time and also for night time with lighting for the safety and convenience of the people moving around the work area.

5.23.8 Permit to work

Contractor shall take permit to work under HT and LT line from CSPDCL. Contractor must take safety measure before start of work at site.



## 6 Tender Data Sheets

### 6.1 Electrical Installation Works

Contractor shall furnish the following details as a part of technical bid. Contractor shall furnish all relevant catalogues relevant to the equipment required for Electrical Installation Works.

#### 6.1.1 11/0.433kV Compact substation with Dry type distribution transformer

S.N.	Description	Unit	Technical Particulars
1	Make		
2	Type		
3	Applicable Standards		
4	Rated output	kVA	
5	Quantity required	Nos.	
6	Transformer location		
7	No load transformer ratio	kV/kV	
8	Number of phases		
9	Rated frequency	Hz	
10	Impedance at all taps	%	
11	No load loss on principal tap	W	
12	Load loss on principal tap and rated kVA	W	
13	Dimensions	mm x mm x mm	
14	Weight	Kg	
15	Number of winding / material of conductor		
15	Method of connection		
(a)	HV winding		
(b)	LV winding		
16	Vector group		
17	LV Neutral		
18	Type of cooling		
19	Tap changer		
20	Tap range	%	
21	Tap step	%	
22	Terminal connection		
(a)	HV terminals		
(b)	LV terminals		
23	Current Transformer		
(a)	On LV		
(b)	On LV Neutral		
24	LV Neutral earthing		

S.N.	Description	Unit	Technical Particulars
25	Insulation of Windings		H.V.
(a)	One minute power frequency withstand voltage (dry and wet)	kV	
		(r.m.s)	
(b)	1.2/50 micro second full wave impulse withstand voltage	kV	
		(peak)	
26	Insulation of bushings		H.V.
(a)	Rated Voltage of bushing	kV	
(b)	One minute power frequency withstand voltage	kV	
		(r.m.s)	
(c)	1.2/50 microsecond full wave impulse withstand voltage	kV	
		(peak)	
(d)	Minimum creepage distance	mm	
27	Whether all the above details attached for each rating of transformer	Yes /No	

## 6.1.2 11kV Ring main Unit (RMU)

S.N.	Description	Unit	Technical Particulars	
			33kV	11kV
1	System Particulars			
1.1	Nominal System Voltage:			
1.2	Highest System Voltage:			
1.3	Frequency			
1.4	No. of Phases			
1.5	Neutral Grounding			
1.6	Fault level for 3 sec			
1.7	Internal Arc withstand level			
1.8	Rated Ingress protection class			
2	Technical Particulars			
2.1	RMU type			
2.2	Bus rating			
2.3	Bus bar material			
2.4	Load Break Isolator rating			
2.5	Load Break Isolator type			
2.6	Breaker type			
2.7	Breaker rating			
2.8	Breaker operation			
2.9	CT ratio/ Class			
2.10	Protection relays			

2.11	Rated withstand voltage at power frequency of 50 Hz			
2.12	Rated Impulse withstand Voltage			
2.13	Tests			

### 6.1.3 11/0.433kV Compact Substations

S.N.	Description	Unit	Technical Particulars
1	System Particulars		
1.1	Nominal System Voltage:		
1.2	Highest System Voltage:		
1.3	Frequency		
1.4	No. of Phases		
1.5	Neutral Grounding		
1.6	Fault level for 3 sec		
1.7	Internal Arc withstand level		
2	Enclosure		
2.1	Rated maximum power of substation		
2.2	Rated Ingress protection class of Enclosure		
2.3	Compartments		
2.4	Type of Ventilation for a) Normal Condition b) Hot Condition		
2.5	Applicable Standard		
2.6	Enclosure material		
2.7	Thickness of sheet		
2.8	Paint color & finish		
3	Technical Particulars for RMU		
3.1	RMU type		
3.2	Bus rating		
3.3	Bus bar material		
3.4	Load Break Isolator rating		
3.5	Load Break Isolator type		
3.6	Breaker type		
3.7	Breaker rating		
3.8	Breaker operation		
3.9	CT ratio/ Class		
3.10	Protection relays		
3.11	Rated withstand voltage at power frequency of 50 Hz		
3.12	Rated Impulse withstand Voltage		

