



**GMDC**  
Gujarat Mineral  
Development  
Corporation Ltd.  
(A Government of Gujarat Enterprise)



Tender Notice no.: **GMDC/GVT/CSR/05/2026**

## **TENDER DOCUMENT**

FOR

**Construction of Visamo at Maa Bayani Temple, Patrapada Odisha**

Through online e-tendering process only

**GMDC – Gramya Vikas Trust**

**GMDC Annexe Office**  
**08, Mill Officer's Colony, Nr. Nanhalal Chambers, Ashram Road,**  
**Navrangpura, Ahmedabad-380009**  
E-mail: [ceogvt@gmdcltd.co.in](mailto:ceogvt@gmdcltd.co.in)  
Website: [www.gmdcltd.com/csr/](http://www.gmdcltd.com/csr/)

## **TECHNICAL SPECIFICATION OF NON-SOR ITEMS**

**Prospective bidders may please download the Tender Document of e-Tender:**

**GMDC/GVT/CSR/05/2026**

**from website <https://gmdctender.nprocure.com> & [https://gmdcltd.com](http://gmdcltd.com)**

## TECHNICAL SPECIFICATION OF NON-SOR ITEMS

**Item No: 31: Granite platform for Kitchen: up to 600mm width : Providing & fixing two layers of platform , first layer using 25mm thick Kota stone of approved shade and second layer using approved shade and sample of Mirror finish Granite, joined together with 1:4 Cement mortar bedding / approved tile adhesive , to true plane & level or to slopes, or close jointed with cement slurry with pigment of matching shade and colour and finishing with the same, including dedo 6", cutting kota & tile as per required shape & size to fit Wash basin/sink & 4" facia with moulding, nosing, chamfered front edges, fixing, disposal of debris etc. work completed including mock up sample, all materials, loading, unloading, transportation, placing at all floors and for all leads, at all floors, all levels, all heights and all shapes, all accessories, Scaffolding, protection sheet etc. work complete as per the detailed drawing, approved sample and instruction of Architect/EIC. Sample mock shall be approved from Architect/EIC. Basic rate of granite is 150/ Sq.ft**

### 1. Materials:

- Granite stone shall be used as per approved sample by client & Architect.
- Tile adhesive and Pigments shall be used of as per approved by EIC/Architect.
- All type of material shall be used for Drinking counter work as per approved make list and confirming to relevant IS codes and approved by EIC/Architect.

### 2. Workmanship:

- Two layers of pantry platform, first layer using 25mm thick Kota stone of approved shade and second layer using approved shade and sample of Mirror finish Granite,
- joined together with 1:4 Cement mortar bedding / approved tile adhesive , to true plane & level or to slopes, or close jointed with cement slurry with pigment of matching shade and colour and finishing with the same,
- Including dedo 1'6", and 3" to 9" facia with moulding, nosing, chamfered front edges, fixing, disposal of debris etc.
- Work complete including all type of joining material, tools, tackles, with finishing, proper even surface etc as per specification and suggestion.
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of EIC/Architect.

### 3. Measurements:

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, finishing, labour, etc. to complete the whole work satisfactorily as per instruction of EIC/Architect.
- No extra payment will be given for any of the reasons.
- The rate shall be for a unit of one Running meter.

**Item No : 32 : Granite Stone Basin Counter for Toilet: up to 600mm width : Providing & fixing two layers of platform , first layer using 25mm thick Kotastone of approved shade and second layer using approved shade and sample of Mirror finish Granite, joined together with 1:4 Cement mortar bedding / approved tile adhesive , to true plane & level or to slopes, or close jointed with cement slurry with pigment of matching shade and colour and finishing with the same, including dedo 6", cutting kotah & tile as per required shape & size to fit Wash basin/sink & 4" facia with moulding, nosing, chamfered front edges, fixing, disposal of debris etc. work completed including mock up sample, all materials, loading, unloading, transportation, placing at all floors and for all leads, at all floors, all levels, all heights and all shapes, all accessorie, Scaffolding, protectiion sheet etc. work complete as per the detailed drawing, approved sample and instruction of Architect/EIC. Sample mock shall be approved from Architect/EIC. Basic rate of granite is 150/ Sq.ft.**

### **1. Materials:**

- 18 mm thick Granite stone shall be used as per approved sample by client & Architect.
- Tile adhesive and Pigments shall be used of as per approved by EIC/Architect.
- All type of material shall be used for counter work as per approved make list and confirming to relevant IS codes and approved by EIC/Architect.

### **2. Workmanship:**

- Two layers of pantry platform, first layer using 25mm thick Kota stone of approved shade and second layer using approved shade and sample of Artificial stone,
- joined together with 1:4 Cement mortar bedding / approved tile adhesive , to true plane & level or to slopes, or close jointed with cement slurry with pigment of matching shade and colour and finishing with the same,
- Including dedo1'6", and 3" to 9" facia with moulding, nosing, chamfered front edges, fixing, disposal of debris etc.
- Work complete including all type of joining material, tools, tackles, with finishing, proper even surface etc as per specification and suggestion.
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of EIC/Architect.

### **3. Measurements:**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, finishing, labour, etc. to complete the whole work satisfactorily as per instruction of EIC/Architect.
- No extra payment will be given for any of the reasons.
- The rate shall be for a unit of one Running meter.

**Item No: 33: Single Leaf Flush Door finish with laminate : Providing and fixing in position 40 mm thick BWP grade single leaf flush doors of approved make and finished with both side 1 mm thick laminate as approved sample. Including Hardware system of SS 304 Grade like Hinges, Mortise lock with knob, door closer, door stopper etc. as per approved make & Sample. Work complete including all type of hardware, fittings, fixtures as per instruction of Client/ Architect etc. complete as per detailed drawings and specifications. work complete Including cost of all labour, materials, safety measures, bending,**

**loading, unloading, transportation, cleaning, protection sheet, at all floor, all level, all depth, all Height, all lead and lift etc. work complete as per the detailed drawing, approved sample and instruction of Architect/EIC. Sample mock shall be approved from Architect/EIC. Equivalent to VNR Series Laminate. (Note: Door opening area shall be measured for payment. No extra payment shall be paid) Basic rate of VNR Laminate is 45 Sq.ft**

**1. Materials:**

- 40 mm thick BWP flush door shall be used as per sample approved by Architect/Client.
- 1 mm thick laminate shall be used for finish of door as per approved make list and confirming to relevant IS codes and approved by Architect/Client.
- Hardware shall used of as per approved by Architect/Client.
- All type of material shall be used for Door as per approved make list and confirming to relevant IS codes and approved by Architect/Client.

**2. Workmanship:**

- Fixing of 40 mm thick BWP grade flush doors as per approved sample.
- Fixing of frame shall be used as per approved sample by Architect/Client
- Fixing of both side 1 mm thick laminate as per approved sample by Architect/Client.
- Fixing of Hardware system of as per approved hardware as per selection of Architect/Client.
- All doors should be properly leveled without any sagging and with smooth opening and closing. There should be no variation or deviation of any kinds.
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of Architect/Client.

**3. Measurements:**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, finishing, labour, etc. to complete the whole work satisfactorily as per instruction of Architect/Client.
- No extra payment will be given for any of the reasons.
- Rate to be inclusive of all material, wastage, necessary tools tackles etc for fixing at all heights and for all floors. Clear opening area shall be measured & paid in Square meter.

**Item No: 34: Kitchen sink: Providing and fixing Kitchen sink as per approved make including all fitting material including Fixing of with necessary plumbing work as per detail drawing and plumbing work .Material approved by architect/EIC. Model Equivalent to NIRALI GRACE JUMBO 685X535X254**

**1. Material:**

- Kitchen sink shall be used as per approved sample by Architect/Client.
- All type of material shall be used as per approved make list and confirming to relevant IS codes and approved by Architect/Client.

**2. Workmanship:**

- Work complete as per above specification.
- Work complete including all types of tools, tackles, labour etc complete at any level and height.

- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of Architect/Client.

**3. Measurements:**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, labour, scaffolding etc. to complete the whole work satisfactorily as per instruction of Architect/Client.
- No extra payment will be given for any of the reasons.
- Rate to be inclusive of all material, wastage, necessary tools tackles etc for fixing at all heights and for all floors.
- The work done shall be measured in Number for area of work done. The rate shall be for a unit of one Number.

**Item No: 35: Sink Cock: Providing and fixing 15mm dia. Sink Cock of as per approved make of selection.**

**Model equivalent to: Jaquar FLR-CHR-5347N**

**1. Material:**

- Sink cock shall be used as per approved sample by Architect/Client.
- All type of material shall be used as per approved make list and confirming to relevant IS codes and approved by Architect/Client.

**2. Workmanship:**

- Work complete as per above specification.
- Work complete including all types of tools, tackles, labour etc complete at any level and height.
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of Architect/Client.

**3. Measurements:**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, labour, scaffolding etc. to complete the whole work satisfactorily as per instruction of Architect/Client.
- No extra payment will be given for any of the reasons.
- Rate to be inclusive of all material, wastage, necessary tools tackles etc for fixing at all heights and for all floors.
- The work done shall be measured in Number for area of work done. The rate shall be for a unit of one Number.

