



VOLUME-II

SCOPE OF WORK & TECHNICAL SPECIFICATION

FOR

**UNDERGROUNDING OF EXISTING OVERHEAD
ELECTRICITY SYSTEM FROM AMBEDKAR
CHOWK TO PANPOSH CHOWK IN ROURKELA
SMART CITY LIMITED (ABD AREA) UNDER
SMART CITIES MISSION**

SCOPE OF WORK & TECHNICAL SPECIFICATION

ELECTRICAL POWER DISTRIBUTION

1.1 SCOPE OF WORK

The following shall be the scope of work under the Smart Road project:

- Supply and laying of HT and LT cables and associated cable laying and interconnection system (Cable Termination of HT & LT Panel) .
- laying of HT and LT cables and associated cable laying and interconnection system (Already Supplied at Site).
- Supply, Installation, Testing and Commissioning of HT Panel, MFP, SFP, VTPN DB and Junction Box etc.
- Installation, Testing and Commissioning of HT Panel, MFP, SFP, VTPN DB and Junction Box etc. of supplied Panels (Already Supplied at Site).
- Earthing System and other accessories.
- All mounting, foundation, supports and hardware accessories for the electrical equipment/ system installations of HT & LT Panel.
- Visit of HT & LT Panel Vendor for Supplied Panels at site.
- Dismantling of existing poles with associated accessories and storage at WESCO store.
- Removal, destring and removal of existing 3ph LT line and storage at WESCO store.
- Removal, destring and removal of existing 3ph 3W 11kV line and storage at WESCO store.
- Supply and laying of DWC HDPE pipes from Main Laid DWC HDPE Pipe to Consumer for connection.
- Miscellaneous statutory equipment as per requirement.
- All civil works associated with equipment/system electrical installations like embedment, chipping, punching, making holes, openings in walls, pipe sleeves, fire/ waterproof sealing, concealed conduiting etc.
- Take necessary statutory approvals for the electrical systems installed. The bidder shall take necessary steps for getting new connection from DISCOM.

CONTRACTOR shall ensure that design of equipment shall be as per specification requirements.

CONTRACTOR shall submit Quality Assurance Plan within 15 days after finalization of order. The QAP shall be discussed between RSCL and the CONTRACTOR before the QAP is finalized.

The CONTRACTOR shall carry out detailed engineering including schematic lighting solution and prepare construction purpose drawings to make its own estimate of ratings & quantities in accordance with the design criteria provided in the technical specification and data sheets, for entire system including illumination system, electrical equipment, cabling system, earthing, and civil works required for completion of works.

The above drawings with plans, elevations, sections or any details (as required) shall be submitted to RSCL or its representative for approval.

Factory Inspection of every electrical equipment shall be carried out by Contractor in all respect.

3D rendered views of the proposed illumination plans shall be provided for approval for the entire project before supply and execution of the same.

Light fixtures selected by the CONTRACTOR shall be submitted to RSCL for approval.

The CONTRACTOR shall submit detailed electrical load calculation, sizing calculation of electrical equipment and explanation on how the fixtures identified are energy efficient before supply and execution of work.

CONTRACTOR shall take due care of the site Seismic conditions while designing all equipment/ components used in lighting and electrical systems covered in this specification. CONTRACTOR shall furnish list of design parameters considered in design to fulfill the above requirement.

Design and detailed engineering of the materials procured by CONTRACTOR is included in scope. CONTRACTOR shall submit each document/ calculations of system which is included in scope to RSCL or its representative for final review/ approval. All design documents/ calculations prepared by CONTRACTOR shall be duly signed by CONTRACTOR and stamped. Documents submitted without fulfillment of this requirement will not be considered as a submission and will be rejected.

Design documents/ calculations prepared by Sub-CONTRACTOR shall be approved by CONTRACTOR and stamped copy of approval along with no-deviation sheet from Sub-CONTRACTOR shall be submitted by the CONTRACTOR to RSCL or its representative for final review/ approval. Documents submitted without fulfillment of this requirement will not be considered as a submission and will be rejected.

Expert or manufacturer supervision for Sub-CONTRACTOR supplied material shall be provided by BIDDER and included in offer.

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, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the CONTRACTOR.

Obtaining approval including load sanction/ load release from TPWOCL shall be in

the scope of CONTRACTOR. All the statutory fees for the above approvals shall be borne by RSCL. Such payments shall be reimbursed to the CONTRACTOR upon submission of stamped receipts to the RSCL. The approvals will include consent for commencement of work and obtaining permission to charge/commission.

All the cost towards liaison with statutory Bodies for seeking all necessary statutory approvals and other activities involving Govt. Agencies viz., drawing approval, testing and commissioning et. shall be borne by the CONTRACTOR.

The CONTRACTOR shall also liaison with Govt. Bodies if required like TPWOCL, PWD, CEIG, RMC etc. for obtaining required permission to work.

CONTRACTOR's scope shall also include all civil works and structural works required for installation of all electrical equipment/ systems such as equipment foundations, Pole foundations and all excavation and backfilling works including those for lighting, earthing, cabling systems etc.

BIDDER should visit site and get ascertained regarding the complete scope of work before submission of Bid.

This specification is the minimum requirement and should be read in conjunction with relevant latest specifications, requirements, rules and regulations of the Local Authority. Any additional requirements as per Local Authority or latest Standards shall be considered by BIDDER

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

Equipment furnished/ supplied under this scope of works shall be complete in every respect with all mountings, fittings, fixtures, and standard accessories normally provided with such equipment and / or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specification. Materials and component not specifically stated in the specification but which are necessary for commissioning and satisfactory operation shall be deemed to be included in the scope of specification and shall be supplied without any extra cost. All similar standard components/ parts of similar standard equipment provided shall be interchangeable with one another.

The CONTRACTOR shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinated performance of the entire system. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

The material supplied by the CONTRACTOR shall be subject to approval of the designated Authorities of RSCL. Samples of the Supply material under the scope of works shall be inspected by RSCL or their representatives either at site or at Manufacturer's works and approve them for supply and execution. Notwithstanding any approval/ instruction given otherwise, if the RSCL, during random check up, finds any nonconformance with the quality of material supplied by the CONTRACTOR with respect to the technical specifications, RSCL shall have the Authority to reject the entire lot/ batch of that particular material and ask to replace

without any cost and time impact to RSCL.

During the construction at site, it shall be the CONTRACTOR's responsibility to take care of the safety and security of its person and material at site. The CONTRACTOR shall be self-reliant with all the requirements including tools and tackles for digging, filling, erecting, lifting, etc. and consumables required for construction like electricity and water at his own cost.

The CONTRACTOR shall carryout the installations in a safe and responsible manner without any inconvenience or danger to public. The CONTRACTOR shall take care not to damage any public/ private property by mistake or by intention during the course of work with its actions and shall be well insured to compensate the owner in case any such incidence happens.

CONTRACTOR shall plan and carry out all supply, installation, testing and commissioning of the entire electrical system conforming to the approved drawing, technical specification and good engineering practices.

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. Any and all other works not indicated above but necessary/ required to complete the job in all aspects, are included in the CONTRACTOR's scope.

The scheme has already been designed considering the consumer details during DPR stage and accordingly tentative quantities of different items are mentioned for reference purpose. The contractor has to make fresh consumer survey after award of contract and prepare the design considering the listed items. If any changes observed in the design than that which is already approved should notify the employer for review and approval before commencement of work.

