

**ELECTRICAL
TECHNICAL SPECIFICATIONS**

TECHNICAL SPECIFICATIONS

1.0 PREFACE

All the Electrical Work shall be carried out as per

- i. The relevant Indian standards formulated by Bureau of Indian Standards
- ii. Indian Electricity Rules 1956 amended time to time.
- iii. National Electrical Code
- iv. PWD Hand Book Government of Maharashtra

1.1 Preamble

The technical specification for electrical services to be provided for Restoration of Kasara Dolphine Jetty, North Yard, MDL, Mumbai is detailed out in this particular document. These are to be read in conjunction with the Drawing Volumes & Bill of Quantities.

SCOPE OF WORK

Scope of work covers under this tender are as below

1. Internal & External Electrical Installations.
2. Supply, Installation, Testing and Commissioning of Power Distribution Board in Workshop to facilitate power supply on jetty
3. Supply, Installation, Testing and Commissioning of LED Flood Lights along side jetty.
4. Supply, Installation, Testing and Commissioning of weather proof enclosures with weather proof 3Phase Power Sockets, Plug power supply along side jetty.
5. External Electrical Installation consisting of Service connection to all Street lights/Flood Lights along side Jetty etc.

NOTE :-

All codes and standards mean the latest where not specified otherwise installation shall generally follow the Indian Standard codes of practice in the absence of corresponding Indian Standards.

1.2 ELECTRIFICATION WORK

General:

All material shall be conforming to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall either carry valid 'Quality Control' certificate issued by the Chief Engineer (Elect), P.W. Dept. Maharashtra State Govt. as included in approved list.

Work shall be carried out as per the Method of Construction specified by BIS. If there is no reference for particular Method of Construction in IS, such work shall be carried out as per the approved Method of Construction specified in chapter 16 of P.W. Dept. Handbook.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

Material shall be tested in approved Testing Laboratory and shall qualify the relevant tests as and when directed by Engineer In-Charge.

Seven copies of all submittals shall be submitted (PWD- 3set, Client- 1set, Design consultant- 1set, Architect- 1 set and Contractor- 1 set) for review.

Recommended Standards:

The following list is showing Indian Standards, which are acceptable as good practice, and accepted standards.

IS 732: 1989	Code of Practice for Electrical Wiring Installations.
IS 4648: 1968	Guide for Electrical Layout in residential buildings
IS 9537 (Part 1): 1980	Conduits for Electrical Installations: General requirements
IS 9537 (Part 2): 1981	Rigid Steel Conduits
IS 9537 (Part 3): 1983	Rigid Plain Conduits of insulating material
IS 3419: 1989	Specifications for fittings for rigid non metallic conduits
IS 694:	PVC insulated cables for working voltages up to and including 1100V
IS 1554 (Part 1): 1988	PVC insulated (heavy-duty) electric cables for working voltages up to and including 1100V
IS 3961 (Part 5): 1968	Recommended current ratings for cables: PVC insulated light duty cables.

IS 4288: 1988	PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages up to and including 1100V
IS 14772: 2000	Specifications for Accessories for household and similar fixed Electrical Installations
IS 3043: 1987	Code of practice for Earthing
SP 30: 1984	National Electrical Code
SP 7 (Group 4): 2005	National Building Code
IS 14927(Part 1): 2001	Cable Trunking and Ducting systems for electrical installations.
IEC 61439	Low voltage switchgear and controlgear assemblies

1. Conduits / Trunking (Casing Capping) (Surface type)

PVC Conduits

- **Specification No** (WG-MA/CON)
- **Scope:**
- **PVC Conduits: Surface**

Providing specified PVC Conduits and erecting as per approved Method of Construction; on surface of wall / ceiling, etc. including entries through walls / slabs / flooring as per requirement, and with all necessary hardware, accessories such as Spacers, Saddles, Bends, Tees, Junction boxes, Check-nuts, etc.; making conduits erection work rigid and duly finishing, removing debris from site.

Material:

PVC Conduit:

PVC pipe minimum 20mm dia and above depending on No. of wires to be drawn (refer Table No. 1/2) ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Method of Construction:

Erection PVC Conduits for Surface type wiring:

General:

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm, round headed screws for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers. Distance between 2 spacers shall not be more than 600mm. Size of conduit shall be correct depending on number of wires to be drawn (as per Table No. 1/2 for PVC conduits). Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm. or ant electrostatic partition/separate pipe should be used. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface and with colour coding conduit (For visual identification) as per Table No. 1/4. Flexible conduits shall be used at expansion joints.

Especially for PVC Conduits of surface type wiring:

In addition to general instructions above, all joints shall be made rigid with resin / adhesive. Wherever offsets are necessary, it shall be done with bending spring. Size of conduit shall be as per Table No. 1/2 for number of wires to be drawn through the conduit.

PVC Trunking (Casing capping)

Specification No (WG-MA/CON)

Scope:

Material:

1 Conduits (Concealed type)

Specification No (WG-MA/CC)

Concealing PVC Conduits in RCC work

Scope:

Providing specified PVC conduit and laying / erecting in RCC work, such as slab, beam, column before casting as per approved Method of Construction along with of all required material including hardware, binding wire, fish wire; accessories such as deep / long neck PVC junction boxes, PVC / MS junction / draw-in boxes, check-nuts, flexible PVC pipe, drawing fish-wires and making all piping rigid, removing debris from site and supervising the work during casting to confirm rigidity, continuity and avoid damages.

Material:**PVC Conduit:**

PVC pipe of minimum 20mm dia and above depending on No. of wires to be drawn (refer Table No.1/2); ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; Couplers, long Bends, deep Junction boxes of required ways and resin / adhesive to make all joints rigid.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; PVC or fabricated from 16g CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plates on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire, steel fish wire etc.

Method of Construction:***Concealing of PVC conduits:******General:***

Work shall be done in co-ordination with civil work and to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No 1/2 for PVC conduits) Separate pipe shall be used for each phase in single phase distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. The distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25m, in such manner so as to facilitate drawing of wires. All PVC conduit bending shall be done with Bending Spring. All joints shall be made rigid with resin.

Concealing of PVC conduits:**In RCC work:**

Work shall be commenced after fixing of steel re-enforcement on centering material. Conduits shall be firmly fixed on steel of RCC work by binding wire. Fixing of conduits shall be such that it will remain rigid during casting of slab, beam, and column even after use of vibrator. Deep junction boxes and other draw-in boxes shall be such that their open end and centering material will not have gap in between so as to avoid concrete entering inside even after fixing covers to steel re-enforcement; and be filled with dry sand. Open ends of conduits; to be concealed in walls, shall be provided with couplers / sockets at ends and be flush with bottom of beam, and located at the center of the beam. As far as possible bunching / grouping of conduits shall be avoided so that it will not affect strength of RCC work especially in beams. Suitable steel fish wire shall be drawn through in the conduits for drawing of wires later on.

Concealing PVC Conduits in walls / flooring**Scope:**

Providing specified PVC conduit and erecting / laying in wall, flooring by making chases / grooves / entries as per approved Method of Construction along with of all required material including hardware such as 'U' nails, binding wire, fish wire; accessories such as PVC / MS junction boxes / inspection boxes, check-nuts, flexible PVC pipe, glands, drawing fish-wires and making all piping rigid, refinishing the surface with cement mortar, removing debris from site.

Material:**PVC Conduit:**

PVC pipe minimum 20mm dia and above depending on No. of wires to be drawn (refer Table No.1/2), ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; Couplers, long Bends, Junction boxes of required ways, type and resin / adhesive to make all joints rigid.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; PVC or fabricated from 16g CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plate on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire 20g, steel fish wire, etc.

Other material for Surface finishing: *Cement, sand, putty, and water.*

Method of Construction:

Concealing of PVC conduits: (General)

Work shall be done in co-ordination with civil work to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No 1/2 for PVC conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. for which the distance between pipes shall not be less than 300 mm or anti electrostatic partition is provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No.1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25m, in such manner so as to facilitate drawing of wires. All bending of conduits shall be done with Bending Spring. All joints shall be made rigid with resin.

Concealing of PVC Conduits In walls / flooring:

Chases shall be made in walls of adequate width, with cutter and chiseling through it. Necessary finishing of the wall surface shall be done. Work in flooring shall not disturb RCC work, Conduits of adequate size shall be erected with use of appropriate accessories, and 'U' nails. All joints shall be made rigid with resin. Draw-in / inspection boxes shall be fixed with check-nut, flush with surrounding surface and earthed.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; PVC or fabricated from 16 SWG CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plates on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire 20g, GI fish wire, etc.

Wires: Mains / Sub-mains / Circuit mains (comprising phase and neutral wires):

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5

Earth Continuity Wire: PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked, of specified size but not less than 1.5 Sqmm as per Table No 1/5

Lugs: Copper lugs of required size & type

Other material: Rubber grommet, bush, harnessing material, flexible conduit etc.

2. LED Fittings (ESD-LED)

A) Surface / Recessed Mounting LED Luminaries

Scope:**Specification No (ESD-LED/IDF)**

Supplying & erecting approved make, Surface / recessed mounting indoor fitting of specified wattage to provide specified lux level at specified height with p.f. > 0.95, complete as per manufacturer's specification, with appropriate driver.

Material:

Fitting: Scientifically designed highly polished & anodized Aluminum reflector ensures precise light control with optimum light utilization either with clear glass / frosted glass cover with ring or as per manufacturer's specification, leading to substantial savings in energy cost and excellent ambient conditions. Frame is fabricated from CRCA/MS sheet and epoxy powder coated white. Percolated frame ensure corrosion free life. Retaining clips for recess mounting fittings to facilitate mounting in false ceilings. Luminaries comprises of a deep drawn MS sheet canopy along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of IS: 10322. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver: The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's: The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt.