**Item No: 36: Bib Tap : Providing and fixing 15mm dia Bib Tap of as per approved make list. Work complete including all type of finishing. Model Equivalent to Jaquar: Opal Prime OPP-CHR-15037PM.**

**1. Material:**

- Bib tap shall be used as per approved sample by Architect/Client.
- All type of material shall be used as per approved make list and confirming to relevant IS codes and approved by Architect/Client.

**2. Workmanship:**

- Work complete as per above specification.

- Work complete including all types of tools, tackles, labour etc complete at any level and height.
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of Architect/Client.

**3. Measurements:**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, labour, scaffolding etc. to complete the whole work satisfactorily as per instruction of Architect/Client.
- No extra payment will be given for any of the reasons.
- Rate to be inclusive of all material, wastage, necessary tools tackles etc for fixing at all heights and for all floors.
- The work done shall be measured in Number for area of work done. The rate shall be for a unit of one Number.

**Item No: 40 : Supply and Fixing of moisture and fire resistant 16 mm thick Anti Aqua Fiber Cement sheet board as per approved make & Sample. Fixing on over fabrication work with necessary nails, screws, joinery fill with silicone sealant, adhesive, accessories, fittings, fixtures, scaffolding, any level ,any height etc complete as per drawing and instruction of Architect /EIC.**

And

**Item No: 41 : Supply and Fixing of moisture and fire resistant 8 mm thick Anti Aqua Fiber Cement sheet board as per approved make & Sample . Fixing on over fabrication work with necessary nails , screws, joinery fill with silicone sealant, adhesive , accessories , fittings , fixtures ,scaffolding , any level ,any height etc complete as per drawing and instruction of Architect /EIC.**

**1. Material:**

- Anti aqua fiber cement sheet board shall be used as per approved make and sample by EIC/Architect.
- All type of material shall be used as per approved make list and confirming to relevant IS codes and approved by EIC/Architect.

**2. Workmanship:**

- Work complete as per manufacturer's specification.
- Work complete including all type of tools, tackles, scaffolding etc complete at any level and height
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of EIC/Architect.
- All the Cubical should be fitted to ensure accurate positioning & level of the ceiling, flooring, wall system as per the site/EIC requirements.

**3. Measurements:**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, labour, scaffolding etc. to complete the whole work satisfactorily as per instruction of EIC/Architect.
- No extra payment will be given for any of the reasons.
- Rate to be inclusive of all material, wastage, necessary tools tackles etc for fixing at all heights and for all floors.

- The work done shall be measured in Square Meter for area of work done. The rate shall be for a unit of one Square Meter.

**Item No: 42 : Roofing Shingles:** Providing and fixing of 3.1 mm thick Premium Series SBS ( Styrene Butadiene Styrene) make Laminated Roofing Shingles with SBS ( Styrene Butadiene Styrene) make fiber glass non-woven polypropylene roof underlayment( Waterproofing membrane) as per approved make and sample by Architect. Fixed on existing fiber cement board /slab with necessary accessories required like silicone , ridges , starter strip, nails or screw, adhesive , installation , fittings , fixtures ,scaffolding , at any level any height etc., complete as per drawing and instruction of Architect /EIC. EN 544- 4E2 Asphalt shingles combined with Glass felt and surfaced with Mineral granules ENISO 11925-2 Class E Fire Resistance For 110 KMPH wind resistance UL (Under Writers Lab) certification for all the above. Material Test certificate and warranty shall be submitted by the contractor. Roofing surface area shall be measured for payment. No extra payment shall be paid for overlapping of shingles.

### **1. Material:**

- Roofing Shingles shall be used as per approved make and sample by EIC/Architect.
- All type of material shall be used as per approved make list and confirming to relevant IS codes and approved by EIC/Architect.

### **2. Workmanship:**

- Work complete as per manufacturer's specification.
- Work complete including all type of tools, tackles, scaffolding etc complete at any level and height
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of EIC/Architect.
- All the Cubical should be fitted to ensure accurate positioning & level of the ceiling, flooring, wall system as per the site/EIC requirements.

### **3. Measurements:**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, labour, scaffolding etc. to complete the whole work satisfactorily as per instruction of EIC/Architect.
- No extra payment will be given for any of the reasons.
- Rate to be inclusive of all material, wastage, necessary tools tackles etc for fixing at all heights and for all floors.
- The work done shall be measured in Square Meter for area of work done. The rate shall be for a unit of one Square Meter.

**Item No: 43: Roof Gutter:** Providing and fixing roof Gutters comprising from High Grade PVC (Polyvinyl chloride) with presence of Polyethylene and acrylic ingredient. they are horizontal, to channel the rain water from the roof to a desired location. water flow to be without leakage in gutter system. Colonial white in colour; Saint Gobain- Vinyl Gutter having a size as per detailed drawing . work complete including all type of fittings , accessories , Scaffolding , tools , tackles , with matching accessories like End caps, Drop Outlet, Gutter Joiner, downspot , Gutter hanger, Inside or / and Outside corner.

### **1. Material:**

- Roof Gutter shall be used as per approved make and sample by EIC/Architect.

- All type of material shall be used as per approved make list and confirming to relevant IS codes and approved by EIC/Architect.

## **2. Workmanship:**

- Work complete as per manufacturer's specification.
- Work complete including all type of tools, tackles, scaffolding etc complete at any level and height
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of EIC/Architect.
- All the Cubical should be fitted to ensure accurate positioning & level of the ceiling, flooring, wall system as per the site/EIC requirements.

## **3. Measurements:**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, labour, scaffolding etc. to complete the whole work satisfactorily as per instruction of EIC/Architect.
- No extra payment will be given for any of the reasons.
- Rate to be inclusive of all material, wastage, necessary tools tackles etc for fixing at all heights and for all floors.
- The work done shall be measured in Running Meter for area of work done. The rate shall be for a unit of one Running Meter.

**Item No: 44: Red mandana Sand stone flooring: Providing & laying average 30 mm thick ((in variation of +/- 5 mm) machined cut sandstone of approved quality, selected and sorted for uniform color & texture, in floor, otta, sill, skirting, tread, coping etc., of specified sizes as per drawing. Stone is to be laid over polymer modified mortar of saint gobain or as per approved make , average 20 mm thickness bedding, with joints, pointing and finishing and filling the grooves with polymer modified mortar/ epoxy grouting , including curing and cleaning with wire brush to remove excess cement on the sides of stone up to the satisfaction of the Architect & Engineer-in-charges etc. complete. Loose and laid sample shall be approved by Architect and EIC before execution. Contractor shall submit Shop drawing for approval of Architect/ EIC before execution. Equivalent to red mandana sandstone.**

### **1. Materials:**

- 30 mm thick Red Mandana Sand Stone shall be used as per approved sample by client & Architect.
- All type of material shall be used as per approved make list and confirming to relevant IS codes and approved by EIC/Architect.

### **2. Workmanship:**

- Work complete as per above specification.
- Work complete including all types of tools, tackles, labour etc complete at any level and height.
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of Architect/Client.

### **3. Measurement**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, finishing, labour, etc. to complete the whole work satisfactorily as per instruction of EIC/Architect.
- No extra payment will be given for any of the reasons.

- The rate shall be for a unit of one Square meter.

**Item No: 45: Baleswar Pink Sand stone on floor: Providing & laying average 30 mm thick (in variation of +/- 5 mm) machined cut sandstone of approved quality, selected and sorted for uniform color & texture, in floor, otta etc., of specified sizes as per drawing .S. Stone is to be laid over polymer modified mortar of saint gobain or as per approved make , average 20 mm thickness bedding , with joints, pointing and finishing and filling the grooves with polymer modified mortar/ epoxy grouting , including curing and cleaning with wire brush to remove excess cement on the sides of stone up to the satisfaction of the Architect & Engineer-in-charges etc. complete. Loose and laid sample shall be approved by Architect and EIC before execution. Contractor shall submit Shop drawing for approval of Architect/ EIC before execution. Equivalent to red Baleswar sandstone.**

**1. Materials:**

- 30 mm thick Baleswar Sand Stone shall be used as per approved sample by client & Architect.
- All type of material shall be used as per approved make list and confirming to relevant IS codes and approved by EIC/Architect.

**2. Workmanship:**

- Work complete as per above specification.
- Work complete including all types of tools, tackles, labour etc complete at any level and height.
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of Architect/Client.

**3. Measurement**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, finishing, labour, etc. to complete the whole work satisfactorily as per instruction of EIC/Architect.
- No extra payment will be given for any of the reasons.
- The rate shall be for a unit of one Square meter

**Item No: 46: Inlay/CNC work: minor Inlay/cnc cutting work Flooring Providing and laying all semi precious stones with all materials and labour as per architects design upon the base red mandana, baleshwar, agarwal white. All stone works for the temple to Architect for their approval before issuing the same for execution. The drawings would include all elements and based on tender items applicable to all stone works for the temple.**

**1. Materials:**

- All type of material shall be used as per approved make list and confirming to relevant IS codes and approved by EIC/Architect.