SL NO.	DESCRIPTION OF WORKS	QTY	UNIT
1	3	4	5
1	Supply, loading, transportation unloading at site, storages at site ,shifting from storage place to site of following sizes of XLPE insulated PVC sheathed, outersheath FRLS, Aluminium conductor flat strip armoured power cable of 11 KV grade conforming to IS amended upto date and as per specifications.		
1.1	11kV, 3C X 300 sq. mm. XLPE insulated, Aluminum conductor	2574	RM
1.2	11kV, 3C X 150 sq. mm. XLPE insulated, Aluminum conductor	100	RM
1.3	11kV, 3C X 120 sq. mm. XLPE insulated, Aluminum conductor	200	RM
2	Supply, loading, transportation unloading at site, storages at site ,shifting from storage place to site of following sizes of XLPE insulated PVC sheathed, outersheath FRLS, Aluminium conductor flat strip armoured		

SL NO.	DESCRIPTION OF WORKS	QTY	UNIT
	power cable of 1.1 KV grade conforming to IS amended upto date and as per specifications.		
2.1	3.5C X 300 sqmm Al A2XFY armoured AL Cable	50	RM
2.2	3.5C X 240 sqmm Al A2XFY armoured AL Cable	4345	RM
2.3	3.5C X 185 sqmm Al A2XFY armoured AL Cable	50	RM
2.4	3.5C X 150 sqmm Al A2XFY armoured AL Cable	50	RM
2.5	3.5C X 95 sqmm Al A2XFY armoured AL Cable	160	RM
2.6	3.5C X 50 sqmm Al A2XFY armoured AL Cable	760	RM
2.7	3.5C X 35 sqmm Al A2XFY armoured AL Cable	180	RM
2.8	3.5C X 25 sqmm Al A2XFY armoured AL Cable	50	RM
2.9	4C X 16 sqmm Al A2XFY armoured AL Cable	1610	RM
2.10	2C X 4 & 3CX6 Sqmm Al Cable	1010	RM
2.11	3cx2.5 Sqmm cu Cable	270	RM
3	Supplying and making outdoor cable end termination with heat shrinkable jointing kit complete with all accessories including lugs suitable for following size of 3 core, XLPE aluminium conductor cable of 11 kV grade as required.		
3.1	11kV, 3C X 300 sq. mm. XLPE insulated, Aluminum conductor	42	Nos
3.2	11kV, 3C X 150 sq. mm. XLPE insulated, Aluminum conductor	4	Nos
3.3	11kV, 3C X 120 sq. mm. XLPE insulated, Aluminum conductor	4	Nos
4	Supplying and making Indoor cable end termination with heat shrinkable jointing kit complete with all accessories including lugs suitable for following size of 3 core, XLPE aluminium conductor cable of 11 kV grade as required.		
4.1	11kV, 3C X 300 sq. mm. XLPE insulated, Aluminum conductor	64	Nos
4.2	11kV, 3C X 150 sq. mm. XLPE insulated, Aluminum conductor	4	Nos
4.3	11kV, 3C X 120 sq. mm. XLPE insulated, Aluminum conductor	4	Nos
5	Supply and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed / XLPE aluminium cable of 1.1kV grade (without cost of cable) as required.		

SL NO.	DESCRIPTION OF WORKS	QTY	UNIT
5.1	3.5C X 300 sqmm Al A2XFY armoured AL Cable	4	Nos
5.2	3.5C X 240 sqmm Al A2XFY armoured AL Cable	194	Nos
5.3	3.5C X 185 sqmm Al A2XFY armoured AL Cable	4	Nos
5.4	3.5C X 150 sqmm Al A2XFY armoured AL Cable	4	Nos
5.5	3.5C X 95 sqmm Al A2XFY armoured AL Cable	40	Nos
5.6	3.5C X 50 sqmm Al A2XFY armoured AL Cable	24	Nos
5.7	3.5C X 35 sqmm Al A2XFY armoured AL Cable	124	Nos
5.8	3.5C X 25 sqmm Al A2XFY armoured AL Cable	4	Nos
5.9	4C X 16 sqmm Al A2XFY armoured AL Cable	350	Nos
5.10	2C X 4 & 3CX6 Sqmm Al Cable	222	Nos
5.11	3cx2.5 Sqmm cu Cable	180	Nos
6	CABLE LAYING		
6.1	HT CABLE LAYING		
	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 11 kV grade of following size in the existing RCC/ HUME/ METAL pipe as required		
	Upto 120 sq. mm	200	RM
	Above 120 sq. mm and upto 400 sq. mm	8745	RM
6.2	LT CABLE LAYING		
	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size in the existing RCC/ HUME/ METAL pipe as required.		
	Upto 35 sq. mm	30281	RM
	Above 35 sq. mm and upto 95 sq. mm	2319	RM
	Above 95 sq. mm and upto 185 sq. mm	100	RM
	Above 185 sq. mm and upto 400 sq. mm	10466	RM
7.1	Supply and laying double walled corrugated (DWC) HDPE Pipe including all necessary connecting Sockets/Couplings/Tees/Bends/End-caps of same materials in existing trench as per IS 14930 part -II suitable for drawing underground cables. 63mm OD / 50mm ID	10520	Mtr.
7.2	Supply and laying double walled corrugated (DWC) HDPE Pipe including all necessary connecting Sockets/Couplings/Tees/Bends/End-caps of same materials in existing trench as per IS 14930 part -II suitable for drawing underground cables. 120mm OD / 100mm ID	6000	Mtr.

SL NO.	DESCRIPTION OF WORKS	QTY	UNIT
7.3	Supply and laying double walled corrugated (DWC) HDPE Pipe including all necessary connecting Sockets/Couplings/Tees/Bends/End-caps of same materials in existing trench as per IS 14930 part -II suitable for drawing underground cables. 200mm OD / 160mm ID	1000	Mtr.
8	Shifting, Testing & Commissioning of following sizes of XLPE insulated PVC sheathed, outersheath FRLS, Aluminium conductor flat strip armoured power cable of 1.1 KV grade conforming to IS amended upto date and as per specifications.		
8.1	3.5C X 240 sqmm Al A2XFY armoured AL Cable	6071	RM
8.2	3.5C X 95 sqmm Al A2XFY armoured AL Cable	1219	RM
8.3	3.5C X 50 sqmm Al A2XFY armoured AL Cable	393	RM
8.4	3.5C X 35 sqmm Al A2XFY armoured AL Cable	1859	RM
8.5	4C X 16 sqmm Al A2XFY armoured AL Cable	12641	RM
8.6	2C X 4 & 3CX6 Sqmm Al Cable	13111	RM
9	Shifting, Testing & Commissioning of following sizes of XLPE insulated PVC sheathed, outersheath FRLS, Aluminium conductor flat strip armoured power cable of 11 KV grade conforming to IS amended upto date and as per specifications.		
9.1	11kV, 3C X 300 sq. mm. XLPE insulated, Aluminum conductor	6071	RM
32643146.06			
10	11kV Distibution Board		
	Supply, Installation, Testing & Commissioning of Distribution Board comprising of 2Nos 11kV LBS and 2No. 11kV VCB and Earth Switch with STR 25kA for 1 Sec. Overload and earthing protection should be required with provision of FRTU (Field remote terminal unit) for SCADA integration; DC Power pack with 1 Hr back up. The same shall have extendable provision.		
10.1	11KV Safe Plus CCV Motorised OD RMU	2	Nos
10.2	11KV Safe Plus CCC+M Motorised RMU	1	Nos
11	SITC of LT Panel - Outdoor IP55 With Canopy (TTA Panel)		
11.1	Existing MFP - T7	1	Nos
11.2	Existing MFP - T9	1	Nos
11.3	Existing MFP - 10	1	Nos
11.4	Existing MFP - 17	1	Nos

SL NO.	DESCRIPTION OF WORKS	QTY	UNIT
11.5	Existing MFP - 18	1	Nos
11.6	Existing MFP - 7	5	Nos
11.7	Existing SFP - 1	25	Nos
11.8	Existing SFP - 2	6	Nos
11.9	Existing SFP - 3	2	Nos
11.10	Existing SFP - 4	2	Nos
11.11	Existing SFP - 5	1	Nos
11.12	Existing Junction Box Type - 4	2	Nos
11.13	Newly Junction Box Type - 2	10	Nos
11.14	Newly VTPN DB - Type 9	10	Nos
12	Installation, Testing & Commissioning of Available HT Panel		
12.1	11KV CCVV+M OD RMU	8	Nos
12.2	11KV C+M RMU	6	Nos
13	Installation, Testing & Commissioning of Available LT Panel		
13.1	MFP-1	1	Nos
13.2	MFP-5	1	Nos
13.3	MFP-6	1	Nos
13.4	MFP-7	1	Nos
13.5	SFP-TYPE-1	7	Nos
13.6	SFP-TYPE-2	4	Nos
13.7	SFP-TYPE-4	2	Nos
13.8	SFP-TYPE-5	6	Nos
13.9	J B TYPE-1	21	Nos
13.10	J B TYPE-2	22	Nos
13.11	J B TYPE-3	22	Nos
13.12	J B TYPE-4	18	Nos
13.13	VTPN DB TYPE 1	1	Nos
13.14	VTPN DB TYPE 2,19	2	Nos
13.15	VTPN DB TYPE 3,4	2	Nos
13.16	VTPN DB TYPE 5, 6	2	Nos
13.17	VTPN DB TYPE 7, 8	2	Nos
13.18	VTPN DB TYPE 9	1	Nos
13.19	VTPN DB TYPE 10	1	Nos
13.20	VTPN DB TYPE 11	1	Nos
13.21	VTPN DB TYPE 12	1	Nos
13.22	VTPN DB TYPE 13	1	Nos
13.23	VTPN DB TYPE 14	1	Nos
13.24	VTPN DB TYPE 15	1	Nos
13.25	VTPN DB TYPE 16	1	Nos
13.26	VTPN DB TYPE 17,18, 20	3	Nos