Metal Core PCB's: The PCB should be of metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Method of Construction:

The fitting shall be fixed firmly in the designated place (False ceiling / unspecified ceiling) with the help of swinging bracket, and making the connection. In case where fittings are to be installed flush with /on false ceiling; layout shall be given to civil wing and work shall be done in co-ordination with civil wing e.g. making recesses in false ceiling.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e each)

B) Bulk Head type LED Luminaries**Scope:****Specification No (ESD-LED/BHF)**

Supplying & Erecting LED bulkhead Fitting of appropriate size with 8 W with minimum 50-70 lux level at ground level with p.f. > 0.95 with frosted glass.

Material:**Fitting:**

Luminaries comprises of a deep drawn MS sheet body with clear acrylic cover of 3mm thickness or as per manufacturer's specification, along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of IS: 10322The surface of the canopy should be powder coated / stove enameled. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver:

The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's:

The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt. The angle of illumination of each LED should be 90degrees and should be mounted on star type of metal core PCB's.

Metal Core PCB's: The PCB should be a metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

Wooden board: As per (WG-PW/PW) 1.6 specified in chapter for Point wiring.

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Method of Construction:

The complete fitting with all the above accessories shall be erected as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e each)

C) LED Street Light / Flood Light Luminaires

Scope:

Specification No (ESD-LED/ODF)

Supplying & erecting Street Light fitting of specified wattage to provide specified lux level at specified height, complete with acrylic cover and gaskets, with appropriate driver circuit and erected on provided bracket.

Material:

Fitting: Luminaries comprises of a deep drawn MS sheet canopy with clear acrylic cover of 3mm thickness, along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of IS: 10322 and Ingress Protection IP-55. The surface of the canopy should be powder coated / stove enameled. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver: The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's: The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt. The angle of illumination of each LED should be 90degrees and should be mounted on star type of metal core PCB's.

Metal Core PCB's: The PCB should be a metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

Method of Construction:

The complete fitting with all the above accessories shall be erected with provided bracket, on wall/street light pole or at any place as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e each)

PVC/XLPE Cables (CB) **Armoured Cables (HT & LT)**

General

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall be as included in approved list.

Work shall be carried out as per the method of construction specified by BIS. If there is no reference for particular method of construction in IS, such work shall be carried out as per the approved method of construction specified in chapter 16 of P.W. Dept. Handbook.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

Cables: (Armoured)

The following list records those Indian Standards in force, which are acceptable as good practice, and accepted standards.

SP 30: 1984	:	National Electrical Code
SP 7 (Group 4): 2005	:	National Building Code
IS 1255: 1983	:	Code of practice of Installation & Maintenance of armoured cables up to 33 kV.
IS 3961: Part 2: 1967	:	Recommended current ratings of PVC cables.

- IS 1554: Part 1; 1988 : PVC Insulated (Heavy duty) Electric Cables; Part 1
for working voltages up to and including 1100 Volts.
- IS 1554: Part 2; 1988 : PVC Insulated (Heavy duty) Electric Cables; Part 1
for working voltages up to and including 3.3 kV to 11 kV.
- IS 10810: Part 63; 1993 : Method for Test of cables, Part 63 Smoke density of
electric cables under fire condition.

Scope: (Armoured cables)

Specification No. (CB-LT/AL, CB-LT/CU, CB-HT)

Providing armoured cable of specified voltage level, size & specified conducting material (Aluminum / Copper) as per **Table no. 7/3** including required material, hardware's for erection and erecting on wall, ceiling, RCC slab or drawing the same through pole, pipe, laying in provided conduit, trench, ducts, trays as per approved method of construction including glands, lugs, etc.

Material:

Cables:

Cables shall be XLPE for LT/MP and XLPE for HT as per Table no. 7/3 and of required construction, colour, shall carry ISI mark, IS No, manufacturer's name, size, duly embossed / screen printed at every metre and having the total count of progressive length in meter at each mark.

Earth wire: Galvanized Iron (G I) wire of appropriate gauge as per Table No 7/1.

Glands: As per specification **(CB-GL)**

Lugs: As per specification **(CB-CL/AL, CB-CL/CU)**

Saddles: Saddles fabricated from GI sheet of required gauge and size depending on dia of cable either galvanized or painted with superior quality enamel black paint with necessary shearing mechanical strength, semi circular shaped with extended piece having suitable holes for fixing.

G I Strip: 22 g x 25 mm width G I Strip.

Clamps: MS Clamps fabricated of required length and shape, having the size of 3/6 mm thick mild steel having 25/50 mm width (as per size of cable), rounded ends with wooden / resin cast grip for holding the cable.

Identification tags: For identifying root, connection position GI strip with identification mark / name embossed / painted with arrangement to tie should be fix on cable or arrangement of ferrules to be done.

Hardware: Sheet Metal (SM) screws of required sizes, plugs / wooden gutties, etc.

Method of Construction:

General:

- a) Irrespective of method of construction the cable ends shall be terminated with appropriate size & type of glands with lugs duly crimped, as directed by Site engineer.
- b) Wherever the cable has to be bent, the turning radius shall be as mentioned in Table No 7/2. Grouping of cables shall be done with adequate distance between cables as mentioned in IS so as to minimize de-rating. Cables shall be tagged/ferruled with identification name / mark at the point from where distribution starts and at ends. Bare earth wire of appropriate size as per Table no. 7/1 shall run along with the cable. Earth wire running with the cable shall be terminated at the earth terminal nearest to cable termination.

Erection of Cable on Surface:

Erection shall be done as per the routes and layout finalized, in perfect level and in plumb. Before fixing the cable shall be straightened as far as possible for good aesthetics look, continuous bare GI earth wire of required gauge as per Table No 7/1 shall be run. Cable with G I wire shall be fixed by saddles firmly clipped on cable and shall be fixed to wall with minimum 50 x 8 mm SM screws with plugs/wooden gutties, etc. (Distance between two supports / saddles shall be maximum 450 mm). Wooden gutties shall be used wherever required (Especially for stone wall). The entries made in wall, floor slab, etc for laying the cable shall be made good by filling and finishing with plastering the same.

Erection of Cable on Trusses:

Cable along with bare GI earth wire, while erecting on trusses, shall be firmly clamped by wrapping GI strip of 22 g, 25 mm width of required length fixed to truss with nuts and bolts.

Erection of Cable on Pole:

Cable along with bare GI earth wire, while erecting on pole, shall be firmly clipped by suitable wooden / epoxy resin cast grips, clamped with 25 x 3 mm or 50x6 mm MS strip of required length and fixed to pole with nuts and bolts.

Laying of Cable in provided Trench/Pole:

While laying Cable along with bare GI earth wire, utmost care shall be taken to prevent damage to the insulation of the cable and to the open end. Cable shall be brought out from trench vertically straight (minimum 1.0 metre above G L). Care shall be taken to inspect the trench so that depth of cable shall not be less than as shown in Table No 7/4. Suitable size of cable loops shall be provided near termination point at adequate depth.

Erecting cable in constructed Trench / duct:

Erection of cable/s in constructed trench / duct, shall be as per guide lines of IS 1255.

Erection of cable/s on trays:

Cable/s shall be tied with PVC tags on GI trays. At bending point care shall be taken so that sharp edges of sheet will not damage insulation of cable.

Mode of Measurement: Executed quantity shall be measured on the basis of running metre per run of cable.

Dismantling

Cable laid underground, or fixed on any surface shall be dismantled carefully without damaging complete with all its accessories, making coil and stored as directed. The surface of the dismantled cable shall be made clear by removing of unwanted material, cement mortar, etc. When cable is dismantled from trench refill back the trench and making the surface proper.

Mode of Measurement: Executed quantity shall be measured on the basis of running metre per run of cable.

Table No 7/1

Size of Bare GI Earth wire to be used with LT Cables upto 1.1 kV

S.No.	Size of cable	Size of bare GI Earth wire to be used with cable
1	2.5 Sqmm to 50 Sqmm of all cores.	12 SWG
2	70 Sqmm to 95 Sqmm of all cores.	10 SWG
3	120 Sqmm and above of all cores.	8 SWG

Table No 7/2

Minimum bending Radius for Cables

S.No.	Voltage level of cables	Single core	Multi core	
			Unarmoured	Armoured
1	Up to 11 kV	20 D	15 D	12 D
2	Up to 22 kV	25 D	20 D	15 D
3	Up to 33 kV	30 D	25 D	20 D

Note: D diameter of cable.

Wherever possible, 25 percent larger radii than the specified above should be used.

Table No 7/3

Current Rating (In Ground) for PVC/ XLPE Insulated 1.1 kV Grade Cables

Nominal area of conductor	Aluminum Conductor		Copper Conductor	
	Single Core	Multi Core	Single Core	Multi Core

Sqmm	PVC	XLPE	PVC	XLPE	PVC	XLPE	PVC	XLPE
10	51	55	46	50	65	71	60	65
16	66	74	60	68	85	95	77	87
25	86	98	76	90	110	125	99	115
35	100	118	92	108	130	150	120	138
50	120	137	110	126	155	175	145	161
70	140	172	135	158	190	220	175	202
95	175	204	165	187	220	260	210	239
120	195	234	185	215	250	301	240	276
150	220	262	210	240	280	336	270	308
185	240	298	235	273	305	381	300	350
240	270	344	275	316	345	441	345	405
300	295	387	305	355	375	496	385	455
400	325	458	335	420	400	586	425	538
500	345	495	-	-	425	635	-	-
630	390	555	-	-	470	710	-	-
800	440	625	-	-	-	-	-	-
1000	490	685	-	-	-	-	-	-

Rating Factors for Variation in Ambient Air Temperature

Air Temperature (°C)	40	45	50
Rating Factor (XLPE)	1.00	0.94	0.88
Rating Factor (PVC)	1.00	0.90	0.81

Table No 7/4

Minimum laying Depth of cables (IS: 1255)