**2. Workmanship:**

- Work complete as per above specification.
- Work complete including all types of tools, tackles, labour etc complete at any level and height.
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of Architect/Client.

**3. Measurement**

- The rate shall be consolidated for all above items.

- The rate shall include the cost of all materials, finishing, labour, etc. to complete the whole work satisfactorily as per instruction of EIC/Architect.
- No extra payment will be given for any of the reasons.
- The rate shall be for a unit of one Square meter

**Item No: 53: Signages: 3D letters with LED : Wall Mounted**

**Material : 3 mm thick exterior grade premium quality ACP sheet (0 .25 mm foil thickness) & and 3D Embossed virgin acrylic/aluminum letters as per approved make and sample by Architect/ Client.**

**Led Light : Rishang(Korea) and SMPS as per approved make and sample by Architect/ Client.**

**The rate shall be for complete item of Designing , providing , fixing & erection , inclusive of all material, labor, wastages, necessary tools & tackles, adhesives, required hardware/accessories , any type of framing work, engraving, required civil work with finishing, LED light .**

**Work complete including all type of material, fittings , fixtures, Finish, loading , unloading , transportation, , all leads ,accessories, sample mock up, all floor , all levels, all heights , etc complete as per drawings ,specifications & instruction of Client/EIC.**

**1. Material:**

- Signage's shall be used as per approved make and sample by Architect/EIC.
- All type of material shall be used as per approved make list and confirming to relevant IS codes and approved by Architect/EIC.

**2. Workmanship:**

- Work complete as per above manufacturer's specification.
- Work complete including all types of tools, tackles, labour etc complete at any level and height.
- The whole work is to be completed as per design; sample material & any other requirement shall be as per instruction of Architect/EIC.

**3. Measurements:**

- The rate shall be consolidated for all above items.
- The rate shall include the cost of all materials, labour, scaffolding etc. to complete the whole work satisfactorily as per instruction of EIC/Architect.
- No extra payment will be given for any of the reasons.
- The work done shall be measured in Square meter for area of work done. The rate shall be for a unit of one Square meter

## **TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

SR. NO	PARTICULARS
1	<b>General Instructions for Electrical Works</b>
2	<b>Technical Specification for HT Cable.</b>
3	<b>Technical Specification for LT Panels.</b>
4	<b>Technical Specification for APFCR Panels.</b>

<b>5</b>	<b>Technical Specification for LDBs &amp; PDBs.</b>
<b>6</b>	<b>Technical Specification for LT Cables &amp; Cable Tray.</b>
<b>7</b>	<b>Technical Specification for Internal Wiring.</b>
<b>8</b>	<b>Technical Specification for Lighting Fixtures</b>
<b>9</b>	<b>Technical Specification for Earthing System.</b>
<b>10</b>	<b>Technical Specification for Lightning Protection system.</b>

## 1 GENERAL INSTRUCTIONS FOR ELECTRICAL WORKS

### 1) PREAMBLE :

The scope of this section is to describe materials and systems for electrical installation works which form together with the project documents, a complete volume of work and quality description.

All electrical installations shall be of high quality, safe, complete and fully operational including all necessary items and accessories whether or not specified in details. All electrical works shall be completed in accordance with the regulations and standards as per the statutory requirement to the satisfaction of the Employer. The general provisions, special provisions and general requirements apply to all items of this specification.

The work shall be carried out simultaneously with building work, civil work, etc. and shall be continued till it is completed satisfactorily along with the completion of essential portions of the building works.

During the progress of work, completed portion of the building may be occupied and be put to use by Employer but the contractor will remain fully responsible for the maintenance of electrical installations till the entire work covered by this contract is satisfactorily completed by him and handed over to Employer.

It is the intention of the specification and drawings to call for finished work, tested and ready for operation. Whenever the words "Supply" or "Provide" are used, it shall mean delivery of material as specified in an assembled manner, ready for installation. Any apparatus, material or work not shown on drawings but mentioned in the specification or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be furnished, delivered and installed by the contractor without additional expenses to Employer. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work and in the contract.

Electrical contractor shall be licensed Contractor registered with R&B Department of Gujarat and shall have completion certificate of three similar project Electrical jobs completed of same cost in last 3 years.

## **2) INTERPRETATION OF PROJECT DOCUMENTS :**

The Specification, Drawings and Bill of quantity shall be interpreted in accordance with good installation practice defined in the appropriate regulations and standards whether specifically referred to or not. If there are any discrepancies or shortfall in the application of the regulations to any aspect of this contract or the contractor considers there is anything detrimental to the standards or inconsistent with his obligations and guarantees, Employer shall be informed prior to signing the contract and thereafter inform the contractor in writing the course to be followed. Where the drawings are to a small scale or are expressed in symbolic terms or are in the form of a diagram, then exact location of items shall not be inferred and in all cases, the work shall be fully integrated with the work of other traders and with the fabric of the building. The contractor shall appraise the duties of all plants and equipments taking account of any additions or variations and shall inform the Employer of any matters which may affect the design. In all cases the equipment installed shall be of appropriate rating for the duty it performs.

The Specifications and bill of quantity shall be considered as part of this contract and any work or material shown on BOQ and not called for in the specification or vice versa, shall be executed as if specifically called for in both. The drawings indicate the extent and general arrangement of the Transformer, L.T. panel, H.T. & L.T. cable route layout etc. and are essentially diagrammatic.

The work shall be installed as indicated on the drawings, however, any minor changes found essential to co-ordinate the installations of this work with other services shall be made without any additional cost to the Employer. The drawings are for the guidance of the contractor, exact locations, distances and levels will be governed by the building. The contractor shall examine all structural and electrical drawings before starting the work, and report to Employer or its representative, any discrepancies, which in his opinion appear on them, and get them clarified.

If any discrepancy is noticed between General Conditions of Contract, specification, Bill of quantity and Drawings, the most stringent of the above shall apply. Bill of quantities, for electrical items, shall be read in conjunction with respective specification. However, in case of conflict between bill of quantities and the specification, former shall govern.

## **3) SYSTEM PARTICULARS :**

LV	:	433 V, 3 Phase, 4 wire, 50 Hz.
Neutral earthing	:	Solid

#### 4) ABBREVIATIONS :

The following abbreviations have been used in the accompanying specifications, drawings and bill of quantity.

IS	:	Indian Standard
BS	:	British Standard
HRC	:	High Rupturing Capacity
GI	:	Galvanised Iron
CU	:	Copper
MS	:	Mild Steel
MV	:	Medium Voltage
LV	:	Low Voltage
PVC	:	Polyvinyl Chloride
AMP	:	Amperes
V	:	Volts
KV	:	Kilo Volts
HV	:	High Voltage
KW	:	Kilo Watt
KVA	:	Kilo Volt Ampere
PF	:	Power Factor
Hz	:	Frequency
KWH	:	Kilo Watt Hour
XLPE	:	Cross Linked Polyethelene
ACB	:	Air Circuit Breaker

LED	:	Light Emitting Diode
PLC	:	Programmable Logic Controller
UPS	:	Uninterrupted Power Supply
DP	:	Double Pole
IEE	:	Institute of Electrical Engineers, London
MCB	:	Miniature Circuit Breaker
TPN	:	Triple Pole and Neutral
SP	:	Single Pole
MCCB	:	Moulded Case Circuit Breaker
VCB	:	Vacuum Circuit Breaker
CT	:	Current Transformer
DB	:	Distribution Board
DG	:	Diesel Generator
BOQ	:	Bill of quantity
SITC:		Supply, Installation, Testing and Commissioning
L.O.I.	:	Letter of Intent / Acceptance letter
ELV	:	Extra Low Voltage System
MP	:	Mega Pixels
CCTV	:	Close Circuit Television
PA	:	Public Address System
FACP	:	Fire Alarm Control Panel
NVR	:	Network Video Recorder

NVMS : Network Video Monitoring Software

## 5) REGULATIONS AND STANDARDS :

The installation shall conform in all respects to Indian Standard Code of Practice for Electrical Wiring Installation IS : 732-1983 and IS : 2214 – 1983 (Silver Nitrate Pure and analytical reagent). It shall also be in conformity with the current Indian Electricity, Rules, Indian Electricity Act, National Electrical Code and Regulations of the Local Electrical Supply Authority in so far as these become applicable to the installation. Wherever this specification calls for a higher standard of material and/or workmanship than those required by any of the above regulations then this specification shall take precedence over the said regulations and standard. In general, the materials equipment and workmanship not covered by the above shall conform to the relevant Indian Standards.