SL NO.	DESCRIPTION OF WORKS	QTY	UNIT
13.27	VTPN DB TYPE 21	1	Nos
13.28	VTPN DB TYPE 22	1	Nos
14.1	Earthing with G.I. earth pipe 4.5 metre long, 40 mm dia including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe etc. with charcoal/ coke and salt as required.	470	Nos
14.2	Providing and fixing testing joint, made of G.I. strip, 125 mm long, with 4 nos. of G.I. bolts, nuts, chuck nuts and spring washers etc. complete as required.	470	Nos.
14.3	Supplying and laying 40 x 10 mm strip GI Strip at 0.50 m below ground as strip earth electrode, including connection/terminating with G.I. nut, bolt, spring, washer etc. as required. (Jointing shall be done by overlapping and with 2 sets of G.I nut bolt & spring washer sapced at 50mm).	4700	Mtr.
14.4	Supplying and laying 25 mm X 5/6 mm G.I strip at 0.50 metre below ground as strip earth electrode, including connection/terminating with G.I. nut, bolt, spring, washer etc. as required. (Jointing shall be done by overlapping and with 2 sets of G.I. nut bolt & spring washer spaced at 50mm)	500	Mtr.
14.5	Supplying and laying 6 SWG G.I. wire at 0.50 metre below ground level for conductor earth electrode, including connection/ termination with GI thimble etc. as required.	2700	Mtr.
15	Existing Sytem Dismantling Cost		
1	Dismantling of existing poles with associated accessories and storage at WESCO store	205	Nos
2	Removal, destring and removal of existing 3ph 5W LT line and storage at WESCO store	5.4	km
3	Removal, destring and removal of existing 3ph 3W 11kV line and storage at WESCO store	4	km
16	Foundation of HT & LT Panel Cost & Civil Work, Core cutting to existing walls	Complete Work as per requirement	

The above schedule is for reference only and should not be considered as final BOQ. The work shall be executed as approved by the authority based on updated consumer survey.

1.2 HT (11kV) Distribution System

The existing 11kV overhead distribution comprises of 100 mm² AAAC, 55 mm² and 35 mm² ACSR conductors. These overhead conductors are being fed from 33/11kV Panposh Substation, 33/11kV Civil Township Substation and 33/11kV Industrial Estate substation. The contractor shall carry out the survey for the existing system from source to end consumer. Determining the substation feeder catering to the proposed area shall be in the contractor's scope.

The system shall be made underground using XLPE armoured cables with load growth consideration. 100% redundant HT cables shall be laid such that in case of fault at a section, the faulty cable shall be replaced from the circuit with redundant cable being connected at the end terminals. The distribution system shall be radial, as per existing system, with the connections to 11kV consumers or transformers being taken through a distribution board/ Ring Main Unit. The Distribution Board / Ring Main unit shall be provided with 2 Nos Load Break Switch and an isolation/breaker provision for 2 Nos of outgoing. The distribution board shall be such that the same can be integrated in a ring distribution system in future. The board shall be a type tested assembly with provision for FRTU. The distribution board shall be suitable for outdoor installation with rain hood and associated civil work. The distribution board shall be mounted on adequate civil support structure with necessary foundation such that the board is at a suitable operating height above or adjacent to the cable trench, as per site availability and approval of Authority's engineer.

1.3 LT Distribution Network

The system is a four wire radial system. The undergrounding shall be using XLPE armoured cables laid in trench. The LT distribution system shall comprise of Main Feeder Pillar, Sub Feeder Pillar and Distribution Boards from the transformer secondary to the consumer end.

Main Feeder Pillar (MFP) shall be placed near to the DT. Each MFP shall have ACB or MCCB as breaker for incomer, from DT secondary, and cater to 8-10 numbers of Service Feeder Pillars (SFPs) via MCCB of adequate current ratings sufficient to cater to the present load situation of the transformer outgoing.

Each SFP shall have MCCB at the incomer. SFP shall be 8 or 12 way with each outgoing catering to 3-5 Junction Boxes (JBs). If fault level is less than 10kA, MCBs shall be provided at the outgoings of SFP else MCCBs shall be provided. The JBs shall be directly connected by tapping from LT bus. The SFPs shall be placed at every 30m interval.

One JB shall be used to feed 3-5 numbers of Smart Meters installed at consumer

premises. Smart Meter installation shall not be in the contractor's scope.

1.4 System Design Parameter:

The electrical system shall be designed as per relevant standards and local regulations with the stringent of the two regulations being the governing parameter.

Following System Parameter shall be adopted for designing the electrical system:

Nominal (Rated) System Voltage	11kV	0.415kV
Highest System Voltage	12kV	1.1kV
Lightning Impulse Withstand Voltage (1.2/ 50 microsecond)	75 kVp	-
Power Frequency Withstand Voltage for 1 minute	28 kV rms	3 kV rms
System Neutral Earthing	Solidly Earthed	Solidly Earthed
Fault Level of System	25kA for 1sec (As per exiting condition)	20kA for 1sec (As per exiting condition)
Frequency	50 Hz	50 Hz
Dynamic Short Circuit Current Rating	62.5 kA peak	As calculated

Service Condition:

- (i) Design Ambient Temperature (Reference Ambient temperature for temperature rise consideration) – 50 °C.
- (ii) Relative Humidity – Maximum - 90%; Minimum – 15%.

1.5 System Design Criteria:

The system shall be designed taking in to consideration the following system variation:

Voltage: +10% to -10%

Frequency: +3% to -3%

Combined voltage and frequency variation: +10% to -10%

The system power factor shall be at least greater than 0.9.

In normal operating condition, cumulative voltage drop shall not exceed 5% measured at Transformer primary or consumer end from the 33/11kV Sub-station or Transformer secondary side for both 11kV and LT system respectively.

The fault level shall be considered as per existing system condition.

For Lighting, following shall be the parameters to be considered:

Nominal Voltage	240V
Phases	1
Frequency	50Hz
Connection	3 wires(Phase, Neutral & Earth)

1.6 LT Panels

Main Feeder Panels (MFPs) shall be outdoor type having incoming sectionalisation and outgoing switchgears as specified. Sub Feeder Panels (SFPs) shall be outdoor type with incoming MCCB breaker and bus bar. All panels design shall be cubical type with IP55 degree of enclosure protection for outdoor installation as per IS: 13947 (Part-I). MFP shall conform to FORM 3B as per IS 61439. The Junction box shall be wall mounted or floor mounted with TPN Aluminium bus bars having groves made for connection of house service connection and suitable for terminating cables from SFP. The LT Panels shall be as per the standards IEC 61439.

Busbar: All panels shall be provided with Aluminum busbar.

- The bus-bars shall be sized considering the following criteria:
- Sleeves made of insulating material on all bus bars.
- Design ambient temperature 50°C.
- Final temperature of the bus-bars complying with requirements of relevant standards.
- Bus bars being inside the panel; De- rating for enclosure and ventilation.
- Bus bar suitability for carrying rated current continuously. The current density (A/mm²) of the bus bar shall not exceed 0.8 for Aluminium bus and 1.6 for Copper bus.

- g) Configuration of bus bars and Proximity effect.
- h) The main bus shall be designed based on the load rating as well as the actual fault level for specified duration at the location of the panel with 10% positive tolerance.
- i) Earth bus of the panel shall be sized suitable for the above fault level for the same duration.