S.No.	Voltage level of cables	Minimum depth from top of the cable
1	Up to 1.1 kV	750 mm
2	3.3 kV to 11 kV	900 mm
3	22 kV to 33 kV	1050 mm
4	At road crossing	1000 mm
5	At railway crossing (from Bottom of sleepers to Top of pipe)	1000 mm

Notes below Table No 7/4:

1.	PVC Insulated electrical cable for voltage grade up to 1.1 kV is based on 8 volts drop.			
2.	The distances are given in meters and after rounding.			
3.	The distances are given in meters and after rounding.			
For Temperature Correction please see as detailed below:				
Ground temp.	20 degree C	25 degree C	30 degree C	35 degree C

Rating factors:	0.95	0.90	0.85	0.80
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Table No 7/5

Distance up to which different sizes of UG Aluminum Conductor Cables 1.1 kV grade, can be used for different current ratings of 8 Volts drop. (PVC insulated, PVC Sheathed, 3 cores or 4 cores)

Maximum Conductor temperature – 70 degree C														
S. No	Current	Distance in meters for the following cable sizes in Sqmm												
	Amp	6	10	16	25	35	50	70	95	120	150	185	240	300
1	5	165	260	415	725	895	1300	1925	2360	3065	3555	4300	5770	6460
2	10	80	130	205	360	450	650	960	1180	1530	1775	2150	2885	3230
3	15	55	85	140	240	300	430	640	785	1020	1185	1430	1920	2155
4	20	40	65	100	180	225	325	480	590	765	890	1075	1440	1615
5	25	30	50	80	145	180	260	385	470	610	710	860	1150	1290
6	30	25	40	70	120	150	215	320	390	570	590	715	960	1075
7	40	20	30	50	90	110	160	240	295	380	445	535	720	805
8	50	-	25	40	70	90	130	190	235	305	355	430	575	645
9	60	-	-	35	60	75	110	160	195	255	295	355	480	535
10	70	-	-	30	50	65	90	135	165	215	255	305	410	460
11	80	-	-	-	45	55	80	120	145	190	220	265	360	405
12	90	-	-	-	40	50	70	105	130	170	195	235	320	360
13	100	-	-	-	35	45	65	95	115	150	175	215	290	320
14	110	-	-	-	-	40	60	85	105	140	160	195	260	290
15	120	-	-	-	-	35	55	80	95	125	145	180	240	270
16	130	-	-	-	-	-	50	75	90	115	135	165	220	250
17	140	-	-	-	-	-	45	70	80	110	125	150	205	230
18	150	-	-	-	-	-	-	65	75	100	115	140	190	215
19	160	-	-	-	-	-	-	60	70	95	110	130	180	200
20	170	-	-	-	-	-	-	55	70	90	105	125	170	190
21	180	-	-	-	-	-	-	50	65	85	100	120	160	180
22	190	-	-	-	-	-	-	-	60	80	90	110	150	170
23	200	-	-	-	-	-	-	-	60	75	90	105	145	160
24	225	-	-	-	-	-	-	-	-	65	80	95	125	145
25	250	-	-	-	-	-	-	-	-	-	70	85	115	130
26	275	-	-	-	-	-	-	-	-	-	-	80	105	115
27	300	-	-	-	-	-	-	-	-	-	-	70	95	105

Cable Joints & End Termination Kits (LT/HT Cables) (JT/LT/HT)

Scope:

Specification No (CB-JT/LT/HT)

Providing straight through cable jointing kit of approved make and jointing cable as per the manufacturer's instructions and duly marking name of jointer and date.

Material:

Joint kit: Kit manufactured by reputed manufacturer with PVC moulds made in two parts, with epoxy compound, earth continuity lead of appropriate cross section having lugs at both ends, aluminum ferrules of the size of the cable, cross shaped epoxy spacer, MS clips for holding the moulds, adhesive for pasting the moulds.

Method of Construction:

Straight through joint Kit: LT/HT Cables

Before providing joint to the cable, the cable ends of the equivalent length of the joint moulds, shall be prepared by removing the outer PVC insulation along with the steel armouring. The ferrule shall then be inserted over the bare core of the cable, and shall be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimped portion shall be wrapped first with the PVC insulation tape and then with the insulation tape used for wrapping HT conductor. The above method shall be carried out for all the cores strictly following the colour code. The leads of the both the cables now shall be placed into the mould by using the epoxy spacer, for having sufficient gap in-between the leads. The earth continuity lead shall be clamped to the both ends of the cable. After covering the cable leads with the PVC moulds, the edges shall be clipped after applying the adhesive on the inside face of the moulds. The pasting of moulds shall be rigid and as far as possible leak proof, so that the epoxy compound shall not spill out. Now the duly stirred epoxy compound shall be poured and fill till the compound rises through the risers provided on the moulds.

After completing the above procedure, the joint shall be allowed to dry out for at least 8 to 10 hours (for epoxy compound to get hardened) depending upon the size of cable. Before connecting to supply, the dry and hardened joint shall be tested for its insulation level with 1000 V/ 5000 V Meggar.

The cable should be fixed or laid in such manner that there should not be pressure on end of moulds or on jointing position of cables

Outdoor/Indoor end termination Kit: LT/HT Cables

Before providing end termination kit to the cable, the cable end of the equivalent length of the moulds, shall be prepared by removing the outer PVC insulation along with the steel armouring. The ferrule shall then be inserted over the bare core of the cable, and shall be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimping shall be done in such a manner that there shall be no air gap. Then the crimped portion shall be wrapped first with the PVC insulation tape and then with the insulation tape used for wrapping HT conductor. The above method shall be carried out for all the cores strictly following the colour code. The leads of the cable now shall be placed into the mould by using the epoxy spacer, for having sufficient gap in-between the leads. The earth continuity lead shall be clamped to the ends of the cable. After covering the cable leads with the PVC moulds, the edges shall be clipped after applying the adhesive on the inside face of the moulds. The pasting of moulds shall be rigid and as far as possible leak proof, so that the epoxy compound shall not spill out. Now the duly stirred epoxy compound shall be poured and fill till the compound rises through the risers provided on the moulds.

After completing the above procedure, the joint shall be allowed to dry out for at least 8 to 10 hours (for epoxy compound to get hardened) depending upon the size of cable. Before connecting to supply, the dry and hardened joint shall be tested for its insulation level with 1000 V/ 5000 V Meggar.

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each).
Cable Glands (GL)

Scope:

Specification Nos (CB-GL)

Termination of cable ends with cable glands for preparing and fixing the cable leads for connection. Cable glands shall be of Flange type.

Material:

Cable glands: Flange type heavy duty. Made of high purity brass metal, with brass washers, rubber rings, threaded stud with washers and nuts.

Method of Construction

Before erection of gland, the cable end shall be prepared by removing the outer PVC insulation up to the point where gland to be fixed, by assessing the length of leads required. Bottom portion of gland shall be inserted over the steel armouring, and then armour strips shall be bent for the length of collar of gland, remaining length of armouring shall be cut. The cable end shall then be, inserted through the entry of plate where the cable is to be terminated. The top portion of gland with washer shall be then inserted in such a manner that the bent armour strip should be touching the surface of the entry. The nuts shall be tightened with spring washers over the projected stud portion. Fixing of gland shall be at right angle to the gland plate. Tightening shall assure continuity of earth. Hole to the gland plate shall be punched / knocked out, of correct diameter with respect to gland size.

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each).

Cable Indicator Plate (CIP)

Scope:

Specification No (CB-CIP)

Providing and fixing of cable indicator plate along the route of under ground cable.

Material:

Cable indicator plate: Circular plate made of cast iron having 100 mm dia. and 6 mm thick.

Iron rod for fixing of cable indicator plate: 700 mm long galvanized iron rod of 12 mm dia., and 150 mm long cross bar welded at bottom or hook to be made with same continuous bar.

Method of Construction:

Cable indicator plate fixed/welded to the 700 mm long iron rod or angle, with 150 mm cross bars welded at bottom as fasteners or bent in 'J' shape to hook the cable in the bent portion, shall be buried along the route of cable in the trench made for laying the cable. For clear visibility, the Cable indicator plate shall be buried in such a manner that the plate should be minimum 200 mm above the ground level and shall be provided at every 15-25 metre in straight run, at both ends of road crossing and immediate before and after turning point of cable.

Mode of Measurement:

Executed quantity will be measured on number basis. (I.e. each).

Street Light Boxes (SB) Cable Lugs (Aluminum & Copper)

Scope

Specification Nos (CB-CL/AL, CB-CL/CU)

Crimping of lugs, and fixing to the terminals with nuts and bolts, etc.

Material:

Lug: Lug shall be of high purity aluminum / copper / bimetallic of required type, with required size of hole and smooth finished both from inside and outside.

Hardware: Brass or Cadmium plated mild steel nuts and bolts, bimetallic washers.

Anti-Oxide paste: Paste of superior quality manufactured by reputed manufacturer.

Method of Construction:

Before fixing of lugs to the cable end, the cable end to the equivalent length of the lug shall be prepared by removing the outer PVC insulation along with the steel armouring and then, the inner PVC insulation. The paste shall be applied to the cable lead and inside the lug prior to the inserting of lug on the cable lead. The lug shall then be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimping shall be done in such a manner that there shall be no air gap. Then the crimped portion shall be wrapped with the PVC insulation tape. (Colour of tape shall be of that of cable lead) The above method shall be carried out for all the cores. The cable end with lug shall then be terminated into the terminal and then be tightened with either brass nuts or Cadmium plated nuts as directed by Engineer in-charge.

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each).

CABLE TRAY & ACCESSORIES

Scope

Scope of these specifications covers the design, material selection, fabrication, testing at manufacturer's works, insurance, packing, transportation, loading/unloading, supply at site and installation of cable trays, trunking(Raceway) and accessories covered herein.

Material and construction (Cable tray)

Cable trays and accessories shall be manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturers' Association (NEMA).