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

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

IS : 8623	Low voltage switchgear & control gear assemblies
IS : 10118	Code of Practice for selection, installation and maintenance of switchgear and control gear
IS : 4237	General requirement for switch gear and control gear for voltage not exceeding 1000 Volt A.C. or 1200 Volt D.C.
IS : 13947	Low voltage switchgear and control gear
IS : 9224	Low voltage fuses
IS : 8828	Circuit breakers for out protection for household and similar installations
IS : 12640	Earth leakage circuit breaker
IS : 1248	Direct acting indicating analog electrical measuring instruments
IS : 2705	Current transformers
IS : 4201	Application guide for voltage transformers

IS : 6875 Control switches for voltage upto and indicating 1000 V A.C. and 1200 V D.C.

IS : 5578 Guide for marking of insulated conductors

IS : 11353 Guide for uniform system of marking and identification of conductors and apparatus transmission

IS : 8197 Terminal markings for electrical measuring instruments and their accessories

IS : 694 Specifications for PVC insulated cables for working voltage upto and including 1100 volts

IS : 2551 Danger notice plates

IS : 3043 Code of practice for earthing

IS : 5216 Guide for safety procedures and practices in electrical work

IS : 1646 Code of practice for fire safety of building : Electrical Installation.

NFC17-102 Code of practice for Lightning Arrestor : Electrical Installation

Indian Electricity Act as amended up to date

Indian Electricity Rules as amended up to date

Rules and Regulations of Bombay Regional Council of Fire Insurance & Association of India for Electrical wiring.

#### **6) FEES, PERMITS AND TESTS :**

The Contractors shall pay for any and all fees and obtain permits required for the installation work. On completion of the work, the contractor shall obtain and deliver to the Employer, certificates of final inspection and approval by the local electric supply authority and the Electrical Inspector.

## 7) ACTUAL ROUTE OF CABLE :

The location of the cables, panel boards etc. is only indicative, therefore, the actual route of cables and the location of panel boards may differ from the plans according to the details of the building construction and the conditions of executions of the installations.

The contractor shall supply and install at his expense all secondary materials and special fittings found necessary to overcome the interference and to supply the modifications on the route of cables and conduits that are found necessary during the work, to the complete satisfaction of the Employer's representative.

## 8) MATERIAL AND EQUIPMENT :

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

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

The makes of electrical equipments, components, accessories etc. have been mentioned in Tender document. However, Client / Electrical Consultant reserves the right to select from the specified make. Contractor shall clearly indicate in the bid document, the make they have considered. No extra claim shall be applicable if client / consultant suggests from the alternative make specified in the tender document.

## 9) MANUFACTURERS :

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

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

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

**10) RATING :**

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

- Outdoor temperature 50 deg.c.
- Temperature under shed 45 deg.c.
- Salty, dusty and humid
- Coastal area

**11) INSPECTION AND TESTING :**

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

1. That the equipment installed complies with specification in all particulars and is of the correct rating for the duty and site conditions.
2. That all items operate efficiently and quietly to meet the specified requirements.
3. That all circuits are correctly fused and protected and that protective devices are properly co-ordinated.
4. That all non current carrying metal work is properly and safely grounded in accordance with the specifications.
5. The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Employer and shall provide test certificates signed by a properly authorised person. Such test certificates shall cover all works.
6. If tests fail to demonstrate the satisfactory nature of the installation or any part thereof then no claims for the extra cost of modifications, replacements or re-testing will be considered. Employer's decision as to what constitutes a satisfactory test shall be final.
7. The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere.

**12) TEST CERTIFICATES :**

The contractor shall submit test certificates for all the electrical material / system installed. These shall be issued by a government recognized inspection office certifying that all equipment, materials, construction and functions are in agreement with the requirements of these specifications, ISI and when ISI is not applicable other approved certifying agencies.

**13) INSTRUCTION MANUAL :**

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

**14) SAMPLES AND CATALOGUES :**

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

For big items such as switchboards, the submission of catalogues shall be enough. Prior to ordering any electrical equipment / material / system, the contractor shall submit to Employer, the catalogues, alongwith the samples, atleast from three different manufacturers. After the selection of manufacturer by Employer, the contractor shall arrange inspection and testing at the manufacturer's factory or assembly shop for final approval. No material shall be procured prior to the approval of the Electrical consultant & Data sheets shall be signed and stamped by consultant and one copy to be submitted to Client.

**15) VENDOR AND SHOP DRAWINGS :**

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

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

**16) AS BUILT DRAWINGS :**

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

- a. Location and details of distribution boards, main switches, switchgear and other particulars.
- b. Location of all earthing stations, route and size of all earthing conductors, manholes etc.
- c. Route and particulars of all cables.
- d. Lighting layout plans with conduit routing layout/cable tray for all the floors along with circuit distribution details.
- e. External Area Lighting Plan

**17) GUARANTEE :**

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

- a. Any defective work or material supplied by the contractor.
- b. Any material or equipment supplied by Employer, which is damaged or destroyed as a result of defective workmanship by the contractor.
- c. Any material or equipment damaged or destroyed as a result of defective workmanship by the contractor.

**18) SPECIAL NOTES FOR BIDDER :**

- a. The contractor should co-operate & coordinate for LT connections to LT panel board of various blocks, so that day to day work should not suffer.
- b. It is in the scope of Contractor to preparing necessary drawing submitting to authorities (i.e. Local supply co., pollution control board, Electrical Inspector, etc), getting their approval / sanction and final certificate to energize the sub-station equipment's. Filling the necessary application to supply co. following up and getting the supply filling the necessary test report to the supply co. inclusive. All official / statutory fees shall be paid by clients & all other required expenses shall be on the contractors account; no extra payment shall be paid to contractor for said job.
- c. LT Panels shall be approved on site by Engineer in Charge & Electrical Consultant.
- d. Contractor shall submit Shop drawings for approval to Electrical consultant based on tender drawings before execution which shall not be on chargeable basis.

- e. The MCB and MCB DBs must be of same make.
- f. Make of components required to be used by contractor to complete the installation, if not mentioned anywhere, shall be required to GOT IT APPROVED by Client/Architect/Consultant before installation in writing manner.
- g. Within a week of work order, the contractor shall submit the sample of each item / component of above mentioned approved make for the approval of the Client/Architect/Consultant.

## **2 TECHNICAL SPECIFICATION FOR HT CABLE**

### **1) SCOPE**

- 1. The scope shall cover supplying, laying, testing and commissioning of 3 core H.T cables which shall be capable of operating at a sustained conductor temperature of 90°C and suitable for a maximum conductor short-circuit temperature of 250°C.
- 2. This specification gives the general requirement of cables. However, it is the responsibility of the vendor to take the joint measurement and obtain client's approval before the placement of orders to the main supplier / manufacturer. Cut lengths will not be accepted.

### **2) REFERENCE CODES & STANDARDS:**

- 1.1. IS : 8130 – 1984      Conductors of Insulated Cables.
- 1.2. IEC : 228 -      Conductors of Insulated Cables.
- 1.3. IS : 10810 -      Methods of various tests on cables and their accessories
- 1.4. IEC : 502 -      Extruded solid dielectric-insulated power cables for rated voltage from 1 KV up to 30 KV.
- 1.5. IEC : 287 -      Calculations of continuous current rating of cables (100% load factor).
- 1.6. IS : 7098 (Part II) -      Cross-linked polyethylene insulated PVC sheathed cable for Voltage from 1.3 KV up to 33 KV.
- 1.7. IS : 5831 - 1984      PVC insulation & sheath of electrical cables.

### **3) OPERATING CONDITIONS**

**Electric system**

- System Voltage : 11 KV/1.6 KV
- Frequency : 50 Hz.

**Environment**

- Ground temperature : 40°C.
- Ambient air temperature : 50°C.
- Solar gain : 1100 w/m<sup>2</sup>
- Earth resistivity : [The bidder shall confirm the Earth Resistivity Test]
- Atmospheric conditions : Humid, salty and dusty

**CONSTRUCTION**

**4) CONDUCTORS**

1. The conductor shall be of circular stranded Aluminium to IS : 8130 & IEC : 228. It shall be clean, reasonably uniform in size & shape smooth & free from harmful defects. Any other form of conductor may also be accepted if in line with modern trends.

**5) CONDUCTOR SCREEN**

1. The conductor screen shall consist of an extruded layer of thermosetting semi-conducting compound which shall be extruded simultaneously with the core insulation.

**6) INSULATION**

1. The insulation shall be super clean XLPE compound applied by extrusion and vulcanized to form a compact homogenous body.

**7) INSULATION SCREEN**

1. Each insulation have an insulation screen in two parts consisting of :
2. Non-metallic semi-conducting compound tape part and a metallic screen part.
3. The non-metallic part shall be directly applied upon the insulation of each core and may consist of an extruded semi-conducting material extruded simultaneously with the conductor screen and insulation (triple extrusion).

4. The semi-conductor shall be readily strippable and must not be bonded in such a manner that it has to be shaved or scraped to remove.
5. The metallic part shall consist of a copper tape helical applied with a 10% overlap. A binder tape of copper shall be applied over the copper wire metallic screen.