Switchgear Sizing/ Selection:

Switchgear shall be sized/ selected considering the following:

- (a) Rating suitable for carrying full load current of the feeder.
- (b) Suitability for Short Circuit Rating for specified duration.
- (c) In panel de-rating of minimum 20% or as provided in Manufacturer's catalogue, whichever is higher shall be considered.
- (d) ACBs shall be considered for switchgear ratings above 630A and MCCBs shall be considered up to 630A. All ACBs and MCCBs shall be rated for Bus fault level or next higher market rating available with $I_{cs}=I_{cu}=I_{cw}=100\%$ for ACB and $I_{cs}=I_{cu}=100\%$ for MCCBs.
- (e) The MFP shall be provided with Microprocessor based overload (O/L), Short circuit (SC) and Earth fault (E/F) release at the panel incomer and outgoing.
- (f) Multi-function meter for measuring current, voltage, power shall be provided for all the incomers, outgoing power feeders.
- (g) 20% spare capacity shall be considered on each panel for future.

1.7 Cabling System

HT cables shall be 11kV earthed grade, multi-core, stranded and compacted aluminium conductor, extruded XLPE insulated (dry cured), extruded semi conducting compound screen with a layer of non-magnetic metallic tape screen, extruded PVC inner sheath (Type ST-2), armoured and extruded overall sheath with Fire Retardant Low Smoke (FRLS) PVC compound (Type ST-2). The cables shall conform to IS-7098 Part -II.

LT Cables shall be 1100V earthed grade, single/multi-core, stranded and compacted aluminium conductor, extruded XLPE insulated, extruded PVC inner sheath (Type ST-2), armoured and extruded overall sheath with Fire Retardant Low Smoke (FRLS) PVC compound (Type ST-2). The cables shall conform to IS-7098 Part -I.

Cables up to & including 10 mm² shall be Copper multi-stranded conductor with PVC insulation galvanized steel round wire armored & cables beyond 10 mm² shall be Aluminum multi-stranded conductor with XLPE insulation &

galvanized steel flat strip armored.

All control cables shall be 650 V grade copper conductors FRLS PVC insulated cables conforming to IS 1544- Part I. For cables above 7 cores, minimum two spare cores shall be considered.

All LT cable shall be conforming to IS 7098 Part I for XLPE cables and IS 1544 – Part I for PVC cables.

The following main aspects shall also be considered while deciding the size of the cables/ wires:

- (a) Supply voltage and frequency.
- (b) Corresponding full load current under site conditions, i.e, necessary de-rating considerations.
- (c) Route length and method of laying of cables.
- (d) Maximum allowable temperature rise under normal full load condition based on the material of cable insulation (XLPE/ PVC).
- (e) Maximum short circuit current duration (fault clearing time) and final temperature of cable during short circuit current flowing through the cable. Load growth consideration for next 15 years shall be considered while arriving at the full load current.
- (f) Following shall be the fault clearing time consideration:
 - (i) From transformer secondary to MFP incomer shall be 1s.
 - (ii) From ACB outgoing of the MFP shall be considered as 0.16s (for Tie feeders if any it shall be 0.5s).
- (g) Appropriate de-rating factors as per cable manufacturer's catalogue and enlisted below shall be considered for sizing the cable:
 - (i) Ambient Air Temperature (minimum 50°C).
 - (ii) Ambient ground temperature (minimum 40°C to be considered).
 - (iii) Method of cable laying.
 - (iv) Depth of cable burial.
 - (v) Thermal Resistivity of Soil (minimum 150°C Cm/ W to be considered).
 - (vi) No. of cables in a group
 - (vii) No. of cable trays in tier.

(viii) Any other de-rating factors as applicable & as per Manufacturer's catalogue.

Bending radius of 12D and 15D shall be provided for LT and HT cables respectively where D is the outer diameter of the cable.

100% redundant HT cables shall be provided for the entire system and 100% redundant LT cables shall be provided at road crossings. These redundant cables shall be provided with necessary end termination such that the same can be connected easily to the RMU/Boards. Necessary safety shall be ensured for these spare cables.

Pipe Laying:

DWC corrugated HDPE pipes shall be directly buried in ground with excavation and backfilling. The average depth of laying shall be 1.0 – 2.0 m below the finished road level as per the applicable section. The size (ID) of DWC corrugated HDPE pipes required shall be tentatively 200mm and 160mm for HT and LT cables respectively. The pipe size shall be ensured by the contractor as per following:

- For LT cables, the pipe sizes shall be arrived considering 40% occupancy by cables
- For HT cables, one pipe shall be considered for each cable.

Crossing Philosophy

In order to cross the road from one side to other, Adequate Size of DWC HDPE pipe shall be provisioned at every 200m interval.

Distribution Board (DB), Feeder Pillar (FP) locations

The 11kV DBs and 415 Feeder pillars shall be placed on the proposed footpath.

For road stretch having trenches (Section A or C), the DBs and FPs shall be located on the trench. The cable shall get its bending radius of 12D for LT and 15D for HT inside the trench.

For pipe laid (Section D), the DBs and FPs shall be located on the proposed footpath area and cables shall cross the drain by DWC corrugated HDPE pipes, as per the trajectory for cable bending requirement, and terminate at the panel. The applicable section shall be finalized in consultation with the Authority Engineer.

1.8 Earthing system

The earthing system shall comprise of one or more earth electrodes, earthing network, mesh or a combination of these in order to obtain grid resistance of less than 1Ω .

Latest version of following standards and codes shall be referred to for designing the Earthing and Lightning protection system:

a)	IS 3043	Code of practice for Safety Earthing
b)	IS/ IEC 62305	Code of Practice for the protection of buildings and allied structures against lightning.
c)	CEA guidelines 2010	Measures related to safety & electric supply.
d)	IEEE 80-2000-2013	IEEE Guide for Safety in AC Substation
e)	CPWD Specifications - 2013	General Specifications for Electrical Works Part I - Internal

Soil Resistivity: The earthing system shall be designed by considering measured soil resistivity during detailed engineering and the earthing calculation shall be done.

Size of Earthing Conductors: The earthing conductor sizes shall be calculated as per IS 3043.

Following factors will be considered for sizing the earthing conductor:

Design Ambient Temperature	50°C
Allowable temperature rise	500°C
For steel welded joints Fault clearing time	1.0 s
Overall earthing resistance of the grid	Less than 1Ω

The maximum values of earth fault current for the design of the earthing system will be considered based on system requirement as follows:

11 kV system : 21kA for 1s

415 V system : 50kA for 1s (will be decided as per actual fault level calculation)

SPECIFICATIONS AND STANDARDS FOR ELECTRICAL WORKS

General

The proposed underground distribution system shall be designed so as to replace the existing overhead distribution system ensuring:

- a) Safety to Personnel and equipment during both operation and maintenance.
- b) Reliability & Continuity of Service.
- c) Minimal fire risk with fail safe feature.
- d) Ease & flexibility of maintenance and operation.
- e) Adequate provision for future expansion and modification.
- f) Maximum inter-changeability of equipment.
- g) Suitability for applicable environmental factors.
- h) Service Condition

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.

The equipment shall be designed and manufactured in accordance with the best engineering practices and shall be suitable for the intended purpose.

Applicable Codes and Standard

The design, material, construction, manufacture, inspection, installation, testing and performance of electrical equipments & systems should conform to the latest applicable Central Electrical Authority (CEA) guidelines, all currently applicable IS, IEC and IEEE standards, Central PWD (CPWD) Specifications, Odisha PWD Specifications, National Building Code, National Lighting Code, National and International codes of practice, statutes, regulations and safety codes in the locality where the equipment will be installed.

DETAILED ELECTRICAL TECHNICAL SPECIFICATIONS

1. HV DISTRIBUTION BOARD

The scope of this specification design, manufacture, testing at manufacturer's works, supply, packing, forwarding and delivery from place of storage/ manufacturer's works to erection site including transit insurance, assistance for testing, installation, commissioning and performance demonstration at site of outdoor type 11 kV

Distribution Board and its accessories with short time current rating of not less than 25kA for 1sec.

CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of DB shall comply with all currently applicable standards, statutes, regulations and safety codes in the locality where the Equipment will be installed. The Equipment shall comply with the latest editions of the Codes and Standards.

The HV Isolator other associated accessories shall conform to the latest revisions and amendments thereof, but not limited to, the following standards.

IEC62271-102 - Alternating current Dis-connector (Load break isolators) and earthing switch.

EC 62 271-1 / IEC 60694 - Panel design, SF6/Vacuum Circuit Breakers.