Cable trays and accessories shall be fabricated using mild steel sheets and hot dip galvanized in accordance with B.S.729 after fabrication. All bolts, nuts and washers shall also be galvanized. The zinc coating shall be uniform, smooth and free from imperfections such as flux & ash, black spots, blisters etc. Cable trays and accessories shall undergo a process of degreasing, pickling in acid & cold rinsing prior to galvanisation.

Cable trays shall be of the following type:

- i. Ladder type with rungs
- ii. Perforated type.

Perforated cable trays shall be generally of channel type and the perforations shall be 10x30 mm oval holes. Perforated cable trays shall also be galvanized. Galvanising shall be in accordance with that specified above for ladder type cable tray.

Ladder type cable trays shall be made from min 1.6mm thick sheet formed in 'C' section of 75/100mm height and inward flanges of 15mm as side runners and 30mm wide x 10mm high rungs ('C' shaped) from a 1.5mm thick sheet. Perforations as mentioned above shall be provided in the width of the rungs. Pitch of the rungs shall not exceed 250 mm center to centre. Rungs shall be tack welded to the side members.

The thickness of sheet steel for perforated trays shall be 1.2 mm and they shall be of the formed channel shape.

Cable trays shall be of following dimensions as specified in BOQ.

Accessories

Following accessories and hardware, as required, shall be supplied with cable trays :

- | | |
|---|----------------------|
| ¾ | Coupler plates |
| ¾ | bends |
| ¾ | Tees |
| ¾ | Reducers |
| ¾ | 4-way cross |
| ¾ | Fasteners (Hardware) |

Testing at manufacturers work

The material for cable trays and accessories shall be offered for stage inspection by the Owner as follows:

- | | |
|---|---|
| ¾ | Prior to fabrication and galvanising. |
| ¾ | After fabrication but before galvanising. |
| ¾ | After galvanising but prior to dispatch. |

During inspection, thickness of sheets, dimensions and weight of zinc coating will be measured. Items not conforming to specifications shall be rejected.

A) Cable Trench (CTR)

General

This part of specification deals with the preparation of trenches in soft soil, hard murum, BT road, and laying of cables inside the trench, etc as per IS: 1255.

Scope:

Specification No (CW-EXN/CTR)

Excavating in all types of soil strata and making trench for laying cable/cables, providing sand bed for laying the cable, covering cable with specified material as per requirement, and finishing the same by making the surface proper with crown on top of the trench.

The following list shows Indian Standards, which are acceptable as good practice, and accepted standards.

SP 30: 1984	:	National Electrical Code
SP 7 (Group 4): 2005	:	National Building Code
IS 1255: 1967	:	Code of practice of Installation & Maintenance of armoured cables up to 33 kV.

Material:

Clay bricks of minimum size 225x110x62.5 mm (L x B x H), burnt in the kiln, of good quality. **Bricks:** Solid
Sand: Screened sand of good quality.

Method of Construction:**Trench in Soft soil / Hard Murum / Tar road: Single run of cable**

Before excavating the soil for preparing trench, route of cable laying shall be got finalized from the site in-charge. Trench of minimum 300 mm width shall be excavated up to minimum depth below the ground surface as per Table No 17.1/1 Bottom of the trench should be carefully levelled and freed from stones. Cable duly straightened shall be laid flat and embedded in the 200 mm layer of screened sand at the bottom of the trench. Bricks shall be laid all over the run of cable as specified below:

Lengthwise for cable up to and including 10 Sqmm of all cores.

Width wise for cable above 10 Sqmm of all cores.

Remaining portion of the trench shall be back filled with the excavated material after removing stones and sharp / hard material, and making the surface proper. Crown of 150 mm shall be provided over the trench. The remaining excavated material shall be removed from site and dumped in scrap yard of Local authorities or at suitable place.

Trench in Soft soil / Hard Murum / Tar road: Two or more cables run of cable

Before excavating the soil for preparing trench, route of cable laying shall be got finalized from the site in-charge. Trench of minimum required width more than 300mm. shall be excavated up to minimum depth as per Table No 5, below the ground surface. Bottom of the trench should be carefully levelled and freed from stones. Cables duly straightened shall be laid flat and embedded in the 200 mm layer of screened sand. The inter-axial distance between two cables shall be between 230 and 400 mm. at the bottom of the trench. Bricks shall be laid all over the run of cable as specified below:

Lengthwise for cable up to and including 10 Sqmm of all cores.

Width wise for cable above 10 Sqmm of all cores.

Remaining portion of the trench shall be back filled with the excavated material after removing stones and sharp / hard material, and making the surface proper. Crown of 150 mm shall be provided over the trench. The remaining excavated material shall be removed from site and dumped in scrap yard of Local authorities or at suitable place.

Trench in Soft soil/Hard Murum/Tar road with half round Hume pipe:

(For cables of size 25 Sqmm. and above shall be covered by min. 150 mm. dia. of RCC Hume pipe)

Before excavating the soil for preparing trench, route of cable laying shall be got finalized from the site in-charge. Trench of minimum required width more than 300mm. shall be excavated up to minimum depth as per Table No 5, below the ground surface. Bottom of the trench should be carefully levelled and freed from stones. Cables duly straightened shall be laid flat and embedded in the 200 mm layer of screened sand. The inter-axial distance between two cables shall be between 230 and 400 mm. at the bottom of the trench. Inverted 150mm. dia. Half

round RCC Hume pipe shall be laid above full length of cable. For more than one cable higher size or more number of Hume pipes are to be provided.

Remaining portion of the trench shall be back filled with the excavated material after removing stones and sharp / hard material, and making the surface proper. Crown of 150 mm shall be provided over the trench. The remaining excavated material shall be removed from site and dumped in scrap yard of Local authorities or at suitable place.

As per 3.1 above, in place of bricks, the cable of size 25 sq.mm and above shall be covered with 150 mm dia. half round Hume pipe.

Mode of Measurement:

Executed quantity shall be measured on the basis of running meter per run of cable.

Table No 17.1/1

Minimum laying Depth of cables (IS: 1255)

S.No	Voltage level of cables	Minimum depth from top of the cable
1	Up to 1.1 kV	750 mm
2	3.3 kV to 11 kV	900 mm
3	22 kV to 33 kV	1050 mm
4	At road crossing	1000 mm
5	At railway crossing (from Bottom of sleepers to Top of pipe)	1000 mm

LV PANEL BOARD

Rated Insulation Voltage Ui	:	Upto 1000 V
Frequency	:	50 Hz
Frequency variation	:	±3% of the nominal value
System design fault level (sym.)	:	50KA for 1 sec
System earthing	:	Solidly Earthed
Rated Impulse Withstand voltage Uimp :	:	12kV/8kV
Degree of Protection	:	IP65

Applicable standards

The equipment proposed in this offer has been designed, manufactured, and tested according to the relevant IEC recommendations.

IEC 61921 / IS 16636 – 2017 - Low-voltage power factor correction banks

IEC 61439-1/2 Low voltage switchgear & control gear assemblies – Part 2 Power switchgear and control gear assemblies

IEC 61641-ed 3 Enclosed low voltage switchgear and control gear assemblies Guide for testing under conditions of arcing due to internal fault

IEC 60529 Degrees of protection provided by enclosures

IEC 60947-2 Low voltage switchgear & control gear – part 2 Circuit breakers

IEC 60947-3 Low voltage switchgear & control gear – Part 3 Switches, disconnectors, switch-disconnectors & fuse combination units

IEC 60068 Environmental testing

IEC 61140 Protection against electric shock – Common aspects for installation and equipment – Basic safety publication

IEC 60947-4-1 Contactors and motor starters LV Equipment Mandatory Specifications

Mandatory Safety Standards and tests

- To ensure safety of the persons and equipment, each rating of the switchboard must be type tested recently in accordance with IEC 61921, IS 16636 : 2017, IEC 61439 - 1 & 2. The testing must have been performed in the independent laboratories witnessed by competent authorities of international repute.
- All the performance type tests must be done with the device mounted inside the switchboards and shall be considered applicable for that particular make only. In case the make is changed separate test must be conducted. Test certificates

must be available for inspection before the quotation is made

- This is a Mandatory specification for low voltage switchboard dedicated for large installations comprising of LV Main distribution boards and Sub - distribution applications and motor control Centers. The specifics of site conditions and special applications are mentioned separately in the annexures This equipment is desired to be installed indoors in the substation or the specific rooms or shop floor. The LV Equipment shall be flexible, made of several type of panels to be coupled with each other for various applications with specifically rated horizontal busbars and vertical busbars for particular vertical section. For personal and equipment safety against accidental touch, each feeder must have Pre-designed finger proof metallic or molded barriers.FRP/Hyles shrouds will not be acceptable under any circumstances.
- Pre-designed Metallic barriers between feeder chambers, Busbar chambers and cable compartment. All the openings between these compartments must be properly sealed and shrouded.
- As per IEC 61921, IS 16636:2017 type tested design metallic partitioning in ensure safety of during operation and maintenance. Metallic partitions on the cable termination must be designed for easy termination of the cable sizes mentioned in the BOQ/ SLD. It should easily possible to reassemble the form partitions after terminations of the cable.
- Differentiated locks (& Keys) for Feeder compartment, Cable compartment and Busbar compartment.
- Several interlocking systems as mentioned elsewhere in this specification or special requirement to prevent inadvertent operation.
- If, specific environmental conditions are mentioned (e.g. Corrosive, conductive, highly humid or outdoor), supplier must submit the processes to be followed to avoid adverse effect on the working of the switchboard.
- Manufacturing Unit - Systems, Safety and Green Initiatives. The Supplier manufacturing unit must have statutory and quality system standards certification
- ISO 9001 Quality Management Systems (QMS)
- ISO 14001 Environment Management Systems (EMS)
- OHAS18001 Certification for occupational health and safety.
- LV equipment shall be modular, metal enclosed pre-engineered, comprehensively type tested as per IEC 61921, IS16636:2017, IEC61439-&2, to house switchgear devices of reputed makes as specified and as per the BOQ/SLD.