**8) LAYING UP**

1. The cores shall be identified on the non-metallic part of the insulation screen by legible printing on the length of each conductor or, by the inclusion of a marker tape.
2. The cores shall be laid up with a right hand direction of lay.
3. No cables shall be directly buried in the ground. They shall be laid in trenches, trays, racks or in conduits or pipes. The cables of different voltage grade shall be laid in different trays. 2 mtr loop to be provided on both the sides.

**Binder tape / Moisture barrier:**

4. During lay up, a suitable open spiral binder may be applied, at the manufacturer's discretion, before the application of an extruded inner covering.

**9) FILLERS**

1. Fillers shall be PVC.

**10) INNER COVERING / SHEATH**

1. The inner covering shall be extruded over the laid up cores to form compact and circular bedding for the metallic layer.

**11) METALLIC LAYER**

1. The metallic layer shall be galvanized steel wire.

**12) OUTER SHEATH**

1. The tough outer sheath, black coloured best resisting PVC polyethylene compound type ST-2 as per IS : 5831 for the operating temperature of the cable shall be provided over the armour as specified in relevant standards by extrusion process.

### 13) CABLE MARKING

**Embossing on outer sheath:**

1. The PVC outer sheath shall be legibly embossed with the legend: "ELECTRIC CABLE 11000 VOLT "etc.
2. The letter and figures shall be raised and shall consist of upright block characters. The maximum size of the characters shall be 13 mm. And the minimum size 15% of the cable circumference or 3 mm. whichever be the greater. The gap between the end of one set of embossed characters as above and the beginning of the next shall not exceed 150 mm.

**Identification of Manufacturer and year of manufacture:**

3. An identification of the manufacturer, the year of manufacturing, cable size shall be embossed at regular intervals on the PVC outer sheath. This shall not affect the spacing between repetitions of the legend as given above.

### 14) SEALING AND DRUMMING

1. After tests at the manufacturers works, both ends of the cable shall be sealed to prevent the ingress of moisture during transportation and storage.
2. Cable shall be supplied in lengths of 500 mtrs. or as required in non-returnable drums of sufficiently sturdy construction.
3. The spindle hole shall be 110 mm. minimum diameter.
4. Each drum shall bear on the outside flange, legibly and indelibly in the English language, a distinguishing number, the manufacturer's name and particulars of the cable viz. voltage, length, conductor size, cable type, insulation type and gross weight shall also be clearly visible. The direction for rolling shall be indicated by an arrow.

### 15) TESTING

1. Type tests and Routine tests shall be carried out in accordance with the relevant IEC standards / IS. The copies of routine test results shall be submitted along with each drum length or part thereof.

### 16) TRANSPORTATION & DELIVERY

1. The cable shall be supplied in the actual length as per joint measurement at site.
2. The cable shall be dispatched at client's store or at site as per detailed instructions given by Client at later stage.

3. The cables shall be loaded from the main vendor's store, transported, unloaded at Client's stores and properly stocked as per instruction of client's local representative.

**TECHNICAL DATA SHEET FOR H. T. XLPE CABLE :**

Sr. No.	Particulars	Description
<b>1.0</b>	<b>ENVIRONMENT DETAILS</b>	
1.1	Ambient Temp In Degree Celsius	50 Degree Celsius
1.2	Ground Temp In Degree Celsius	35 Degree Celsius
1.3	Relative Humidity	90 % At 35 Degree Celsius
1.4	Altitude	< 1000 Meter Above MSL
1.5	Atmosphere	Non Corrosive, Humid and Dusty
<b>1.0</b>	<b>SYSTEM DETAILS</b>	
1.1	System Voltage	AS PER TENDER
1.2	System Frequency	AS PER TENDER
1.3	Grounding	AS PER TENDER
1.4	Fault Level	AS PER TENDER AS PER TENDER
<b>1.0</b>	<b>CABLE</b>	
1.1	No. of Cores	3 (Three)
1.2	CABLE CONDUCTOR	
1.1.1	Size Of Conductor	As per BOM
1.1.2	Material	High Purity Aluminium
1.1.3	Construction	Stranded
1.1.4	Shape	Compacted Circular
1.1.5	Confirming To	Is-8130
1.3	Conductor Screen	Extruded Semi-conducting Material
<b>1.4</b>	<b>CONDUCTOR INSULATION</b>	
1.4.1	Material	High Purity Void And Moisture Free Cross Linked Polyethylene (XLPE) Using Gas Curing Process

<b>Sr. No.</b>	<b>Particulars</b>	<b>Description</b>
1.4.2	Thickness	> = 5.5mm
1.5	INSULATION SCREEN	EXTRUDED SEMI-CONDUCTING MATERIAL HAVING COPPER TAPE OVER IT
1.6	CORE IDENTIFICATION TAPE	Yes Required
1.7	CORE LAYING	Right Hand Direction
1.8	INNER SHEATH / COVER	Extruded
1.9	<b>ARMOURING</b>	
1.9.1	Material	Flat Steel GI Strip
1.9.2	No Of Strip	4
1.9.3	Size Of Strip	0.8 mm
1.10	<b>OUTER SHEATH</b>	
1.10.1	Material	PVC
1.10.2	Type	St-2 As Per Is-5831-1984
1.10.3	Thickness	> = 1.4 Mm
1.10.4	Colour	Black
1.11	MARKING ON OUTER SHEATH	YES
1.11.1	Voltage Grade	Yes
1.11.2	No. of Cores/Size of Conductor / Material of Conductor	Yes
1.11.3	Type Of Insulation	Yes
1.11.4	Details About Armour	Yes
1.11.5	Details Of Standards	Yes
1.11.6	Year Of Manufacturer	Yes
1.11.7	Any Other Details	Yes
<sup>4</sup> .0	<b>TESTING</b>	
<sup>4</sup> .1	Type Test As Per Is	Certificate To Be Provided for each drum
<sup>4</sup> .2	Routine Test As Per Is	Yes To Be Witnessed By Client
<sup>4</sup> .3	Acceptance Test	Yes To Be Witnessed By Client

Sr. No.	Particulars	Description
.0 <sup>5</sup>	<b>CABLE DRUM</b>	<b>Non Returnable</b>
.1 <sup>5</sup>	Material	Wooden / Steel
.2 <sup>5</sup>	Marking On Cable Drum	As Per Manufacturer's Standard

### 17) MODE OF MEASUREMENTS

1. The cables will be measured in meters. The unit rate shall include cutting the cable into required lengths, packing, loading, unloading, insurance, transportation, delivery to stores/site as per work order, stocking in stores, testing of cables at stores etc. of medium voltage cable. Total quantity in meters shall be measured lug to lug basis.

## 3 TECHNICAL SPECIFICATION FOR PCC,MCC,LT PANELS

### 1) SCOPE OF WORK

1. Main Distribution Panels, Sub-Distribution Panels and Final Distribution shall be covered under this section. Panels/Boards shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, 4 wire system with neutral grounded at transformer. All Distribution panels shall be CPRI tested design and manufactured by an approved manufacturer. CPRI certificate shall be made available.
2. Distribution panels shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1991.

### 2) CONSTRUCTION FEATURES:

1. Distribution panels shall be 2 mm thick sheet steel cabinet for indoor installation, dead front, floor mounting/wall mounting type and shall be form as per site construction requirements.
2. The Distribution panels shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors and folded covers, Neoprene gasket, padlocking arrangement and bolted back.
3. All removable/ hinged doors and covers shall be grounded by flexible standard connectors.
4. Distribution panel shall be suitable for the climatic conditions as specified in Special Conditions. Steel sheets used in the construction of Distribution panels shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components.
5. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal.

6. The general construction shall confirm to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage up to and including 1100 V AC.
7. All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned.
8. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts.
9. Self threading screws shall not be used in the construction of Distribution panels.
10. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels.
11. Minimum operating clearance of 300 mm shall be provided between the floor of Distribution panels and the lowest feeder compartment.
12. Distribution panels shall be of adequate size with a provision of spare switchgear as indicated on the Single Line Diagram. Feeders shall be arranged in multi-tier.
13. Knockout holes of appropriate size and number shall be provided in the Distribution panels in conformity with the location of cable/conduit connections.
14. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required.
15. Every cabinet shall be provided with Trifoliate or engraved metal name plates.
16. All panels shall be provided with circuit diagram engraved on PVC sheet.
17. All live accessible connections shall be shrouded and shall be finger touch proof and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

### **3) BUSBAR CONNECTIONS:**

1. Bus bar and interconnections shall be of high conductivity electrolytic grade aluminium / copper as indicated in the bill of quantities complying with requirement of IS : 5082 – 1981 and of rectangular cross section suitable for carrying the rated full load current and short circuit current and shall be extendable on either side.
2. Bus bars and interconnections shall be insulated with heat shrinkable sleeve of 1.1 KV grade and shall be colour coded.