IEC 60265 - High voltage switches.

IEC 60273/IS :2099 - Characteristics of Indoor & Outdoor post insulators

IEC 60265 - High voltage switches

IEC 60529/IS 13947(Part-1) - Degree of protection provided by enclosures

All codes and standards referred to in this specification shall be understood to be the latest version on the date of offer made by the Bidder unless otherwise indicated.

SYSTEM PARTICULARS

- *Nominal System Voltage:* 11 kV
- *Highest System Voltage:* 12 kV
- *Frequency:* 50Hz $\pm 3\%$
- *No. of Phases:* 3 Phase
- *Neutral Grounding:* Solidly Grounded
- *Fault level* 25kA for 1 sec
- *Max Ambient Temperature for design and temperature rise shall be 50°C.*
- *Bus rating:* 630A
- *Bus bar material:* EC grade Copper
- *Breaker type:* Fuse Switch Unit isolator

The switchgear shall be metal enclosed, outdoor type with switch fuse unit and isolator. Design and construction shall be such as to allow extension at either end.

All the HV design must ensure conformity to IEC-60298.

The cable glands shall be of double compression type brass glands. Gland plate shall be of 3mm minimum thickness. For Single core cables the Gland plate shall be of Al material.

Gaskets shall be EPDM Type. Hardware shall be stainless steel. Paint shall be two epoxy coats over 2 coats of primer. Epoxy painting may be powder epoxy coated or spray painted epoxy.

Aluminium etched 11 kV Caution boards written in three languages (English, Hindi, Oriya) shall be riveted on the panel as well as on the Doors of the HT DB. Stickers are not acceptable.

The Distribution Board shall have provision for installation of FRTU for future integration.

Additional canopy for rain protection shall be provided as an integral part of feeder pillar distribution box.

HV Switchgear

- (a) The switchgear should be fixed type, Vacuum circuit breakers with O/C & E/F relay and corresponding auxiliary equipments and accessories.
- (b) The 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.
- (c) The tank should be filled with SF6 gas at an adequate pressure. The degree of protection for gas tank shall 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 criteria (a system for which no handling of gas is required throughout service life of approximate 30 years) and ensure the gas leakage to 0.1 % per year as per IEC.
- (d) 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.
- (e) The tank shall be totally metal enclosed, vermin and dust proof suitable for tropical climate use as detailed in the specification. The switchgear & switchboard 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.
- (f) Circuit Breaker:

Circuit breaker shall be Vacuum Circuit Breaker (VCB). These shall be triple pole, single throw and suitable for local / remote operation.

Circuit Breaker shall be provided with operating mechanism, self powered Static relay (Over current & Earth Fault Protection) with associated CTs for control and protection of Distribution Transformer. Relay should have facility to display the

maximum loaded phase current also. Relay should also have facility to trip the breaker from remote commands without shunt trip coil.

An integral cable earthing switch with full making capacity shall also be provided with Circuit Breaker. Earthing switches shall be mechanically interlocked with the associated breakers to prevent accidental earthing of live circuit or busbars.

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.
- (g) Ratings of HV Circuit Breakers, Current Transformers & relay settings shall be selected considering the ambient conditions. The bus bars, Vacuum Circuit Breaker shall have adequate continuous rating as per the requirement and in accordance with relevant IS / IEC standard.
- (h) The complete switchgear shall be suitable for breaking capacity as specified in the datasheet and/ or relevant standards.
- (i) Busbars shall be of copper and complete with all connections to the switch or breaker. Continuous rating of Copper busbars shall be adequate considering all derating factors. The busbars should be fully encapsulated by SF6 gas inside the tank.
- (j) 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.
- (k) Each Cable compartment shall be provided with three bushings of adequate sizes to terminate the incoming / outgoing, HT cables. Cable compartment shall be front access, Arc proof and interlocked with the respective earthing switches. From safety point of view, it should not be possible to open the cable box unless the earth switch is ON.
- (l) 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.

- (m) The moving contacts of the earthing switch shall be visible in the closed position through transparent covers.
- (n) Suitable padlocking arrangements shall be provided as stated below:
 - Circuit Breaker manual operating handle in the “OFF” position.
 - Each feeder Panel operating handle in ‘Closed’ ‘Open” or ‘Earth’ position.
 - Each isolator operating handle in ‘Closed’, ‘ Open’, or ‘Earth’ position.

FITTINGS AND ACCESSORIES

The DB shall be provided with following fittings and accessories:

- Rating & diagram plate
- 2 Earthing terminals
- Cable box with HV plug-in connectors
- Base Channel
- MS supports for mounting of DB at minimum 300mm above HFL

2. LT PANELS

The scope of supply covers design, manufacture, testing and supply of LT Panels.

LT panel shall be CPRI /Independent international test house tested for all the tests as per IEC 61439-1 & 2.

LT Panel shall also be tested of design as per Seismic Zone II of IEC 60068-3-3.

Panel shall be rated for Impulse withstanding capability equal to or greater than the switchgears inside the panel.

The metal enclosed switchgear shall be designed to operate continuously with reference of ambient temperature of 50°C without any de-rating.

The equipment shall be designed and manufactured in accordance with the best engineering practice and shall be such that has been proved to be suitable for the intended outdoor purpose.

Provision for interlocking of LV Incomer breaker with HV side breaker shall be provided such that if the HV breaker trips then the LV breaker will trip and it shall not be possible to close the LV breaker unless the HV side breaker is closed.

The Panel shall be outdoor type having incoming sectionalisation and outgoing switchgears as specified. The design shall be cubical type. The degree of enclosure protection shall be IP55 for outdoor as per IS: 13947 (Part-I). Additional canopy for rain protection shall be provided as an integral part of feeder pillar distribution box.

CONSTRUCTIONAL REQUIREMENTS:

All panel boards shall be free standing, metal enclosed, single front, fabricated with 2mm CRCA sheet steel for all doors, partitions and covers and 2 mm CRCA sheet steel for load bearing sections including all ACB feeders. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels.

The gasket shall be suitable to withstand all weathers for long tenure of service. All hardware shall be HD Galvanized or stainless steel.

All LT panels shall conform to FORM 3B as per IS 61439.

For operator safety IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

Each door & cover shall have adequate reinforcement of suitable ribs & stiffeners. All such door shall open at min 105°. All feeders and cable alleys shall have hinged type door with panel locks. All bus-bar covers and other panel covers shall be screw fixed. Cable alleys and bus-bar chamber shall have minimum width of 300mm.

All doors shall be with concealed type hinges and captive screws. Rear doors of panels requiring rear access shall be provided with removable hinged doors. Side covers of panels shall be with removable panels.

All doors shall be provided with durable and easy fitting locks with special keys to ensure opening by authorized personnel. Rubber grommets shall be provided at the cable entry.

All mounting accessories like base channels, cross angles if required, nuts, bolts etc. shall be supplied by the vendor. The panel shall be mounted at a height of more than 300mm from HFL. Necessary RCC foundation for the panel erection shall be in contractors scope.

All the panels shall have uniform height. The operating height of all the panels shall not be less than 300mm and not more than 1900mm. Panel height should not be more than 2450mm.

All the panel boards shall have cable entry from bottom. Split gland plate of 2mm thick shall be supplied for termination of power, control and instrumentation cables sized as per the required no. of cable mentioned in the SLDs and 20% spare space for future addition.

BUS-BARS:

- a) Bus-bar of the panels shall be rated for Continuous current at site conditions.
- b) All bus-bars shall be electrolytic grade copper or aluminium. BIDDER shall specify the purity and conductivity of the bus bar along with the BID.