S.N.	Description	Unit	Technical Particulars
4	Technical Particulars for Dry type distribution transformer	Contractor to fill distribution transformer data sheet	
5	Technical Particulars for LV Panel	Contractor to fill 415V metal enclosed switchgear data sheet	
6	Technical Particulars for FPI (Fault passage indicator)	Contractor to fill 415V metal enclosed switchgear data sheet	
7	Technical Particulars for FRTU (Field remote terminal unit)	Contractor to fill remote terminal unit data sheet	
8	DC System		
9	Tests		
10	Type of earthing for CSS		

## 6.1.4 415V Metal Enclosed Switchgear (Outdoor DT box &amp; Service feeder Pillar)

S. N.	Description	Unit	Technical Particulars
<b>1</b>	415 V Switchgear And Busbar Ratings		
(a)	Rated voltage phase and frequency		
(b)	System Neutral Earthing		
(c)	Maximum system voltage		
(d)	One minute power frequency voltage		
	i) Power circuits		
	ii) Control circuits		
	iii) Aux. Circuits connected to Sec of CTS		
(e)	Continuous current rating of Busbars under site reference Ambient Temperature and type		
(f)	Busbar insulation		
(g)	Reference Ambient Temperature		
(h)	Maximum Temperature of Busbars, Droppers and Contacts at Continuous		
	current rating under site ambient temperature		
(i)	Short Circuit current withstand for Busbars and droppers		
	(i) Short time 1 sec		
	(ii) Dynamic Rating		
<b>2</b>	Switchgear Constructional Requirements		
(a)	Type of Construction		
(b)	Thickness of sheet steel		
	(i) Frame, Frame enclosures, doors, covers and partitions		
(d)	Colour finish shade		
(e)	Earthing bus	Material	
		Size	
	Earthing conductor	Material	
		Size	
(g)	Minimum clearances in air of live parts		
	(i) Phase to Phase		
	(ii) Phase to Earth		
(h)	Cable entry to cubicles		
<b>3</b>	Instrumentation Transformers		
(a)	Current transformer		
	(i) Ratio		
	(ii) Burden		

S. N.	Description	Unit	Technical Particulars
	(iii) Accuracy Class		
(b)	Voltage transformer		
	(i) Ratio		
	(ii) Burden		
	(iii) Accuracy Class		
4	Type of Starter for MCC Panel		

Note: Contractor has to submit The above Data Sheets for 415 V MCC/Feeder Pillar/  
/Lighting DBs Etc.

#### 6.1.5 HV, LV Power & Control Cables

S. N.	Description	Unit	Technical Particulars	Technical Particulars	Technical Particulars	Technical Particulars
			33kV power cables	11kV power cables	0.415kV power cables	Service cables
1	Name of the Manufacturer					
2	Conductor(stranded/solid)					
2.1	Form circular/segmented					
2.2	Nominal diameter in mm					
2.3	Effective cross sectional area sq mm					
3	Whether cores identified by numeral for cable with five core and above.					
4	Whether incremental running lengths are marked on cable at every 1 m interval.	Yes/No				
5	Finished cable					
5.1	Diameter under armour in mm					
5.2	Diameter over armour in mm					
5.3	Overall diameter in mm					
6	Whether cables will carry ISI stamp.	Yes/No				

S. N.	Description	Unit	Technical Particulars	Technical Particulars	Technical Particulars	Technical Particulars
			<b>33kV power cables</b>	<b>11kV power cables</b>	<b>0.415kV power cables</b>	<b>Service cables</b>
6.1	If not explain reasons					
7	Cable drums					
7.1	Length of cables in cable drum and tolerance					
7.2	Weight of cable drum without cables					
7.3	Weight of cable drum with cables					
8	Type of end sealing					
9						
9.1	Any other details the VENDOR would like to furnish?					
9.2	List of deviations if any from specification, data sheet-A and applicable standard furnished					
9.3	Conductor screen					
9.4	Insulation					
9.5	Insulation screen					
9.6	Sheath					
9.7	Armour					

#### 6.1.6 Lighting Fixtures & Accessories

S. N.	Description	Technical Particulars
1	General	
1.1	Name of Manufacturer and Country	
1.1.1	Type of Luminaries	
1.1.2	Accessories	
1.2	Applicable Standards for	
	a) Luminaries	
	b) Accessories	
2	Technical Details	
2.1	Lamps	
2.1.1	Maximum permissible supply voltage variation	