General

- The switchboard shall be metal enclosed, free standing, floor mounting, compartmentalized, extendable on both sides, modular type, suitable for indoor installation with dust & vermin protected.
- The switchboard shall complies to latest edition of IEC 61439-1&2, Test certificate shall be issued by a reputed authority.
- The equipment shall be suitably constructed for safe, proper and reliable operation without undue wear, corrosion, heating or other operating trouble.
- Panel builder shall produce valid licensed agreement made with original manufacturer.
- The weatherproof housing shall be manufactured from Hot Galvanized Iron confirming to international specification and suitable for mounting on a flat concrete base or pier 300 mm above ground level.
- The enclosure frame shall be from OEM. The frame shall be of bolted design made of Galvanized iron with 9 fold structure for better rigidity and strength with 275GSM. No welding frame to be considered.
- All the load bearing members shall be made of GI sheet steel and it shall be of a totally enclosed design with cables entering from the Top/bottom and secured by cable cleats or glands and maintains equipotentiality of the switchgear.
- The housing shall be arranged for front access/Rear access by means of hinged doors which shall be screwed to secure them.
- All openings/corners shall be smooth without burrs, smooth. The openings for passing control wires and cables shall be smoothed or provided with suitable rubber gaskets. Doors and covers shall be provided with gasket to ensure specified IP degree.
- All hardware shall be treated to achieve resistance to corrosion. Joints and connections shall be made using high quality 8.8 grade steel bolts, nuts & washers. Specific washers shall be used to ensure effective continuity.
- The switchboards shall be formed using distinct vertical panels comprising of different compartments
- Full metal sheet shall be provided between two adjacent vertical panels running up to full height of the switchboards.
- All the meters,CTs, auxiliaries pertaining the feeders will be housed together in the same compartment respecting the connection rules, clearances recommended by standards and the manufacturers guidelines. For the ACB feeders however, the protection relays, other auxiliaries like control/selector switches, meters etc. shall be mounted in a separate compartment near to the breaker compartment with proper labelling
- The rated impulse withstand voltage of the system shall be 8kV for ACB & MCCB feeders for total panel.
- The Electrical Panel shall have a rated short time withstand current of 50 kA for 1 second
- The busbar will be designed for mounting on insulated supports that are sufficient in number to accept the flow of peak short circuit current upto 254kA.

- The switchboard Main distribution panel shall restrict the internal arcs faults within the compartment to ensure maximum safety to the operating personnel and also to minimize the downtime for replacement and repairs. Type test certificate shall be carried out to verify the arc containment within the compartment for 50kA, 0.3sec as per IEC 61641.
- The Switchboard shall have Seismic withstand of Zone –IV.
- Even under extreme condition of short circuit or Mal-operation there will be no danger in the vicinity of the assembly.
- The switchboard shall be with Outer glass door with gasket to prevent from accidental / unauthorized operation of switchgears.
- The glass should be of minimum 4mm thick which should comply Mechanical impact of IK-09.
- The doors should be with pre-assembled handle (reversible) with 4 closing points must be used, double tongue standard type with locking system must be chosen.
- No hylam sheets to be used for segregation, GI sheet is preferable.

Quality assurance

- The panel manufacturer should have ISO 9001 certification. And shall have a minimum experience of 10 years in the field of switchgear assembly. Enclosure system and switchgear components shall be from the same manufacturer
- The entire switchboard shall be of bolted design to avoid welding cracks in case of welded design.
- The switchboard shall be of modular kit design for easy transportation and assembling at site by which Quick and error free assembly can be achieved.
- Finger touch proof design ensures highest safety to maintenance personnel.

Enclosure manufacturing

- The switchboard shall be factory manufactured by OEM or manufactured by authorized Franchisee of OEM based on design given by OEM.
- The switchboard shall be complete design verified assemble as per IEC 61439-1&2.
- The enclosure protection shall not be less than IP-52 unless other specified in BOQ.
- The switchboard shall be modular, extendable cubicle, fully compartmentalized and floor mounting.
- The form of separation shall be Form-4, a modular individual mounting arrangement shall be used and the internal separation shall be carried out using GI sheets with 275GSM.
- The switchboard frame (Uprights) shall be pre-punched and bent with minimum 1.5mm thickness and fitted with a multipurpose hinge, used to assemble the door and to couple the structures, both laterally and rear.
- Base/top steel sheet painted (epoxypolyester RAL 7035 orange peel), with inlet/outlet for cables. They are supplied pre-mounted by means of a three-way joint, which is able to provide considerable structural rigidity.
- The switchboard construction should be with universal width which can be used for both Incoming vertical as well as outgoing feeder vertical.
- Zinc coating will be provided on the sheets which will prevent rust formation during storage and handling for processing, in addition to giving corrosion protection to the finished product.
- The GI sheet used in the enclosure shall be 275gsm.
- The sheet steel used for the enclosure manufacturing will pass through the pretreatment process for surface treatment.
- The outer doors and cover shall be Poly urethane gasket to prevent from ingress of duct.
- The glass should be of Tempered glass to avoid sharp edges in case of damage.
- External and internal painting with electrostatic application of thermosetting powder enamel with epoxy polyester binders. Grey orange peel RAL 7035 colour, total thickness of min 80 micron.
- The painting should pass the resistance test to saline fog (min 193 hours)
- The switchboard shall have integral base frame.
- The doors and covers shall be made of CRCA sheet steel of thickness as per OEM standard

Switchboard Configuration

- The switchboard shall be configured with Moulded case circuit breaker, MPCB, MCB, Contactors and other equipment's as per BOQ.
- The MCCBs shall be arranged in multi-tier formation. The incoming Air Circuit breaker shall be arranged in single tier formation only but double tier formation can be arranged to facilitate operation and maintenance which is applicable to only outgoing ACBs only.
- The switchboards shall be adequate size with a provision of spare space to accommodate possible future additional switchgear.
- Special care has to be taken to ensure effective earthing of the frame and doors if the switchboard.
- All panels and covers shall be properly fitted. The unused holes in the panel shall be closed with suitable grommet.
- The panel has to be provided with "Danger" label confirming to relevant standard.

Switchboard Compartmentalization

- The switchboard shall have separate totally enclosed compartment for main horizontal busbar, vertical busbars, ACBs, MCCBs and Cable chamber.
- The switchboard shall be with Form 4b construction.
- Insulated shutters shall be provided between drawout and fixed portion of the switchgear such that no live parts are accessible with equipment drawn out. Degree of protection within compartments shall be atleast IP 2X.
- Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker "ON" and "OFF" position.
- For incoming vertical separate and adequate compartments shall be provided for accommodation instruments, indicating lamps, control contactors and control MCB etc.
- Outgoing MCCBs "ON" and "OFF" operation can be performed only after opening the door.
- Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be located in front of switchgear only.
- A suitable wire way with cover shall be provided to take interconnecting control wiring between vertical section.
- In case of dead front access panel separate cable chamber and vertical chamber to be provided for easy maintenance.
- In case of rear access panel cable compartment can be provided in the rear only for outgoing vertical with sufficient space for easy termination. The incoming and outgoing cables can either entering from bottom or top depending on the site requirement.
- Proper cable support shall be provided in cable compartment to support and clamping the cable.

Switchboard Busbar

- Busbar shall be made of high conductivity Aluminium of ETP grade busbar and shall be of rectangular cross section.
- The busbar shall be suitable for full load current for phase busbar and half/full rated current for neutral busbar or as stipulated in BOQ.
- The busbar system shall be designed as per the pre-defined guidelines provided by the original manufacturer.
- The fault level rating of the busbar system shall be as per the drawings however the minimum short circuit withstand capacity shall be 50KA RMS for 1second.
- The busbar system shall be type tested by the manufacturer at reputed laboratory for short circuit withstand capacity. The neutral and earth busbars shall also be type tested for the short circuit withstand capacity.
- The busbar system shall be supported adequately at regular intervals as per OEM guidelines based on the type test results on a specially designed busbar supports. The supports shall be independently fixed to structure to strengthen the busbar arrangement. Wherever required additional intermediate supports shall be provided between the busbars.
- All vertical droppers shall also be adequately supported as per the manufacturer guidelines and the test results. The Vertical busbars shall be connected to the main busbars by suitable sized and graded bolt & nut and contact washers.
- The busbar shall be supported on Non-breakable, glass reinforced polyamide 6.6 insulated supports able to withstand operating temperature of 140°C.
- The busbar support should qualify glow wire test of 690°C.
- The supports shall comply UL 94 safety of Flammability Plastic Materials for Parts.
- The busbar support should withstand the impulse voltage of 12kV.
- The material and busbar support spacing should be same as per the type tested assembly.
- The minimum clearance to be maintained for enclosed indoor air insulated busbar shall be as per IEC guidelines.
- The dimensioning of the busbar system shall be as per the rated current of the mainswitching device, the short circuit current, the maximum rated permissible temperature at permanent operation and the ambient temperature around the busbars. The selection of busbars shall be supported by calculations and recommendations from the OEM.
- The neutral busbar shall run along with the phase busbars. Neutral busbar running at bottom or in the cable chamber/alley will not be accepted in case of Form-4 construction.
- Earth busbar shall be running throughout the panel fitted directly on to the structure for connection of the protective conductors to provide equipotential bonding of exposed conductive parts. Earth busbar shall be located at the bottom of the panel in case of bottom entry and top of the panel in case of Top entry.
- All non-current carrying metallic components shall be permanently connected to earth.
- Hardware used for busbar connections shall be zinc plated, yellow passivated / bichromated steel of 8.8 grade. Tightening of busbar bolts shall be done as per manufacturer recommendations and pre-defined guidelines using calibrated torque wrenches.
- Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirement. The material for auxiliary supply bus will be insulated electrolytic copper. Wires.
- With aluminium bus bars, only aluminium wire/solid bar connections shall be made for incoming/outgoing mountings on the switchboards.