- c) All the bus bars shall be sleeved with heat shrinkable black colour PVC sleeve or better insulation with coloured polyester tapes for phase identification at regular intervals/ locations. Make and Type test reports carried out at accredited laboratory, of such sleeves shall be submitted during testing.
- d) BIDDER shall submit all calculations & documental proof of the adequacy of the bus bar sizes to meet the continuous and short time current ratings specified for reference during procurement/ manufacturing.
- e) Vertical bus-bars shall have S.C. rating same as main bus bar and shall be suitable for all connected load of vertical section.
- f) BIDDER shall ensure that incoming feeder shall be suitably designed for terminating the required no. of runs of 1.1kV grade XLPE insulated armoured cables with 20% spare capacity. BIDDER shall consider the necessary arrangement (dummy panel, adapter panel, rear extension etc.) if required, for terminating the cables within the limits specified above.
- g) The bus-bars shall be designed considering the following criteria:
 - Current density of 0.8A/sq mm maximum for aluminium and 1.6A/Sq mm for copper.
 - Sleeves made of insulating material on all bus bars.
 - Bus bars carrying rated current continuously at Design Ambient Temperature shall be considered as 50°C and temperature rise shall be considered as per latest relevant standard.
 - Configuration of bus bars and Proximity effect
 - Bus bars shall withstand the short time rating of the panel.
- h) Bus bar supports shall only be SMC irrespective of bus bar size. The span between the two insulators shall be as per the approved TYPE TEST REPORT for short time rating. Joint positions and insulators shall be properly adjusted so that they don't interfere. Bus bar bending shall be carried out on appropriate machines designated for the same rather than doing manually.
- i) Neutral bus-bars of the panel boards shall be rated equal to the size of phase bus.
- j) All bus-bar shall be treated with anti-oxide paste wherever bi-metallic contact is required.
- k) The material and spacing of the busbar support should be same as per the type tested assembly.

EARTHING:

- a) Earth bus bars of Aluminium material shall be run all along the panel, extended out at both ends of value equal to the rated symmetrical short circuit rating of the associated switchboard/ panel. The same shall be properly supported to withstand stresses induced by the rated symmetrical short circuit current.
- b) Earthing bus-bar shall be terminated at both ends of the switchgear to suit the connections to earthing conductor. The locations where the bus are protruding out of the panel boards, CONTRACTOR shall ensure that proper ingress protections are provided at all such locations.

- c) All doors and detachable components inside the feeder are required to be earthed individually with green (with yellow band) colour PVC insulated multi stranded copper conductor wire of size 4 sq.mm duly crimped with ring type lugs and are to be looped & connected to horizontal earth bus.
- d) Earthing bus shall be run continuously in panel drawn out suitably considering respective cable entry inside the panel.
- e) Separate Al earth bus shall be provided at each cable alley for all the panels.

POWER WIRING (INSIDE THE FEEDER):

- a) All power wiring for rating upto and including 63A shall be carried out with 1.1kV grade coloured HFFR/ FRLS PVC insulated, coloured for phase identification, multi stranded copper wires duly crimped with ring type lugs.
- b) Power connections for rating above 63A shall be done with AL bus bars (machine bend for proper profile) insulated with black heat shrinkable sleeves with phase identification coloured tapes duly supported on SMC insulators and placed with required minimum clearance of 25mm between phases and between phase to ground/ neutral. Such bus when brought out of the feeder for cable connections shall be sufficient enough and profiled suitable for termination of the number of LT cables as indicated above.

CONTROL WIRING (FOR PANEL AND FEEDERS):

- a) All panel Control wiring shall be done by 1.1kV grade HFFR/FRLS PVC insulated multi-stranded copper wire. CT circuit wiring shall be done with minimum 2.5 Sq.mm size wire of above specification. Control and Potential circuits shall be wired with minimum 1.5 sq. mm size wires of above specifications. Wires shall be gray coloured with suitable crimp able copper lugs. CT's & PT's wiring shall be colour coded for multi-phase identifications (R-Y-B-N).

GENERAL REQUIREMENTS:

- a) DP MCB shall be provided for all control circuits where the fault level is less than 10kA. Else the control supply shall be tapped through a control transformer of adequate capacity supplied with MCCB/ MPCB/ SFU of adequate short time rating. Independent DP MCBs shall be provided for each circuit such that tripping due to fault in one circuit should not affect other functions adversely.
- b) Self explanatory Wiring diagrams with terminal and wire numbers, component numbers shall be provided on the inner face of the door of each feeder. Drawing set in the panel shall be laminated.
- c) All labels for identification of feeders as well as internal and external components as per legends provided By EMPLOYER shall be on white acrylic sheet with black engraving. These labels shall be fixed by screws/rivets and shall not be pasted.
- d) Aluminium etched 415V Caution boards written in two languages (English, Hindi) shall be riveted on the panel at locations where live bus bars are present and need isolation before any access to it. In case secondary covers have been

provided inside the panel, then caution boards shall be also marked on these boards in addition to the external covers. Stickers are not acceptable.

- e) Selector/control switches shall have an 'Off' position. The 'Off' position shall not be wired in any circuit and shall be utilised to disconnect (or bypass) power supply to control circuit for any maintenance work.
- f) All electrical panels (internal components & arrangement) shall have finger touch protection, for human safety viz. working on one component shall not cause shock to the personnel due to any other live component in the panel. Also, the terminal live parts shall not be accessible by fingers (finger cannot come in contact with live parts of the terminals).
- g) No openings/ holes meant for fixing hardware shall be left open. All the hardware (esp. screws, nuts, bolts, and washers) shall be in all appropriate positions & properly tightened.
- h) Phase separators, shrouds, falling tool barriers shall be suitably provided. Any additional requirements as observed at any stage upto handing-over shall be provided (for safety and ease of maintenance) without any cost implication to the EMPLOYER.
- i) All PVC/engineering plastic based items (including but not limited to conduits, casing-capping, trough, trunk, enclosures, covers, plugs, etc) shall be with FR properties.
- j) Lifting hooks/eyes shall be provided in each shipping section of the equipment and shall be removable type. The equipment shall be given tropical and fungicidal treatment.
- k) Insulation mat of suitable standard width shall be provided in front of the HV and LV panels.
- l) Atleast one 230V, 1Ph, Space heater shall be provided for each vertical section of the switchboard. Each Space heater shall be provided with an isolating switch, a thermostat and dedicated MCB protection of appropriate rating. Heater shall be mounted at bottom of the panel with cover to avoid accidental contact of heater with skin.
- m) 230V 1Ph, Panel illumination (11W CFL/ LED fixture with lamp, limit switch and isolation switch) along with 1 no. 5/15A 5 pin socket with switch shall be provided for each vertical section. Bare holder with open lamp is not acceptable.
- n) Adequate space shall be provided for terminating the outgoing cables.

EQUIPMENT REQUIREMENT:

a) MCCB:

- All the panels shall have MCCBs upto 630Amp. All MCCBs shall be rated for 415V, 3 Ph, 50Hz.
- All MCCB shall be microprocessor based. MCCB shall have O/C, S/C Protection. Wherever MCCBs are used as incomer these shall be provided with earth fault & time delay or as specified in SLD. MCCBs of suitable Icu=Ics=100% ratings.

- There should be earth fault indication on panel door.
- Rated operational voltage will be 415V AC with +/-10% variation.
- All MCCBs shall be with Utilisation Category "A".
- All the MCCBs shall invariably be Current Limiting type, features like Double Break, Positive Isolation functions shall be Integral feature of the device and shall provide a cut off in, < 10 ms for prospective currents during faults. All MCCBs shall be provided with rotary handle with door interlock and extension links/ spreaders with proper shrouds. No live part accessible even after opening the front cover.

b) ACB:

- From 800 A onwards ACBs shall normally be used. These should have 50 kA ($I_{cu}=I_{cs}=I_{cw}$) Short Circuit Current rating with microprocessor based overload, short circuit and earth fault protection at 415 volts, 50 Hz.
- The air circuit-breakers (ACBs) used in low-voltage installations shall be designed, built and tested in compliance with the standards of the IEC 947-2 & EN 60947/ IS 19947 (Part-II) : 1993.
- Rated operational voltage U_e should be 690 V.
- The rated insulation voltage shall be equal to or greater than 1000 V.
- Overload protection shall have adjustable setting from 50% to 100% of the ACB's rating.
- The ACB release shall be self-powered, requiring no external power supply. For it to operate, it is sufficient for one phase to be loaded at 20% of the rated current of the current transformer.
- Power loss in breakers should also be watched for selection.
- Utilization category-B
- Releases are also available with LCD display which displays all three phase current & neutral current, running voltage, average voltage and maximum voltage. These releases will also display maintenance date like no. of operations, & fault history (last 10 trips and type of fault). To protect the load and cables from repetitive over temperature protection. In case of BMS connectivity through Ethernet communication, the release shall enable the user ON, OFF, Trip status communication.
- Individual fault indication LED's (OL,SC & EF) backed by lithium battery to give indications even when the CB is off and electrical fault trip (OL& SC) alarm indication on panel shall be available on trip units for easy & faster identification of cause of fault.
- ACB with microprocessor based trip release with adjustable (O/C, S/C & E/F Protection) with adjustable current & time delay & %loading bar graph for each phase.
- For Distinct Fault Indication, required voltage supply shall be derived from the existing control supply by BIDDER. No separate charges shall be asked for later during execution.
- All instrument transformers shall be cast resin type and shall have insulation of class B or better.
- Indicating lamps shall be of the Multi chip LED type with low watt consumption.