S. N.	Description	Technical Particulars
2.1.2	Luminous output	
	a) After 100 burning hours	
	b) After 1000 burning hours	
2.1.3	Average burning hour life	
2.2	Ballasts & Starters	
2.2.1	Maximum permissible supply voltage variation	
2.2.2	Power loss at nominal working voltage	
2.2.3	Maximum hot spot temperature of ballast	
2.2.4	Conductor material of ballast	
2.2.5	Insulation class of ballast winding	
2.2.6	Average life of	
	a) Ballast	
	b) Starters	
2.4	Luminaries	
2.4.1	Earthing terminal	
	a) Material	
	b) Suitable upto conductor size	
2.4.2	Internal wiring size	
2.4.3	Terminal block suitable for conductor size	
2.4.4	Sheet steel thickness of	
	a) Housing	
	b) Reflector	
2.4.5	Wire guard thickness	
2.4.6	Descriptive catalogues enclosed	

## 6.1.7 Lighting System Equipment

S.N.	Description	Unit	Technical Particulars
1	Lighting Distribution Boards And Lighting Panels		
1.1	System Particular		
(a)	Voltage		
(i)	3 Phase, 4 wire 50 Hz system		
	Rated	V	
	Maximum	V	
	One minute withstand voltage	V	
(ii)	D.C. system		
	Rated	V	
(b)	System short-circuit level		
	(i) At 415 V, A.C.	kA (rms)	



S.N.	Description	Unit	Technical Particulars
	(ii) At 110 V.D.C.	kA (D.C.)	
(c)	Reference ambient temperature	deg C	
1.2	Indicate the type and routine tests to be carried out		
1.3	Distribution Board/Panels		
(a)	Main, floor mounted distribution boards		
(i)	Main Lighting distribution board(A.C.)		
	Make		
	Type		
	Degree of protection		
	Bus bar material		
	Bus bar current rating	A	
	Short circuit current rating	kA	
	Details of Incoming and Outgoing feeders		
	Cable entry		
	Location		
	Each complete board/panel, Lx Wx D		
	Dimensional drawing enclosed		
	Indicate the type and routine tests to be carried out		
(ii)	Emergency lighting panel (D.C.)		
	Make		
	Type		
	Degree of protection		
	Bus bar material		
	Bus bar current rating	A	
	Short circuit current rating	kA	
	Details of Incoming and		
	Outgoing feeders		
	Cable entry		
	Location		
	Each complete board/panel, LxWxD		
	Dimensional drawing enclosed		
	Indicate the type and routine tests to be carried out		
(iii)	Three phase DBs, wall/structure mounting		
	SLDB for indoor area		
	Make		
	Type		
	Details of Incoming and Outgoing feeders		
	Degree of Protection		
(iv)	SLDB for outdoor area		

S.N.	Description	Unit	Technical Particulars
	Make		
	Type		
	Details of Incoming and Outgoing feeders		
	Degree of Protection		
(v)	Paint Finish		
	Colour shade		
2	Air-Break Switches		
2.1	Make		
2.2	Type		
3	Miniature Circuit Breaker		
3.1	Make		
3.2	Type		
4	Earth Leakage Circuit Breaker		
4.1	Make		
4.2	Type		
4.3	Leakage Current $I_N$	mA	
5	Instrument Transformers		
5.1	Make		
5.2	Type		
5.3	Output		
5.4	Accuracy Class		
6	Meters		
6.1	Make		
6.2	Type		
6.3	Accuracy Class		
7	Relays (If Any Provided)		
7.1	Make		
7.2	Type		
7.3	Voltage Rating	V	
7.5	No. of Contacts		
	a) Normally open		
	b) Normally closed		
8	Flame Proof Enclosures		
8.1	Make		
8.2	Suitable for use in hazardous area		
	a) Area classification		
	b) Gases/Vapour group		
8.3	Dimensional Drawings and Literature of each required equipment flameproof enclosure including fixing details enclosed	Yes/No	
8.4	Approval certificates of relevant statutory authorities enclosed	Yes/No	

S.N.	Description	Unit	Technical Particulars
9	<b><u>Light Control Switches</u></b>		
19.1	Make		
10	<b><u>Receptacle, Plug And Switch</u></b>		
10.1	Make		
11	<b><u>Lighting Wires</u></b>		
11.1	Make		
11.2	Applicable Standard		
11.3	Voltage Grade	V	
11.4	Conductor Material	Cu/Al	
11.5	No.of Strands	mm <sup>2</sup>	
11.6	Colour Coding		
12	<b><u>Conduits</u></b>		
12.1	Make		
12.2	Material		
12.3	Finish (Galvanised /Black Enamel/Any special anti-corrosive coating)		
12.4	Sizes offered and wall thicknesses		
1325	Supply of necessary couplings, bends, tees, necessary for conduit routing included	Yes/No	
13	<b><u>Junction Boxes</u></b>		
13.1	Make		
13.2	Material and Gauge		
13.3	Painted / Galvanised		