3. Bus bars shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system.
4. All bus bars shall be provided in a separate chamber and all connections shall be done by bolting.
5. Additional cross sectional area to be added to the bus bar to compensate for the holes.
6. All connections between bus bars and breakers shall be through solid copper / aluminium strips of proper size to carry full rated current and insulated with insulating sleeves.
7. Maximum current density for the bus bars shall be 0.8-1A/sq.mm for aluminium and 1.4 A/sq.mm for copper bus bars.
8. The busbar shall be housed in a separate compartment. The busbar shall be isolated with 3 mm. thick bakelite sheet to avoid any accidental contact. The busbar shall be arranged such that minimum clearance between the busbar are maintained as below :

Between phases	:	25 mm. minimum
Between phases and neutral	:	25 mm.
Between phases and earth	:	25 mm.
Between neutral and earth	:	20 mm. minimum

#### **Maximum allowable temperature for the Bus bar to be restricted to 85 deg C**

#### **4) TEMPERATURE – RISE LIMIT**

1. Unless otherwise specified, in the case of external surface of enclosures of bus bar compartment which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per IS 8623(Part-2) 1991.
2. All main distribution panels and sub distribution panels shall be provided with MCCB of appropriate capacity as per Single Line Diagram.
3. All final Distribution boards shall be provided with Miniature Circuit Breakers.
4. Final Single Phase Distribution boards shall be connected to the incoming supply through double pole MCB units & earth leakage circuit breakers.
5. All wiring for final distribution boards shall be concealed behind 5 mm thick bakelite sheet or M S sheet cover.
6. All Distribution boards shall be completely factory wired, ready for connection.

7. All the terminals shall be of proper current rating and sized to suit individual feeder requirements.
8. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram.
9. All the switches and circuits shall be distinctly marked with a small description of the service installed.
10. Continuous earth bus sized for prospective fault current shall be provided with arrangement for connecting to station earth at two points. Hinged doors/ frames shall be connected to earth through adequately sized flexible braids.

## 5) CABLE COMPARTMENTS

1. Cable compartment of adequate size shall be provided in the Distribution panels for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables.

## 6) SWITCHGEARS

### 6.1 MOULDED CASE CIRCUIT BREAKER (MCCB)

- 6.1.1 The MCCB should be current limiting type with trip time of less than 10 msec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ. MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2/IEC 60947-2 and should have test certificates for Breaking capacities from independent test authorities CPRI / ERDA or any accredited international lab.
- 6.1.2 MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses
- 6.1.3 The breaking capacity of MCCB shall be as specified in the schedule of quantities.
- 6.1.4 The rated service breaking capacity (Ics) should be equal to rated ultimate breaking capacities (Icu).
- 6.1.5 MCCBs for motor application should be selected in line with Type-2 Co-ordination as per IEC-60947-2, 1989/IS 13947-1.
- 6.1.6 The breaker as supplied with ROM should meet IP54 degree of protection.

### 6.2 CURRENT LIMITING & COORDINATION

6.2.1 The MCCB shall employ maintenance free minimum let-through energies and capable of achieving discrimination up to the full short circuit capacity of the downstream MCCB. The manufacturer shall provide both the discrimination tables and let-through energy curves for all.

#### **Protection Functions**

6.2.2 MCCBs with ratings up to 200 A shall be equipped with Thermal-magnetic (thermal for overload and magnetic for short-circuit protection) trip units (as per Single line diagram).

6.2.3 Microprocessor MCCBs with ratings 250A and above shall be equipped with microprocessor based trip units (as per Single line diagram).

6.2.4 Microprocessor and thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorised access to the settings

6.2.5 Microprocessor trip units shall comply with appendix F of IEC 60947-2 standard (measurement of rms current values, electromagnetic compatibility, etc.)

6.2.6 Protection settings shall apply to all poles of circuit breaker.

6.2.7 All Microprocessor components shall withstand temperatures up to 125 °C.

6.2.8 Rotary handles to be provided for operation where ever required as indicated in Single line diagram.

#### **6.3 TESTING**

6.3.1 Original test certificate of the MCCB as per IEC 60947-1 &2 or IS13947 shall be furnished.

6.3.2 Pre-commissioning tests on the switch board panel incorporating the MCCB shall be done as per standard specifications.

#### **6.4 INTERLOCKING**

6.4.1 Moulded, case circuit breakers shall be provided with the following interlocking devices for interlocking the door of a switch board.

- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent the door being opened when the breaker is in ON position.
- Defeat-interlocking device to open the door even if the breaker is in ON position.
- PLC controller to operate the Motorised Breakers in sequence as indicated logic diagram in SLD.

- 6.4.2 The MCCB shall be current limiting type and comprise of quick make – Break switching mechanism. MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable over load & short circuit pick-up both in Thermal magnetic and Microprocessor Trip Units.
- 6.4.3 All MCCB with microprocessor based release unit, the protection shall be adjustable Overload, Short circuit and earth fault protection with time delay.
- 6.4.4 The trip command shall override all other commands.

#### 6.5 MINIATURE CIRCUIT BREAKER (MCB)

- 6.5.1 Miniature Circuit Breaker shall comply with IS-8623-1993/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection.
- 6.5.2 The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B, C, D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer.
- 6.5.3 The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.
- 6.5.4 The housing shall be heat resistant and having high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the external operating handle.

#### 6.6 RESIDUAL CURRENT CIRCUIT BREAKER CURRENT OPERATED TYPE (RCCB)

##### **System of Operation**

- 6.6.1 Residual Current Circuit Breaker shall confirm to IEC 61008. RCCB shall work on the principle of core balance transformer.
- 6.6.2 The incoming shall pass through the toroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer.
- 6.6.3 In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage current exceeds a predetermined critical

value. RCCB shall be current operated independent of the line voltage, current sensitivity shall be of 30 mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations.

### **Mechanical Operation**

6.6.4 The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing /opening of all the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under tripping conditions.

### **Neutral Advance Feature**

6.6.5 The neutral moving contact shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact First before the phases; and at the time of opening, the neutral shall breaks last after allowing the phases to open first. This is an important safety feature which is also required by regulations.

### **Testing Provision**

6.6.6 A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB / RCCB and the operating handle shall move to the "OFF" position.

## **6.7 AIR CIRCUIT BREAKER**

### **6 Construction:**

**.7. 1** The ACBs shall follow IS 13947-1993 Part 1-5 & have following features:

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

### **Release:**

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

#### **6 ACB Performance:**

**.7.** **3**

1. ACB performance inside panels at ambient 50 Degree.
2. I<sub>th</sub> Symmetrical breaking, 50KA
3. Making capacity peak 87.5 KA
4. Short time rating, 1sec. 50KA

#### **7) ELECTRICAL POWER AND CONTROL WIRING CONNECTION :**

1. Terminal for both incoming and outgoing cable connections shall be suitable for 1100 V grade, aluminium / copper conductor PVC insulated and sheathed, armoured cable and shall be suitable for connections of solderless sockets for the cable size as indicated on the appended drawings for the Panels.
2. Power connections for incoming feeders of the main Panels shall be suitable for 11000 V grade aluminium conductor (XLPE) cables.
3. Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.
4. Both control and power terminals shall be properly shrouded.
5. 10% spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block, so that not more than one outgoing wire is connected to per terminal.
6. Terminal strips for power and control shall preferably be separated from each other by suitable barriers of enclosures.
7. Wiring inside the modules for power, control, protection and instruments etc. shall be done with use of 660 / 1100 V grade, PVC insulated copper conductor cables conforming to IS : 694 and IS : 8130. Power wiring inside the starter module shall be rated for full current rating of respective contactor, but not less than 4.0 sq.mm. cross-section area. For current transformer circuits, 2.5 sq.mm. copper conductor wire shall be used. Other control wiring shall be done with 1.5 sq.mm. copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solderless sockets at the ends before connections are made to the terminals. All wires shall be FRLS grade.
8. Control power for the Motor starter module shall be taken from the respective module switchgear outgoing. Control power wiring shall have control fuses, (HRC fuse type) for circuit protection. All indicating lamps shall be protected by HRC fuses.

9. Particular care shall be taken to ensure that the layout of wiring is neat and orderly. Identification ferrules shall be filled to all the wire termination for ease of identification and to facilitate checking and testing.
10. "CUPAL" washers shall be used for all copper and aluminium connections.
11. Final wiring diagram of the Panels power and control circuit with ferrules numbers shall be submitted alongwith the Panels as one of the documents against the contracts.

**8) TERMINALS :**

1. The outgoing terminals and neutral link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformers for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted, only one conductor may be connected in one terminal.

**9) WIREWAYS :**

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

**10) LABELS :**

1. Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

**11) NAME PLATE :**

1. A name plate with the Panels designation in bold letters shall be fixed at top of the central panel. A separate name plate giving feeder details shall be provided for each feeder module door.
2. Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc. shall suitably be identified by providing stickers.
3. Engraved name plates shall preferably be of 3 ply,(Red-White-Red or Black-White-Black) lamicold sheet. However, black engraved perpex sheet name plates shall also be acceptable. Engraving shall be done with square groove cutters.
4. Name plate shall be fastened by counter sund screws and not by adhesives.