- Each incomer shall be provided with a Multi Function Meter displaying all electrical parameters like (but not limited to) current, voltage, kW, kVA, KVA_r, kWh, MD, PF, Hz, (THD measurement only in main PCC incomer) etc. and shall have provision for remote communication with SCADA/ BMS..
- The switchgear shall be complete with all equipment such as CT, VT, switches etc. duly wired up to terminal blocks. Terminal blocks shall be located at suitable place for easy access. CT shorting, isolating terminals shall be provided for CTs and isolating terminals shall be provided for VT connections. Twenty (20) percent spare terminals shall be provided in each cubicle. Ring type lugs suitable for termination of 2.5 sq mm copper wires shall be used.

3. CABLES AND CABLE CARRIER SYSTEM

SCOPE

This specification also covers the design, material, construction features, manufacture, inspection and testing at the VENDOR's/his SUB-VENDOR's works and delivery to site of HT Cables 11 kV and LT Cables, Cabling Accessories, etc.

APPLICABLE CODES & STANDARDS

The design, construction, manufacture and performance of the equipment/components shall conform to latest applicable standards as on date of submission of the bid and comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment/components will be installed. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

Unless otherwise specified, equipment shall conform to the latest applicable standards for cables IS 1554, 7098, 8130, 5831, 3975, IEC 60183, 60227, 60502, 60885, 10418.

TECHNICAL SPECIFICATION FOR CABLES & CABLE TERMINATION

The various types of cables covered in this specification shall meet the following requirements:

XLPE Insulated HV Power Cables

The conductors shall be screened by extruded semi-conducting compound and XLPE insulated. The cores shall be screened by extruded semi-conducting compound in combination with non-magnetic metallic tape (copper tape preferred). The inner sheath over laid up cores and outer sheath over the armour shall be extruded black PVC compound type ST-2. Core identification shall be by printed numerals. The construction, performance and testing of the cable shall comply with IS 7098-Part 2 (Cross Linked Polyethylene Insulated PVC Sheathed Cables for working voltages from 3.3kV upto and including 11kV).

1100 V Grade XLPE Insulated Power Cables

The cable shall be extruded XLPE insulated. The inner sheath over laid up cores and outer sheath over the armour shall be extruded PVC compound type ST-2. Core identification shall be by printed numerals. The construction, performance and testing of the cable shall comply with IS 7098-Part1 (Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100 V).

1100 V grade PVC insulated Power / control cables

The cables shall be insulated with extruded PVC compound type C, provided with inner sheath and outer sheath of extruded black PVC compound type ST-2.

The construction, performance and testing of the cable shall comply with IS 1554 - Part 1 (PVC insulated heavy duty electric cables for working voltages upto and including 1100 V).

1100 V Grade Lighting/Misc./Light duty unarmoured cables

Cables shall be insulated with extruded PVC type-C. Outer sheath shall be extruded black PVC type ST-2. The sheathed cables shall be weather proof suitable for indoor/outdoor use. Twin and multicore cables shall be laid up and filled with thermoplastic material, bound by plastic tape and provided with outer sheath.

The construction, performance and testing of the cable shall comply with IS 694 (PVC insulated cables for working voltages upto and including 1100 V).

For all LT power and control cables, double compression glands with aluminium lugs for Aluminium cables and tinned Copper lugs for Copper cables shall be used in indoor and outdoor application.

The termination shall be inclusive of miscellaneous items such as clamps, cleats, cable tags, cable markers etc.

In general cable installation works shall be carried out in accordance with IS 1255 – 1983, latest version. At road crossings, the depth of the Pipe shall be minimum 1m else proper concrete encasing shall be provided.

For Underground cables, cable marker shall project 150mm above ground and shall be spaced at an interval of 30 metres, and at every change in direction. They shall be located on both side of road and drain crossings on finished surface like foot path etc. Top of cable marker/joint marker shall be sloped, to avoid accumulation of water/dust on marker. The marking shall be accomplished with a separate colour tiles/ paver block for highlighting the route of the cable.

Cable tags shall be provided on all cables both at feeder pillar end as well as on each pole (just before entering the equipment enclosure).

Cable Glands

- a) Double compression type cable glands shall be used for the termination of all the power and control cables. 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.

- b) For single core cables, gland shall be with brass ring.
- c) Cable glands shall be with metric threads.
- d) Cable glands shall be conical (& not flange type).

Cable Lugs

- a) Cable lugs shall be of tinned Copper, solder less crimping type for Cu cables & Al lugs for the Al cables.
- b) The current rating of the lugs shall be same as that of the respective cable conductors.
- c) Ring type cable terminations shall be used.
- d) Insulated lugs are not acceptable for any cable terminations.
- e) Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.
- f) Double hole extended neck (long barrel neck) type lugs shall be used in case of cables above 185 sq. mm.
- g) Fork terminals shall be used for luminaires & decorative switch/ socket. Pin terminals may be acceptable during execution only in case other terminals/ lugs cannot be accommodated.
- h) Reducer / wire pin terminals shall be avoided for MCB terminations. MCB terminations shall be with 'long palm terminals.
- i) All terminations in Feeder Pillars / enclosure for earthing & neutral busbars / terminals shall be with ring type terminals.
- j) All earthing terminations shall be with ring type lugs only.
- k) All control & interlock cable terminations shall be with ring type lugs.
- l) Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs [This shall especially be ensured for Al cable terminations & any bimetallic terminations (Cu cable termination using tinned Copper lugs)].
- m) 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.

The cable carrier system covers the supply of cable racks, cable trays and its supporting accessories hardware and their installation. It shall be the responsibility of the Contractor to complete the cabling system in all respects.

Cable trays shall be of Galvanised Steel and of perforated type, complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware as required. All hardware (i.e. bolts, nuts, screws, washers, etc.) shall be hot dip galvanised. (galvanisation thickness not less than

70 microns).

Each 2.5 metre section of all types of cable trays and all elbows, tees, crosses, etc. shall be provided with two side coupler plates and associated bolts, nuts and washers.

REQUIREMENT OF SPECIAL SHEATH FOR FRLS CABLE

Tests and Test Equipment

Cables shall be subjected to routine and acceptance tests in accordance with standards specified. Test methods shall conform to IS 10810 (Methods of Test for Cables). Type tests and optional tests according to applicable standards shall be conducted on cables as specified. Contractor shall ensure use of calibrated test equipment having valid calibration test certificates from standard laboratory traceable to National Standards. Outer sheath for FRLS/FS cables shall meet the following test requirements related to flame retardance, low smoke emission, low acid and toxic gas emission. The Contractors shall have proper test apparatus to conduct all the relevant tests as per the applicable Standards mentioned herein.

Test for flame Retardance

a) Oxygen Index

The critical oxygen index value shall be minimum 29 when tested at 27 +/-2 deg.C as per ASTM-D-2863 and the temperature index value shall be minimum 250oC at oxygen index of 21 when tested as per NES 715.

b) Flammability

- Cables shall pass test under fire conditions as per IS-10810- Part-53.
- Cables shall also pass tests as per IS-10810 Part- 61 & Part-62.
- Fire survival cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.

Test for smoke generation

The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The maximum smoke density rating shall not be more than 60% when tested as per ASTM-D-2843.

Tests for acid gas generation

The hydrochloric acid generation when tested as per IEC 754-1 shall be less than 20% by weight.

Tests for Resistance To Ultra Violet Radiation

This test shall be carried out as per DIN 53387. The retention values of tensile strength and ultimate elongation after the tests shall be minimum 60% of tensile strength and ultimate elongation before test.

Tests for water absorption

Outer sheathes shall be subjected to tests for water absorption as per IS 10810. When additional characteristics are required, the tests shall be as agreed to between Employer and VENDOR before the placement of order.