- With copper bus bars, only copper wire/solid bar connections shall be made for incoming/outgoing mountings on the switchboards.
- The cross section of the neutral bus bar shall be the same as that of the phase bus bar for bus bars of capacities upto 200A; for higher capacities, the neutral bus bar must not be less than half the cross-section of that of the phase bus bar.
- Each bus bar shall be suitably insulated with PVC sleeves/tapes. The insulation of the rising mains shall be capable of withstanding the voltage of 660V of A.C
- Bus bar has to be as per TTA design of OEM .
- Bus bar support insulators shall be class *F insulators made of non- hygroscopic, non-combustible, track resistant and high strength FRJP/ SMC/DMC material, and shall be of suitable size and spacing to with stand the dynamic stresses due to short circuit currents. The spacing between two insulators should not exceed 250 mm.
- The minimum clearance to be maintained for enclosed indoor air insulated bus bars for medium voltage applications shall be as follows:
 - Between Min. Clearances
 - Phase to earth 26mm
 - Phase to phase 32mm
- For strip connection from bus bars to switchgear, the above clearances don't apply.
- Bus bar joints shall be thoroughly cleaned and suitable oxidizing grease shall be applied before making the joint.
- High tensile bolts, plain and spring washers shall be pro-vided to ensure good contact at the joints.
- The overlap of the bus bars at trie joints shall be not less than the area of the cross section of the bus bars.
- Bus bars and main connections shall be marked by color or letter as per table shown below.

Sr. No	Busbar and main connections	Colour	Letter/Symbol
i)	ThreePhase	Red, Yellow, Blue	RY.B.
	TwoPhase	Red, Blue	R.B.

Sr. No	Busbar and main connections	Colour	Letter/Symbol
	SinglePhase	Red	R
ii)	Neutralconnection	Black	N
iii)	Connectiontoearth	Green	E
iv)	Phase variable (such as connectionstoreversiblemotors)	Grey	Gy.

Instruments

- Instruments shall be digital flush mounting type. Digital Load Managers shall be provided for the parameters as indicated in the SLD and B.O.Q. Energy meters shall be suitable for 3 phase 4 wire unbalanced load. Energy meters shall be mounted flush and gaskets shall be used for making the door cut-out dust tight.
- All meters unless otherwise specified shall be with RS485 port and necessary software for parameter display at remote PC shall be provided by vendor along with the panels/meters.
- Electrical indicating / measuring instruments shall be of 96 x 96 mm Digital MFM unless otherwise specified. These shall be mounted semi-flush with only flanges projecting. All meters shall be 1 accuracy class unless otherwise specified.

Current Transformer

- Current transformers as specified in drawing shall be provided for each circuit conforming to relevant IS : 2705. CTs shall be epoxy resin cast with bar primary or ring type and shall be mounted on fixed portion of the switchgear cubicle. Facilities shall provided for short circuiting and earthing of CT secondary leads at the terminal blocks. Also test links, shall be provided in CT secondary leads to carry out current and phase angle measurement tests with CTs. in service.
- Class I accuracy for metering and Class 1 and 5P10 for protection with rated burden of 15/30 VA on secondary.
- Error limit to specific class of accuracy.
- Current transformers shall be designed to withstand the thermal and mechanical stresses resulting from fault currents equal to the maximum interrupting and momentary current ratings respectively of the circuit breakers.
- Insulation level of the CTs shall correspond to the voltage level of the switchgear. CTs shall have polarity marks indelibly marked on CT terminals and at the associated terminal blocks.
- The arrangement of mounting and supporting the CTs shall be such as to take care that tracking along insulator surface from busbars to CT supporting metal clamps, cleats and bolts resulting - over shall be avoided.

Meters and Indicators

- The meters and relays shall comply the following: -
- MISC type with Class – I accuracy.
- Ammeters, Voltmeters, with 96 x 96 mm size flush mounting type with selector switches and back up fuses
- Maximum Demand electronic meters with integration time of 30 minutes, wherever specified.
- Indicating lamps shall be LED type with control MCB. All indicating lamps shall be colour coded.

Relays

- Relays shall conform to IS: 3231 and shall be mounted semi flush with only flanges projecting on the front. All protective relays shall be in drawout cases with built - in test facilities. Necessary test plugs shall be the contractor. Test blocks and switches when supplied separately, shall be located immediately below each relay for testing. Auxiliary relays and timers shall be in non-drawout cases. All protective relays shall be provided with externally hand reset, positive action, and operation indicators.
- Wherever the relays external to ACBs are specified, they shall comply the following features:
 - Inverse time characteristic with minimum time over current having 50 – 200% setting.
 - Instantaneous earth fault having 20-80% setting.
 - Direct acting trip coil to suit 5A CT secondary and with time delay dash pot or TC fuses.
 - Shut trip coils to have necessary DC power source with associated charger.
 - Discrimination of operating characteristics for trips and delay elements with up and down streams switchgear.
 - Testing of relays by primary injection and secondary injection.
 - Enclosed in dust proof flush mounting drawout type cases.
 - Accessible for setting and resetting from the front.
 - Provided with positive acting hand-reset flag indicators visible from the front.
 - Access to setting devices shall be possible only after the front covers are removed. Access to resetting shall be external to the case.
- Auxiliary relays shall be rated to operate satisfactorily between 70% and 110% rated voltage.
- Each relay shall be provided with at least two separate voltages from contacts. Make and type of relays shall be as approved by the Engineer.

Control & Selector Switches

- Control and instrument switches shall be of the rotary type provided with plates engraved with switch operating positions and suitable for semi - flush mounting with only the switch front plate and operating handle projecting out. The contact assembly at the back of the switch shall be fixed and accessible from the back.
- Control switches shall have momentary contacts, spring return to center with pistol grip handles. Instrument and selector switches shall have stay put contacts with oval knurled handles. Three number of contacts, their rating and their operation in each switch shall be as per the requirement of the connected circuit and the control schematics. Controls supply 240 V, 1Ø A.C. for vacuum contactor and control circuit shall be tapped after main switch but before power fuses and P. T. shall be provided for each meter feeder with necessary protection.

Annunciators

- Annunciators when specified shall have audible alarm and visual display through translucent plastic window of 50mm x 65mm (minimum) size engraved with appropriate function in block letters on each windows. “Acknowledge” “Reset” and “Lamp Test” pushbuttons with alarm buzzer shall be provided common for the annunciation system in the relay compartment of switchgear.
- On receipt of an alarm impulse, audible alarm shall be sounded and lamps inside appropriate window shall start flickering. On pressing of “Acknowledge” button the audible alarm shall stop sounding and lamp shall glow steady. By pressing the “Reset” button, the trouble lamp shall not reset unless the alarm condition has disappeared. Annunciator shall provide sealed in lamp indication and audible alarm shall be ready to operate for any new alarm condition immediately after audible alarm is reset for a previous alarm condition.

Cable Termination

- For power cables, cable boxes with cable pot heads/sealing ends shall be provided in the switchgear in a separate compartment to suit the types, sizes of cables shown in cable schedule. Connecting leads of adequate size with terminal clamps/lugs, shall be supplied for connecting cable box terminals to switchgear power terminals.
- For control cable entry to each switchgear cubicle, separate removable type gland plate shall be provided with cable through to lead these cables upto the control terminals. Gland plate and control cable through shall be adequately sized for the number of control and instrument cables emanating from the cubicles.

Space Heater & Receptacle

- Each switchgear cubicle shall be provided with space heater rated for 230 V, single phase, A.C. Supply. The capacity and location of these space heater inside switchgear cubicles shall be such that temperature through out the cubicle section is maintained at least 5 deg. C above dew point by common thermostats to prevent any moisture condensation. MCB shall be provided inside each switchgear cubicle to control the power supply to the space heaters.

- Each switchgear cubicle shall be provided with one, 3pin receptacle - plug with on-off switch rated for 5 Amps, 240V, 1 phase A.C. supply along with 10W lamp

Internal Wiring

- Switchgear shall be supplied completely wired internally to equipment and terminals and ready for external cable connection at the terminal blocks. All wiring for controls and instruments shall be carried with 1100/660 volts grade PVC insulated copper conductor wires of minimum size 2.5 Sq.mm. Wire terminations shall be made with solder less, crimping type & copper lugs which firmly grip the conductor and insulation. Engraved core identification yellow colour plastic ferrules marked to correspond with switchgear wiring diagram shall be fitted at both end - terminations of all the cubicle internal wiring.
- Spare contacts of relays, control switches, auxiliary contacts of circuit breakers etc. Shall be wired to terminal blocks. At least 10% of the terminals shall be provided as spare for future use. Terminal blocks shall be 650 V grade, rated for minimum 15 Amps and complete with insulating barriers, terminal stud, washers, nuts and lock nuts and identification marks. Each terminal shall be suitable to receive 6.0 sq.mm. conductor.
- Control and space heater supplies will be provided at one point in switchgear cubicle for each line up to switchgear. In each cubicle and running the entire length of line up of switchgear, control wiring through shall be provided to carry the interconnecting wires between cubicles and the common control and space heater buses. Also inter-cubicle wiring for interlocks and controls shall be carried out through this wiring through. These wires shall be suitable terminated and tagged between transport sections.
- Potential free contacts shall be provided for each breaker for ON / OFF Trip signal for IBMS system as standard.

Earthing

All vertical panels shall be connected to a copper /GI earth bus bar running throughout the length of the switchboard. The minimum earth bus size shall be 50x6 mm. All doors and movable parts shall be earth educing flexible copper connections to the fixed frame of the switchboard. Provision shall be made to connect the earthing busbar to the platform earthing grid at two ends. All non-current carrying metallic parts of the mounted equipment shall be earthed. The washer used for earthing connection shall be specific type to ensure & good earthing connection.

Name Plate

Suitable engraved white on black name plates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

Painting

All metal surfaces shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Pre-treatment shall be done using 9-11 tank process. The content of the tank shall be regularly checked for concentration and ph value records of this shall be subject to inspection. After pretreatment sheet shall undergo Powder coating to achieve Uniform thickness of 70-120 microns.