**12) DANGER NOTICE PLATES :**

1. The danger notice plate shall be affixed in a permanent manner on operating side of the Panels.
2. The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.
3. The danger notice plate, in general, meet the requirements of local inspecting authorities.
4. Overall dimensions of the danger notice plate shall be 200 mm. wide x 150 mm. high.
5. The danger notice plate shall be made from minimum 1.6 mm. thick mild steel sheet and after due pre-treatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.
6. The letters, the figures, the conventional skull and bones etc. shall be positioned on plate as per recommendation of IS : 2551-1982.
7. The said letters, the figures and the sign of skull and bones shall be painted in signal red colour as per IS : 5-1978.
8. The danger plate shall have rounded corners. Location of fixing holes for the plate shall be decided to suit design of the Panels.
9. The danger notice plate, if possible, be of ISI certification mark.

### **13) EARTHING**

1. Earthing shall be provided as per IS: 3043-1987.

### **14) PAINTING**

1. All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating).
2. The shade of colour of panel inside/outside shall be as per BOQ confirming to IS Code No.5.

### **3. LABELS**

1. Engraved PVC labels shall be provided on all incoming and outgoing feeder.
2. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

### **4. METERS**

1. All voltmeters and indicating lamps shall be through MCB's.
2. Meters and indicating instruments shall be flush type.
3. All CT's connection for meters shall be through Test Terminal Block (TTB).
4. CT ratio and burdens shall be as specified on the Single line diagram/BOQ.

## **5. CURRENT TRANSFORMERS**

1. Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps.
2. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.
3. The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits.
4. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections.
5. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

## **6. POTENTIAL FREE CONTACTS**

1. Potential free contacts shall be provided for connection to Building Automation System in panels indicated in Schedule of Quantities.

## **7. INDICATING PANEL**

1. All meters and indicating instruments shall be in accordance with relevant Indian Standards. Meters shall be flush mounted type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB/MPCB as per relevant fault level and toggle switch.

## **8. TESTING**

1. Testing of panels shall be as per following codes:
  - I. IS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages upto and including 1000 VAC.
  - II. IS: 13947 : 1993 Degree of protection
  - III. IS: 5578 & 11353:1985 Arrangement of bus bars.

## **9. WIRING**

1. In wiring a distribution panel it shall be insured that total load of various distribution panel and/or consuming devices is divided evenly between the phases and number of ways as per Consultants drawing.

## **10. INSTALLATION**

1. Installation of all LT panels shall include but not limited to the following to complete the installation, testing and commissioning:
2. Transporting materials from stores to exact location of installation.
3. Supply and installation of required base frame made of MS angle or channel sections and duly painted with black paint.
4. Positioning, aligning, fixing, assembling, and installation of LT panel issued free of cost by Client after carrying out proper cleaning and inspection.
5. Site supervision, testing for proper functioning / operation, and pre-commissioning tests.

## **11. COMMISIONING & ONSITE TESTING**

1. All switchboards shall be tested for dielectric test with 1000V megger.
2. All earth connections shall be checked for continuity.
3. All busbar connections shall be checked and tightened properly.
4. All cable terminations and terminal shrouding shall be checked if they are properly done.
5. The operation of protective devices shall be tested by secondary injection test.
6. The operation of circuit breaker shall be tested for all interlocks.
7. Functional test shall be done for all ACBs, MCCBs and other components.
8. Indicating lamps and meters shall be checked for proper working.

## **12. WORKMANSHIP:**

1. The contractor shall erect the panel at site in co-ordination with the supplier if required.
2. He should check for loose ends on the part of the supplier and shall inform client and consultant for the same.
3. Physical and continuity tests shall be carried out by contractor.
4. Also the field tests carried out by the supplier shall be recorded by the contractor.

## **13. MODE OF MEASUREMENT:**

1. Contractor shall be paid for one panel erection as per BOQ Quantities part.

## **4 TECHNICAL SPECIFICATION FOR THYRISTOR BASED APFCR PANEL**

## 1) SCOPE

This specification covers design, manufacture, and supply, testing of capacitor bank and automatic power factor correction panel with capacitor banks suitable for continuous duty.

## 2) CODES AND STANDARDS

1. The design manufacture and performance of power factor improvement capacitor / capacitor banks shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also confirm to the latest applicable Indian/British/IEC standards. In particular the equipment shall conform to the latest revisions of the following:
  - 2. When the above standards are in conflict with the stipulation of this specification, this specification supercedes them.

## 3) CONSTRUCTION

### 3.1 Capacitor Bank

Capacitor banks shall comprise of identical delta connected three phase units. The individual capacitor unit shall be manufactured out of mixed dielectric design comprising of bi axially oriented polypropylene film and capacitor tissue paper.

Each individual element of the capacitor tissue unit shall be provided with silver fuse wire.

The capacitor unit shall consist of many such elements in series / parallel combinations for getting the desired KVAR output.

The capacitor shall be thermal stability & MPP/APP TYPE AS SPECIFIED IN SINGLE LINE DIAGRAM.

The dielectric losses of the capacitor shall be restricted to 2 watts per KVAR.

The phase terminal connections of the capacitor unit shall be brought out at the top through metal insulators, which should be soldered to the fabricated top cover.

The capacitor shall be provided with suitably rated discharge resistors.

The capacitor shall be designed to withstand the electrodynamics and thermal stresses caused by transient over current during switching.

### 3.2 Busbar Chamber

Capacitor bank shall be provided with a bus - bar chamber. The chamber shall be dust and vermin proof in construction, fabricated from 2-mm. thick sheet steel. Continuous neoprene rubber gaskets shall be copper on all mating surfaces. TPN Bus - bars shall be of copper supported on epoxy insulators of adequate rating and strips.

The bus - bar sizes and clearance shall be suitable for connection of cables through crimping type cable lugs. Bus- bar chamber shall be extended suitably on one side to cable and box at the end of bus - bar chamber undrilled removable gland plate and access covers to be provided for cable entry as required.

#### **4) EARTHING**

The enclosure of individual capacitor unit shall be provided with 2 nos. 10 mm dia. earth terminals, each complete with two plain and one spring washer, nuts etc. These terminals shall be effectively bonded to the common sheet steel framework. Each bank will have two external earth terminals in the bus-bar chambers complete with hardware.

#### **5) PAINTING**

All sheet steel shall be thoroughly cleaned, degreased and phosphated, painted with two coats of paint. The type and shade of paint be as specified in Data Sheet.

#### **6) DRAWINGS**

The following drawings shall be submitted along with the bid :

- a.** General arrangement drawing showing overall dimensions, weight, internal arrangement and mounting details.
- b.** Terminal chamber, showing bus-bar arrangement with all dimensions.

#### **7) TEST & TEST CERTIFICATES :**

- 7.1.** Vendor shall carry out all routine tests as specified in IS : 2834 and shall furnish the test certificates.
- 7.2.** The vendor shall also carry out the thermal stability test on the units in the presence of purchaser representatives.
- 7.3.** The capacitor units shall be tested from electric supply authorities like G. E. Board / A. E. Co. and the test certificates in duplicate shall be furnished to client and also the copy shall be submitted to the electric supply authority while getting the power supply released from them.

#### **8) CAPACITOR PANEL**

Capacitor control panel shall be automatic if specified in the Data sheet.

The panel for capacitor shall be fabricated from 2.0 mm thick sheet steel and shall be finished as per clause no.5.0. Earthing terminals shall be provided as per clause no. 4.0. The panel shall be provided suitably rated TPN copper bus-bar supported on epoxy insulators and with heat shrinkable type sleeves. Each capacitor unit shall be connected to main bus bar through contactors of suitable rating ( 9 Nos. of double the rating of capacitor current ) with safety margin. Each unit shall be of 10/15/20/25/50 KVar – ALL PP- (APP) as specified.

Protective MCCB / HRC switch fuses of suitable rating shall be provided with base/holders. Connections shall be made with PVC insulated flexible copper cables having crimped copper lugs.

Continuous earthing conductor/ strip of G.I. shall run through and all capacitor units shall be earthed.

Sufficient ventilation shall be provided in the capacitor compartment to limit the temperature rise. Cooling fans shall be provided with ON-OFF switches as per requirements.

The main bus-bar shall be terminated on suitably rated MCCB as per data sheet. vertical compartment with detachable gland plate shall be kept for incoming cable connections from bottom or top as specified.

Capacitors units shall be mounted on angle frame of strong construction.

The panel shall be mounted on M.S. channel section at bottom for easy installation.

The panel shall be provided with lifting hooks / Eye bolts for handling.

Automatic power factor correction sensing relays (APFCR) shall be provided with all related circuits and contactors for controlling the power factor to max. 0.98 by energising the contactor and related capacitor bank "ON" or "OFF" as per load conditions.

The controller shall be set for time lag of 45 seconds so that on sensing the low or high power factor it energises or deenergises the contactor after 45 seconds.

The Dust and vermin proof switching compartment shall be isolated from capacitor mounting compartment. The panel shall be provided with :

- a. MCCB of adequate capacity as specified.
- b. 100 x 100 mm. flush type 0-500 V digital voltmeter with selector switch.
- c. 100 x 100 mm. flush type digital Ammeter with suitable rated C.T. and selector switch.
- d. Supply "ON" indication lamp (R-Y-B).
- e. Power factor meter 0.5 lag to 0.5 lead.