Testing and Commissioning

The Contractor shall carry out commissioning tests in the presence of the Client's representative. The evaluation of test results and decision passed by the Client's representative regarding the test results will be final and binding on the Contractor. Any additional tests or repetition of tests to establish satisfactory operation of any equipment shall be carried out by the Contractor, if so desired by the Client's representative at no extra cost.

The completion checks and commissioning tests to be carried out shall include, but not be limited to, those described in subsequent paragraphs, as applicable to the individual equipment/system.

All checks and tests shall be as per the Manufacturer's drawing manuals, relevant codes of installation and commissioning checklists described in subsequent paragraphs.

Among other commissioning tests, the following shall be carried out at site after completion of installation. Contractor shall ensure to use calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards / International Standards. All tests to be carried out in the presence of Client's representatives.

- a) Switchboard: Power frequency high voltage test, IR test, operation tests
- b) Cables
 - All new LT cables shall be megger tested before terminating / jointing. After terminations / joints shall be megger tested by 1000V megger.
 - All HT cables shall be megger tested before terminating / jointing. After terminations / joints shall be megger tested by 5000V megger.
 - Cable core shall be tested for
 - Continuity
 - Absence of cross phasing
 - Insulation resistance to earth
 - Insulation resistance between conductors
- c) Earthing System

Continuity of all conductors and joints shall be checked. The Client's representatives

may ask for earth continuity tests, earth resistance measurements and other tests, which in his opinion are necessary, to prove that the system is in accordance with design, specification, code of practice and CEA Regulations 2010. Earth resistance value should be not greater than one (1) ohm or as per local regulatory requirements, the stringent one to be applicable.

The Contractor shall carry out insulation resistance tests by a megger of following rating

Control circuits up to 220 V 500 V megger

Power circuits up to 1.1 kV 1000 V megger

In general, the following checks shall be carried out on all the equipment/systems, as applicable.

- a) Name plate details according to approved drawings/ specifications
- b) Any physical damage or defect and cleanliness
- c) Tightness of all bolts, clamps and connections
- d) Oil leakages and oil level
- e) Condition of accessories and their completeness
- f) Clearances
- g) Earthing connections
- h) Correctness of installation with respect to approved drawings/specifications
- i) Lubrication of moving parts
- j) Alignment
- k) Correctness and condition of connections

Commissioning Tests

The following commissioning tests are to be carried out on all the equipment/systems, as applicable and as desired by EMPLOYER/ STATUTORY requirements.

- a) Insulation resistance measurement of equipment, accessories, cabling/wiring etc.
- b) Dielectric tests on equipment, accessories, cabling/ wires etc.
- c) Continuity tests

- d) Calibration of indicators, meters, relays, etc.
- e) Control and interlock checks
- f) Settings of equipment and accessories
- g) Checking of accuracy/error
- h) Checking of operating characteristics, pick-up voltages and currents, etc.
- i) Operational and functional tests on equipment, accessories, control schemes, alarm/trip/indication circuits, etc.
- j) Operational Checks for all the equipments for Auto and Manual mode.
- k) Measurement of guaranteed/approved design values including lighting levels, earth resistance measurement, etc.
- l) Complete commissioning checks of the system

Specific Tests to be carried out for various Equipments are as follows;

HT Distribution Board

- a) Check of electrical wiring.
- b) Tests on auxiliary and control circuits.
- c) Check of electrical operation of safety (interlocking, automatic changeover, Local / Remote operations in test as well as service position including all electrical interlocks etc).
- d) Check of mechanical operations (insertion and withdrawal of removable parts, locks and interlocks system, operation of safety shutters, Anti pumping device operation etc.).
- e) Protection system operation stability and sensitivity by primary injection testing method including testing of metering circuits
- f) Check of setting of all protective and measurement devices (e.g. protection relays, smart devices, etc.).
- g) IR values of power and control circuits
- h) Panel indication, annunciation, space heater circuits
- i) Spare contact for customer use

LT Switchgear Panels

- a) Check of electrical wiring.

- b) IR Values of power circuits & control circuits
- c) Tests on auxiliary and control circuits.
- d) Check of electrical operation of safety (interlocking, automatic changeover, Remote closing / Tripping circuits etc...).
- e) Check of mechanical operations (insertion and withdrawal of removable parts, locks and interlocks system, operation of safety shutters, charging - closing - tripping of breaker etc..).
- f) Check of setting of all protective and measurement devices (e.g. protection relays, smart devices, Secondary injection testing of protective relays/releases, Trip circuit healthiness and tripping through relays/ release etc...).
- g) Indication / Annunciation / Panel space heater circuit / Space contacts for customer use
- h) CT testing for polarity, ratio, IR values and magnetization for class PS characteristics
- i) PT testing for ratio, IR values
- j) Testing of modules for DOL/ Star-Delta/ATS/ Soft Starter starting or any other starting method as per the schematic drawings applicable.

HV & LV power cable, control cable & cable accessories

- a) IR Values before Hipot
- b) Hi Pot test for MV & HV cables.
- c) IR Values after Hipot

Earthing System

- a) Earthing resistance of each electrode
- b) Earth continuity check.
- c) Overall resistance of earthing installation.

List of vendors

Sr. No.	Material/ Equipment	Vendor
1.	Switchgear / Switchboard MV	Siemens ABB Schneider Electric
2.	Static Power Meter & Logger (Trivector	As per DISCOM Company

	Meter)	
3.	Protection Relays (Numeric / Electro mechanic Type)/ Auxiliary relays)	Schneider Electric Siemens Alstom GE
4.	Potential & control Transformer (CT/PT)	Automatic Electric Precise Kappa Pragati
5.	Current Transformer (Cast Resin Epoxy Coated)	Automatic Electric Gilbert & Maxwell Kappa Pragati
6.	Electronic Digital Meter (A/V/PF/HZ/KWH) /MFM with LCD/LED Display.	Schneider Siemens AE Socomec L & T Rishabh
7.	HRC Fuse and Fuse Fitting	ABB GE Siemens L&T
8.	ACB / MCCB/ Contactors	ABB Schneider Siemens L&T
9.	Change over switch (automatic/ manual)	HPL Hager Socomec GE
10.	Thermister relay	Alstom/ Minilec/ Siemens
11.	Push Buttons	ABB L&T Schneider Siemens BCH
12.	MFP Panels - Totally Type Tested Assembly (TTA) Other LT Panels – Non TTA (As Per IEC61439- 1 & 2). To be sourced directly from OEM or authorized licensed partner.	Advance Panels & switchgears (P) Ltd. Adlec Power Pvt Ltd. Control & Switchgears Anant Power Balaji Electro-control & Switchgear

13.	Switches, Time Delay Relay	Schneider Siemens Hager Legrand
14.	Indicating Lamps	Siemens Schneider ABB L&T BCH Esbee
15.	HT Power & Control Cables	Universal NICCO KEI KEC International Finolex CCI
16.	LT Power & Control Cables	Universal NICCO KEI KEC International Finolex CCI LAPP India
17.	HT/ LT Jointing Kit & Termination Kit	Birla-3M Raychem M seal
18.	Termination (Lugs)/ Cable Glands(Double compression)	Commet Dowell Jainson
19.	Selector Switches	Kaycee ABB Siemens Schneider
20.	Alarm Annunciators (solid state type with LED illumination) / Facia Annunciator	Industrial Instruments & Controls Minilec Alstom ICA
21.	Cable Management Systems- Raceways/Floor Boxes, Cable trays	Legrand OBO-Betterman MEM
22.	Cable tray hangers and Supports	Gripple Hilti
23.	Metal Clad Plug & Socket (Industrial)	Legrand Schneider Neptune (Balls)

24.	MCB/RCCB/ SPD/RCBO/ MPCB	Schneider Siemens ABB L & T
25.	Distribution Boards(MCB DBs)	Legrand Schneider Siemens ABB L & T
26.	Fire Sealant & Fire Retardant Paint	India Ltd. I at
27.	Fire Barriers / Sealing	Brattberg Roxtec Signum Navell Multikil
28.	Water barriers/sealing system	Roxtec Rayflate (Tyco Electronics)
29.	Terminal Blocks /connectors	Jainson Elmex Connect well Wago
30.	Single Phase Preventers	Minilec Siemens Schneider Electric L&T
31.	Water Tight Polycarbonate Boxes	Hensel Legrand Phraser