#### 6.1.8 Smart Street Lighting System

S.N.	Description	Technical Particulars
1	<b>LED Fixture</b>	
i	Model	
ii	System Voltage	
iii	System Wattage (LED + Driver)	
iv	LED Efficacy	
v	Light Output (after all losses) from Luminaire	
vi	LED Life	
vii	Driver Type	
viii	Driver Efficiency	
ix	Driver Life	
x	Applicable Codes	
xi	Dimming Facility	
xii	Housing	
xiii	Luminaire Fixing Arm coating	

S.N.	Description	Technical Particulars
xiv	Tests report	
xv	Approved Makes of LEDs	
<b>2</b>	<b>Pole</b>	
i	Type	
ii	Height	
iii	Thickness	
iv	Foundation	
v	Foundation Bolts	
vi	Foundation Nuts	
vii	Quantity	
<b>3</b>	<b>System Requirements</b>	
i	Duty Cycle	
ii	Wind Speed Resistance	
iii	System Protections	
<b>4</b>	<b>Smart street lighting management system :</b>	
i	Type	
ii	Type of installation	
iii	Protection class	
iv	Type of Protections	
v	Measuring components	
vi	Storage capacity	
vii	Communication	
viii	Quantity	
<b>5</b>	<b>Battery and Battery Box</b>	
i	Capacity	
ii	Type of battery	
iii	Permitted Depth of Charge	
iv	Battery back-up time	
v	Approved Makes	
vi	Mounting Position	
vii	Battery Box Material & Protection	
viii	Battery Box Protection	
<b>6</b>	<b>Flood light Pole/Mast</b>	
i	Type	
ii	Height	
iii	Thickness	
iv	Foundation	
v	Foundation Bolts	
vi	Foundation Nuts	
vii	Quantity	
viii	No. of flood lights to be fixed per pole	

## 6.2 LIST OF SPARES

Contractor shall provide all the spares required for the satisfactory & trouble free operation for complete electrical system. It is in the scope of contractor to supply all the spares part during the operation & maintenance period.

## 7 LIST OF PREFERRED MAKES

All the electrical equipments to be supplied under this contract have to be preferred makes as listed below. The equipment of those manufacturers, who have sufficient proven experience of manufacturing the respective equipment of similar capacity, shall be considered. The respective equipment should have been manufactured, supplied, installed, commissioned successfully and should be running satisfactorily since at least last 5 years continuously. Certificates from end users, regarding their satisfactory Performances, shall have to be submitted in this regard.

Sr. No.	Equipments	Make
1.	Compact substation	Siemens ,ABB Schneider Electric
2.	Switchgear/Switchboard MV–11kV (VCB)/ RMU / FRTU	Siemens ,ABB Schneider Electric
3.	Distribution Transformers	As per CSPDCL make
4.	Protection Relays (Numeric / Electro mechanic Type)/ Auxiliary relays)	ABB, Schneider Electric , Siemens Alstom
5.	Potential Transformer (PT)	Automatic Electric, Precise Kappa, Pragati
6.	Current Transformer (CT)	Automatic Electric, Gilbert & Maxwell Kappa, Pragati
7.	Electronic Digital Meter (A/V/PF/HZ/KWH) /MFM with LCD/LED Display.	Schneider , Siemens ABB, L&T, secure, GE make, Legrand
8.	ACB / MCCB	ABB, Schneider, Siemens, Legrand
9.	Contactors	ABB, Schneider, Siemens ,L&T
10.	Electronic / Microprocessor based relays	Siemens, ABB, Schneider Electric