Interlocks

It shall not be possible to push "in " a drawn out circuit breaker in closed condition or withdraw a circuit breaker in closed condition.

It shall be possible to operate a circuit breaker only in the defined "Full in" or "Service" and "Test" position inside the panel. It shall not be possible to operate the breaker in intermediate positions while inserting or withdrawing circuit breaker.

Tests

Inspection and shop testing for all panels as per IS Standard shall be offered to consultant/owner's representatives. The tests to be done shall include: Physical checking, Megger/insulation resistance, (1000V Megger), H.V. test Functional tests including control and interlock functions, Automatic operation simulation etc. Any such tests required by local authorities, Electricity Boards and for complying statutory requirements.

MCCB

- MCCBs shall be of micro processor based with RS 485 port or thermal magnetic as per SLD
- All MCCB's shall be universal mounting line load interchangeable and with door interlock & handle. All MCCB's on Distribution Panels shall be provided with variable setting.
- Door handles will be provided with pad locking arrangement.
- All MCCB's on Main panel shall be provided with shunt release and 2No. + 2NC Auxiliary contact block. All MCCB's shall be provided with suitable spreader links on both sided for bus bar and cable connections.
- All MCCB's shall have clear ON, OFF & TRIP positions.

- MCCB's should comply with IS 13947 part -2, IEC (6094) and IEC 60947-3 & IEC 60947 part – 2.
- The MCCB shall be suitable for universal mounting i.e. the load/line shall be interchangeable with shrouded incoming contacts.
- The MCCB shall be suitable for minimum operating voltage of 415V.
- The thermal setting shall be adjustable from 64 % to 100% of its normal current.
- The magnetic setting shall be adjustable from 3.5 to 10 In (normal current).
- Trip reset should be available Manual / Automatic.
- Isolator switches for electronic circuits to open the MCCB automatically.
- The MCCB's must house transparent label holder to ensure circuit identification.
- The MCCB's must have fully insulated safety shutters.
- Overload Zone adjustable from 0.4 to 1 in with line (For 630 amp & above MCCB)
- Short circuit Zone adjustable from 1.5 to 10 In with time.
- MCCBs encapsulated poles double roto active mechanism to lower the thermal dynamic stresses in the installation.

DATA SHEET (MCCB)

	MLTP Incomer & Breaker in Synchronising Panel.	MLTP Outgoing Feeder	Other Panel Incomer	Other Panel Outgoing Feeder
Release Type	Microprocessor Based	Based / Thermal Magnetic Based (as per SLD)	Microprocessor Based	Microprocessor Based / Thermal Magnetic Based (as per SLD)
Breaking Capacity	Ics=100% of Icu,	Ics=100% of Icu,	Microprocessor Based (315A to 800A)	TMD
Nos. of Pole	4 Pole (100 % neutral)	4 Pole (100 % neutral) / 3 Pole (With Neutral CT) as specified SLD	4 Pole (100 % neutral)	4 Pole (100 % neutral) / 3 Pole (With Neutral CT) as specified SLD
Note: Neutral CT should be provided in case of Ground Protection				
Protection	LSIG	LSIG / TMD as specified SLD	LSIG	LSIG / TMD as specified SLD
Communication Module over Modbus TCP/IP.	RS-485/Modbus TCP/IP Port to monitor	RS-485/Modbus TCP/IP Port to monitor	RS-485/Modbus TCP/IP Port to monitor	RS-485/Modbus TCP/IP Port to monitor (IF REQUIRED)
	1. Cause of Tripping	1. Cause of Tripping-	1. Cause of Tripping	1. Cause of Tripping
	2. Mech. Cycle	2. Mech. Cycle-	2. Mech. Cycle	2. Mech. Cycle
	3. Electrical Cycle	3. Electrical Cycle-	3. Electrical Cycle	3. Electrical Cycle
	4. Contact Wear (%)	4. Contact Wear (%)-	4. Contact Wear (%)	4. Contact Wear (%)
	5. Trip History	5. Trip History-	5. Trip History	5. Trip History
Other	PFC for ON/OFF/TRIP	PFC for ON/OFF/TRIP as specified SLD	PFC for ON/OFF/TRIP as specified SLD	PFC for ON/OFF/TRIP as specified SLD
Mounting	Universal	Universal	Universal	Universal
Circuit Breakers shall confirm to Electrical Standards	IEC60947-I & II, IS 13947	IEC60947-I & II, IS 13947	IEC60947-I & II, IS 13947	IEC60947-I & II, IS 13947
Rated Operational Voltage: Ue	433V, +10%	433V, +10%	433V, +10%	433V, +10%
Current Rating(In) of Circuit Breaker shall be declared at	500C	500C	500C	500C

Utilisation Category	Class A	Class A	Class A	Class A
Suitable for Isolation	Yes	Yes	Yes	Yes
Operating Principle	Current Limiting	Current Limiting	Current Limiting	Current Limiting
Method of Installation	Fixed	Fixed	Fixed	Fixed
No. of Poles	As mentioned in SLD	As mentioned in SLD	As mentioned in SLD	As mentioned in SLD
Rated Insulation Voltage: Ui at 50 Hz	690V	690V	690V	690V
Rated Impulse withstand Voltage at Main Circuits	8kV	8kV	8kV	8kV
Rated Impulse withstand Voltage at Aux. Circuits	4kV	4kV	4kV	4kV
Short Circuit Making Capacity-Max. Prospective Peak Current	Shall be equal to (Icu X 2.1)	Shall be equal to (Icu X 2.1)	Shall be equal to (Icu X 2.1)	Shall be equal to (Icu X 2.1)
Mechanical Features:				
Three Distinct Positions ON/OFF/TRIP on MCCB	Yes	Yes	Yes	Yes
Flexibility of Connecting load either on TOP or BOTTOM	Yes	Yes	Yes	Yes
Possibility of Interchanging the protection release of MCCB on site	Yes	Yes	Yes	Yes
Extended Rotary Handle with Padlocking Facility	Yes	Yes	Yes	Yes
Door Interlock	Yes	Yes	Yes	Yes
Release Functions				
True RMS Sensing	Required	Required	Required	Required
Overload (L) Protection With Setting	Adjustable	Adjustable	Adjustable	Adjustable
Instantaneous Protection (I)	Adjustable	Adjustable	Adjustable	Adjustable
Integral Test facility for testing healthiness of Release	Required	Required	Required	Required
LED Indication to show % Loading of the release	Required	Required	Required	Required
Thermal Memory	Required	Required	Required	Required
Interlock	As specified in SLD	As specified in SLD	As specified in SLD	As specified in SLD
a) Bowden Wire	-	-	-	-
b) Castel lock provision	Yes	Yes	Yes	Yes
Under Voltage Coil with Continuous Rating and front Accessible	Yes	-	Yes	-
Shunt trip Coil with Continuous Rating and front Accessible	Yes	Yes	Yes	No

Miniature Circuit Breakers (MCB)

- MCB's shall be of current limiting type, ISI marked confirms to IS 8828 – 1996.
- The power loss per pole shall be low and shall be in accordance with IS 8828 – 1996.
- All cable entries shall be either from bottom or top.
- MCB's shall be of C - curve characteristic & shall have quick make & break non-welding self wiping silver alloy contacts for 10 kA short circuit both on the manual & automatic operation & Should have indication on front face
- All the active, live parts of MCB's should be out of human reach, ensuring safety & confirms to IP: 55 degree of protection.
- The MCB's must house transparent label holder to ensure circuit identification.
- The MCB's must have fully insulated safety shutters.
- The MCB's shall have lockable switching lever.
- The Minimum electrical endurance shall be 20,000 operations.
- The housing of the MCB shall be mounted self-extinguishing DMC (Dough Moulding Compound).
- The short circuit Current shall be brought to zero within 4 to 5 milliseconds from the time they are established.
- All MCB's shall have a minimum short circuit Capacity of 10kA RMS.
- Single Pole / Single pole with Neutral / Double Pole / Triple pole / Four pole: MCB, ISI marked as per IS 8828 : 1996 (IEC 60898) with hammer trip and watch mechanism 15 arc plates, 10 KA capacity with nominal rating of 240/415V.

Distribution Board suitable for MCB's (MCBDB)

- Horizontal / Vertical type DB's
- MCBDB suitable for 230 V / 415 V, horizontal/vertical, with door of specified ways (poles), shall be phase segregated type having residual current protection in each phase, surface / flush mounting to house incoming and outgoing MCB's, and erected on iron frame.
- DB's shall be prewired and shall be fabricated as per IS: 8623.
- Suitable for flush mounting & surface mounting, with 100 A copper bus bar (or as specified) (For Horizontal type DB), neutral bar, earth bar & cable ties for cable management.
- In case of Vertical DB the bus bar shall be of 250 A rating (or as specified)
- DB's shall be of IP – 43 degree of protection with double door arrangement.
- All the MCB distribution boards shall be fabricated out of 18 SWG thick sheet steel duly rust inhibited through a process of degreasing, pickling, phosphating & powder coating to an approved colour over primer & shall be of the totally enclosed dust proof type suitable for wall mounting.
- All components shall be mounted on DIN rails & covered totally with a sheet steel cover rendering it finger-safe. Access to the internal connections shall be only through removing the cover sheet.
- All DB's shall be internally prewired using copper insulated high temperature PVC wires.
- Bus bars & neutral bar shall be fully insulated with standard colour code.
- Bus bar withstanding capacity shall be 10kA.
- DB's must have facility of reversing door without modification, pan assembly for ease of installation & convertible locking.