11.	Push Buttons	ABB, L&T, Schneider ,Siemens, BCH
12.	Outdoor DT box and service feeder pillar	As per CSPDCL approved make
13.	Timer Switches	L&T GIC, Siemens, Theaben, Protime, Schneider, Legrand, ABB
14.	Indicating Lamps	Siemens, Schneider ,ABB ,L&T BCH
15.	HT/ LT Power & Control Cables	Universal, NICCO, KEI Polycab or as per CSPDCL
16.	HT/ LT Jointing Kit & Termination Kits	Birla-3M, Raychem, Safe Kit M seal or as per CSPDCL make
17.	Termination (Lugs)/ Cable Glands	Commet, connectwell, Dowell Jainson, as per CSPDCL
18.	Selector Switches	Kaycee, ABB ,Siemens, Schneider
19.	Alarm Annunciators (solid state type with LED illumination) / Facia Annunciator	Industrial Instruments & Controls Minilec, Alstom ICA
20.	GI pipes(ISI Approved) & accessories	AKG, BEC, Precision or as per CSPDCL
21.	DWC HDPE pipe	As per CSPDCL
22.	RCC Hume Pipe	As per CSPDCL
23.	Earthing strip (GI and Cu)	As per CSPDCL
24.	Maintenance free earthing & GI earthing	As per CSPDCL
25.	MCB/RCCB/ SPD/RCBO	Legrand, Schneider , Siemens, ABB
26.	Distribution Boards( MCB DBs)	Legrand, Schneider , Siemens ,ABB
27. a	Light Fixtures (street lighting) LED	Wipro, Philips, GE, Crompton Greaves, Bajaj
28.	Flood lighting	Wipro, Philips, Bajaj Crompton Greaves

29.	Street Poles	Bajaj, cromton, transfoil, aster, wipro
30.	Insulating mats	Electromat, Dozz, Raychem RPG
31.	Terminal Blocks /connectors	Jainson, Elmex, Connect well, Wago
32.	Selector Toggle Switch	Kaycee, Salzer (Larsen & Toubro) ABB
33.	Water Tight Polycarbonate Boxes	Hensel , Legrand, Phraser
34.	Capacitor	ABB, Legrand, L&T , as per CSPDCL make
35.	Earthing	As per CSPDCL approved make list

#### 7.1 Note:-

- 7.1.1 Only one of the above makes of the materials will be acceptable. Contractor has to comply with the approved makes given in the tender document.
- 7.1.2 Contractor shall offer the equipment of makes mentioned above. Other makes are subjected to Client approval before procurement.
- 7.1.3 Samples from all the approved makes shall be offered for selection.
- 7.1.4 For standardization, inventory, electrical system coordination, the Employer/ Employer's Representative can insist on any one make from the makes indicated above.
- 7.1.5 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.

## 8 Performance Criteria

### 8.1 General

- 8.1.1 Contractor shall carry out the work in accordance with the detailed design and Good for Construction drawings to be prepared by contractor.
- 8.1.2 Preliminary drawings, Specifications, data sheets and other documents forming part of the Contract.
- 8.1.3 Contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.
- 8.1.4 Contractor shall guarantee that the Electrical system as installed shall perform to complete satisfaction of the owner.
- 8.1.5 Contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.
- 8.1.6 Rating of all items shall be appropriate for the conditions on the particular site on which the item will be used. All the equipment shall be fit for continuous work under the most severe weather conditions of site.
- 8.1.7 At the close of the work and before issue of final certificate of virtual completion, contractor shall furnish written performance guarantee against defective materials and workman-ship for a period of five years from date of testing, commissioning and handing over.
- 8.1.8 Contractor shall hold himself fully responsible for reinstallation or replacement free of cost to Owner the following:
  - d) Any defective work or material supplied by contractor.
  - e) Any material or equipment damaged or destroyed as a result of defective workmanship by contractor.

### 8.2 MANUFACTURERS

- 8.2.1 All the electrical equipments to be supplied under this contract have to be of reputed makes. The equipment of those manufacturers, who have sufficient proven experience of manufacturing the respective equipment of similar capacity, shall be considered. The respective equipment should have been manufactured, supplied, installed, commissioned successfully and should be running satisfactorily since at least last 5 years continuously. Certificates from end users, regarding their satisfactory Performances, shall have to be submitted in this regard.



- 8.2.2 Where manufacturers have furnished specific instructions relating to the materials used in this job, covering points not specifically mentioned in these documents, these instructions shall be followed in all cases.
- 8.2.3 Where manufacturer's names and/or catalogue numbers are given, this is an indication of the quality, standards and performance required.
- 8.2.4 For items not covered under the List of Approved Makes', Contractor shall offer items of first class quality, standards and performance and obtain the approval of Construction Manager/Consultants before procuring them.
- 8.2.5 Where interfacing occurs, equipment shall be mutually compatible in all respects.

**Annexure to Volume-III D**  
**Electrical Works**