Residual Current Circuit Breaker (RCCB)

- RCCBs shall be ISI marked as per IS 12640 (part 1) – 2000 and Confirming to IEC 61008-1.
- It shall work on residual current energy, having 30 milliamp sensitivity (or as specified) and shall protect against earth leakage. Tripping time shall be maximum 30 millisecond (or as specified).
- Breaking capacity shall be 20 kA with hammer trip and watch mechanism 15 arc plates.
- RCCB shall operate for rated leakage at nominal Ten volts AC, and also in both, Neutral Open & Snapping condition.
- RCCBs shall have trip free mechanism with quick make & break non-welding self wiping silver alloy contacts for 20 KA short circuit current both on the manual & automatic operation. Test knob facility shall be provided.
- All the active, live parts of RCCBs should be out of human reach, ensuring safety & confirms to IP20 degree of protection.
- The RCCBs must house transparent label holder to ensure circuit identification.
- The RCCBs must have fully insulated safety shutters.
- The Minimum electrical endurance shall be 20,000 operations.

Residual Current Circuit Breaker with over voltage cut Off (RCBO)

- RCBO's with integral combination of RCCB+MCB, shall be ISI marked as per IS 12640 (part 1) – 2000 and Confirming to IEC 61008-1. It shall work on residual current energy, having 30 milliamp sensitivity (or as specified) with protection against earth leakage and over voltage upto 290 Volts.
- Tripping time shall be maximum 30 milliseconds (or as specified).
- Breaking capacity shall be 20 kA with hammer trip and watch mechanism 15 arc plates.

- RCCB shall operate for rated leakage at nominal Ten volts AC, and also in both, Neutral Open & Snapping condition.
- RCBO's shall have trip free mechanism with quick make & break non-welding self wiping silver alloy contacts for 10 kA short circuit both on the manual & automatic operation. Test knob facility shall be provided.
- All the active, live parts of RCBO's should be out of human reach, ensuring safety & confirms to IP20 degree of protection.
- The RCBO's must have transparent label holder to ensure circuit identification.
- The RCBO's must have fully insulated safety shutters.
- The Minimum electrical endurance shall be 20,000 operations.

Surge Protection Devices

- Surge Protection Devices shall compliance according to IEC 61643-11:2012 and EN 61 643-11:2012 electrical installations must be protected against direct lightning and surge impulses with din rail Class I+II/Type 1+2 (10/350 μ s) surge arresters.
- SPDs use MOV technology to allow for high lightning discharge currents, pluggable types avoid ejection of the cartridge during the discharge of the current and non-blow out technology avoids fire risks.
- The SPD must provide either common protection in TNC network or common and differential mode protection in TT and TNS networks according to IEC 61643-11:2012 recommendations.
- Supply, install and connect Surge Protective Devices with the following technical characteristics:
 - Technology : Metal oxide varistors
 - Impulse current wave form 10/350 μ s : $I_{imp} = 25$ kA
 - Maximal discharge current wave form 8/20 μ s : $I_{max} = 60$ kA
 - Nominal discharge current wave form 8/20 μ s : $I_n = 25$ kA
 - Voltage protection level : $U_p \leq 1.5$ kV
 - Nominal voltage : $U_N = 230$ V
 - Maximum continuous operating voltage : $U_c = 255$ V
 - Short circuit withstand = 50 kA
 - Integrated thermal disconnecter
 - Pluggable cartridge for an easy and quick intervention
 - Visual state indicator
 - Safety system
 - Auxiliary contact
 - No electrical consumption on visual state indicator
 - Back up protection with Fuse or Circuit breaker : ≤ 125 A ;
 - Certified standard IEC 61643-11 and EN 61643-11.

Testing & Inspection

- During fabrication, switchgear may be subject to inspection. Manufacturer shall furnish all necessary information.
- All routine verification and acceptance tests shall be carried out as per IEC 61921, IS 16636:2017, IEC 61439 at manufacturer's work under his care and expense.
- If specifically agreed heat run test may be performed at manufacturer's works. Heatrun test shall be performed at least on one incomer and two outgoing vertical panels of the ordered switchboard., shall include the following sections of the bus duct as a minimum:
- Acceptance tests shall be as a general visual check shall be carried out. This shall cover measurement of overall dimension, location, number and type of devices, terminal boxes, location and connection of terminals etc.,
- Manual and electrical operation of Circuit Breakers. / relays shall be checked under the worst conditions of auxiliary supply voltage.
- Dry insulation test with power frequency voltage shall be conducted for the main and auxiliary circuits Insulation resistance of the main and auxiliary circuits and bus duct shall be checked before and after High voltage withstand test.
- Operation check shall be carried out on selected typical feeder/s for control function /interlock as per the schematic diagrams by manually simulating fault conditions and operation of control switches/relays etc.
- Relays shall be tested with secondary injection test equipment. Breaker trip unit shall be tested using specific breaker test kit.
- For equipment bought from other sub-suppliers, certified test reports of tests carried out at the manufacturers works shall be submitted. Normally all routine tests as specified in the relevant standards shall be conducted by the sub-supplier at his works.

Certification

- All offered equipments shall be of same design as per the type test report and shall have same constructional features and materials as per the type test reports as per IEC 61921, IS 16636:2017.

- Shall have been type tested and witnessed by an authority of international repute, approved by the purchaser. Type test reports shall submitte during technical bid evaluation or during inspection at FAT.
- Shall have been in continuous satisfactory service for similar application.

Manufacturing Facilities

- To ensure timely delivery and adherence to project schedule supplier must have following
- Adequate assembly area to assemble 500 switchboard cubicle in one month.
- CNC press and bending machines in the same facility.
- Paint shop along withpermanent 9 – 11 tank pretreatment Plant.
- Adequate Loading & Unloading area.
- Suppliers have routine test equipment
- Inhouse temperature rise test facilities.
- Quality control documentation and system and processes shall be available for inspection for all the previous and running work orders.

Specific requirements

Vendor is required to make his proposal based on these documents. If there is any deviation or any alternatives must be specifically mentioned in the proposal.

TECHNICAL DATA SHEET

SR No	Parameter	Specification	To be Filled By Contractor
1	Type of Panel	Compartmentalized	
2	Type of Mounting	Free standing Floor Mounted	
3			
4	Fault kA	36kA–1sec	
5	Thickness of CRCA sheets	Structural members - 3mm Covers and doors - 2mm Base channel - ISMC75 Glandplate - 3mm	
6	Painting / Process	Epoxypaint / As per 9 tank process	
7	Paint shade	interior & Exterior: RAL 7032	
8	Details of busbar	Electrolytic grade Aluminium of specified rating	
9	Cable Entry	Bottom / Top as specified inr espective drawings	
10	Enclosure Protection / Ventilation	IP –65 with louvers for Ventilation	
11	ControlWiring/ PowerWiring	Insulated 660 Volts Cu wire. Voltage Circuit : 1.5sqmm Current Circuit :2.5sqmm	
12	Cable Lugs / Cable glands	Asr equired	
13	Operating Height	1800mm max	
14	Mounting height of Relays / Meters ControlSwitches	Range 350mm to 1900mm	
15	TypeofC.T.	Cast resin	
16	Reference Ambient Temperature	40 Deg.C	
17			
18	Makes of the components to be used	As per approved makelist	
19	Components to be used	As per SLD & specifications	

MAKE OF MATERIAL

SR.NO.	ITEM	STANDARD MAKE
1	LT PANEL BOARDS	APJ ELECTRICAL / ABAK ENGG / ZENITH ENGG.
2	DISTRIBUTION BOARDS	LEGRAND / SCHNEIDER / L&T / ABB
3	MEDIUM VOLTAGE CABLE	RRCABLE / FINOLEX / POLYCAB
4	CABLE TRAY	INDIANA/OBO BETTERMAN/LEGRAND/PROFAB
5	LT SWITCHGEAR (ALL RANGE)	L&T / ABB / SCHNEIDER ELECTRIC / SEIMENS
6	LT MCCB	L&T / ABB / SCHNEIDER ELECTRIC / SEIMENS
7	LT MCB, ELCB	LEGRAND / ABB / L&T / SCHNEIDER ELECTRIC / SEIMENS
8	LT SFU	L&T/ ABB / SCHNEIDER ELECTRIC / SEIMENS
9	LT CONTACTORS	L&T/ ABB / SCHNEIDER ELECTRIC / SEIMENS
10	CHANGE OVER SWITCH	SOCOMEK / HPL / ASCO / ABB / HAGER
11	METERS (DIGITAL)	AE / ENERCON / SCHNEIDER / MECO / NIPPEN
12	LOAD MANAGER	ENERCON / NIPPEN/ L & T
13	RELAYS	SIEMENS / SCHNEIDER ELECTRIC / GE / L & T
14	INDICATING LAMPS	SIEMENS / SCHNEIDER ELECTRIC / L & T / ABB
15	ELECTRIC TIMER	SIEMENS / L&T/ ABB
16	SELECTOR SWITCH	KEYCEE / SALZER / AE
17	LUGS	DOWELLS / JAINSON / COMET
18	TERMIAL BLOCKS	ELMEX/WAGO/CONNECTWELL
19	CABLE GLAND	DOWELLS / JAINSON / COMET
20	PVC CONDUITS AND ACCESSORIES	ASTRAL / PRECISION / DIAMOND / AKG
21	M.S. CONDUIT AND ACCESSORIES	AKG / BEC / STEELCRAFT
22	MODULAR SWITCHES, SOCKETS & OTHER ACCESSORIES	MK-HONEYWELL / LEGRAND / SCHNEIDER
23	METAL CLAD SOCKET WITH MCB	MDS / SIEMENS / LEGRAND
24	PVC JUNCTION BOX	SINTEX / CLIPSAL / SPELSBERG
25	WIRES FOR INTERNAL WIRING	POLYCAB / FINOLEX / RRCABLE
26	FLEXIBLE WIRE	POLYCAB / FINOLEX / RRCABLE

MAKE OF MATERIAL

SR.NO.	ITEM	STANDARD MAKE
27	LIGHT FIXTURES	HAVELLS / WIPRO / CROMPTON
28	Weatherproof MCB PLUG AND SOCKET COMBINED	Neptune India / Crompton Greaves/L & T/ Bajaj