- f. KVAR meter of suitable rating.
- g. "ON" - "OFF" push button with suitable thyristor based size contactor.
- h. By - pass switch for each capacitor unit for manual operation.
- i. Automatic Power Factor correction relay unit with ON-OFF mode selector switch.
- j. Capacitor Heavy Duty Contactors (Thyristor based).

The capacitor panel shall be installed away from wall with sufficient distance for better cooling and ease of maintenance.

The following drawings shall be submitted before procurement for approval from the Consultants..

1. General arrangement and Fabrication details.
2. Power wiring diagram of capacitor panel.
3. Control wiring diagram of capacitor panel/
4. C.T. connection.

## **9) MODE OF MEASUREMENT:**

1. The APFCR Panel shall be measured in Nos as per BOQ Quantities.

## **5 TECHNICAL SPECIFICATION FOR LDB & PDB**

### **1) SCOPE OF WORK**

1. Distribution Boards (DBs) shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, neutral grounded at transformer. The DB shall be minimum dielectric strength of 1.5 KV / Sec. All Distribution Boards shall be manufactured by a manufacturer listed in Appendix-I.
2. LDB's shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-2675-1983.

### **2) CONSTRUCTION FEATURES**

1. DB's shall be made out of 1.6 mm thick high quality CRCA sheet steel and shall be pre-treated and powder coated sheet steel used in the construction of LDB shall be folded and braced as necessary to provide a rigid support for all component.
2. DB shall be suitable for indoor / outdoor installation, wall mounting free standing type, in double door construction.
3. The Final Distribution Boards shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket, padlocking arrangement.
4. All removable/ hinged doors and covers shall be grounded by 1.0 sqm tinned stranded copper connectors.
5. Final Distribution Boards shall be suitable for the climatic conditions. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal.
6. The general construction shall confirm to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage upto and including 1100 V AC.
7. All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of LDBs.
8. Knockout holes of appropriate size and number shall be provided in the LDB's in conformity with the location of cable/conduit connections. Detachable sheet steel gland plates shall be provided at the top / bottom to make holes for additional cable entry at site if required.

### **3) DISTRIBUTION BOARDS SHALL COMPRIZE OF THE FOLLOWING:**

- 3.1 A panel for mounting where appropriate incoming supply circuit breaker & other auxiliaries for Control & distribution as required.
- 3.2 Installations accessories shall be part of the DB for fixing conductor and rails for mounting MCB's and RCCB's etc. Neutral bus bars & earthing bus bars required in the circuit. All busbars in the LDB shall be insulated type.
- 3.3 Service cable /interconnection shall be part of the Distribution Boards.
- 3.4 The board shall be installed at a height such that the operating is within reach of the normal human height i.e. 1.2 to 1.8 meters from finish floor level.
- 3.5 Degree of protection shall be IP-52 for indoor application, IP-54 for kitchen & laundry and IP-55 for outdoor application.
- 3.6 All three phase distribution boards shall have 4 rows and single phase distribution boards shall have single rows for housing of MCB's and RCCB's unless noted otherwise.
- 3.7 Phase segregation to be maintained in all three phase distribution boards.
- 3.8 Earthing shall be provided in each LDB's.

### 3.9 MINIATURE CIRCUIT BREAKER (MCB)

3.9.1 MCB's shall have quick make and break no welding self-wiping silver alloy contacts for 10 KA short circuit both on the manual and automatic operation.

3.9.2 Each pole of the breaker shall be provided with inverse time thermal over load and instantaneous over current tripping elements, with trip free mechanism.

3.9.3 In case of multi-pole breakers, the tripping must be on all the poles and operating handle shall be common. Breakers must conform to BS 3871 with facility for locking in OFF position.

3.9.4 Pressure clamp terminals for stranded/solid conductor insertion are acceptable up to 4 sq.mm. Aluminium or 1.5 sq.mm.

3.9.5 Copper and for higher ratings, the terminals shall be suitably shrouded. Wherever MCB isolators are specified they are without the tripping elements.

### 3.10 RESIDUAL CURRENT CIRCUIT BREAKER CURRENT OPERATED TYPE (RCCB)

3.10.1 The RCCB should suffice all the requirements of IS as per code IS - 12640 - 1988. The RCA should be current operated and not on line voltage.

3.10.2 The RCCB should ensure mainly the following functions:

- Measurement of the fault current value.
- Comparison of the fault current with a reference value.
- The RCCB should have a toroidal transformer which has the main conductors of primary (P - N) which check the sum of the current close to zero.
- All metal parts should be inherently resistant to corrosion and treated to make them corrosion resistant.
- It should be truly current operated.
- It should operate on core balance toroidal transformer.
- Its accuracy should be  $\pm 5\%$ .
- It should operate even in case of neutral failure.
- It should trip at a present leakage current within 100 mA
- Its enclosure should be as per IP 30.

- Its mechanical operation life should be more than 20,000 operations.
- It should provide full protection as envisaged by IE rules - 61-A, 71 - ee, 73 - ee, 1985 and also rule 50 of IE rule1956.
- It should conform to all national and international standards like IS: 8828-1993, IS: 12640-1988, BS 4293 - 1983, CEE 27 (International commission Rules for the approved of electrical equipment).

## **EARTHING**

1. Earthing shall be provided as per IS:3043-1987.

## **4) PAINTING**

1. All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be of Siemens gray paint shade no. RAL-7032 of IS Code No.5.

## **5) LABELS**

1. Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

## **6) TESTING**

1. Testing of panels shall be as per following codes:

- i. IS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages upto and including 1000 VAC.
- ii. IS: 13947 : 1993 Degree of protection

## **7) WIRING**

1. In wiring a distribution panel it shall be insured that total load of various distribution panel and/or consuming devices is divided evenly between the phases and number of ways as per Consultants drawing.

## **8) WORKMANSHIP:**

1. The D.B. shall be properly grouted in the wall in concealed manner taking care that the powder coating is not scratched and dents are not formed on the D.B., MCBs and ELCBs.

2. In the distribution boards shall be fixed as per the circuit details provided.
3. All the wires terminating in the MCBs and the ELCBs shall be lugged for proper contact and ferrules depicting the circuit nos shall be provided. D.B.s mounted in concealed manner shall have a groove around it so as to save the finish of the plaster and colour during future opening of the door.
4. The distribution boards shall have circuit chart tagged on the door for future maintenance. Danger notice plates shall be fitted to the distribution boards with screws and not stuck so as to assure its presence for a longer duration.

## **9) MODE OF MEASUREMENT:**

2. The distribution boards shall be measured in Nos as per BOQ Quantities.

## **6 TECHNICAL SPECIFICATION FOR LT CABLES & CABLE TRAY.**

### **1) SCOPE OF WORK**

1. The Medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer's instructions. The cables shall be delivered at site in the original drums with manufacturer's name, size and type clearly written on the drums.
2. All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of handling during transportation, loading, unloading etc.
3. The cable shall be supplied in single length i.e. without any intermediate joint or cut unless specifically approved by the client.
4. The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practise.

### **2) MATERIAL**

1. The MV cables shall be cross linked polyethylene (XLPE) insulated PVC sheathed of 1100 volts grade as asked for in the schedule of quantities. Cables upto 10 sq.mm shall be with copper conductor and 16 sq.mm and above shall be with aluminium conductor.

### **3) Technical Requirements:**

1. All XLPE Aluminium/Copper Power cables shall be 1100 Volts grade, multi core constructed as per IS : 7098 Part-I of 1988 as follows :
  - 1.1 Stranded Aluminium /Copper conductor in case of 10 sq.mm. and above whereas solid conductor in case of 10 sq.mm. and below.

- 1.2 Cores laid up.
- 1.3 The inner sheath should be bonded over with thermo-plastic material for protection against mechanical and electrical damage.
- 1.4 Armoring should be provided over the inner sheath to guard against mechanical damage. Armouring should be Galvanised steel wires or galvanised steel strips. (In single core cables used in A.C. system armouring should be non-magnetic hard aluminium Wires/Strips. Round steel wires should be used where diameter over the inner sheath does not exceed 13 mm; above 13 mm flat steel armour should be used. Round wire of different sizes should be provided against specific request.)
- 1.5 The outer sheath should be specially formulated heat resistant black PVC compound conforming to the requirement of type ST2 of IS : 5831-1984 extruded to form the outer sheath.
2. Conductor shall be of electrolytic Aluminium/Copper conforming to IS : 8130 and are compact circular or compact shaped.
3. Insulation shall be of XLPE type as per latest IS general purpose insulation for maximum rated conductor temperature 70 degree centigrade.
4. In Inner sheath laid up cores shall be bonded over with thermoplastic material for protection against mechanical and electrical damage.
5. Insulation, inner sheath and outer sheath shall be applied by extrusion and lapping up process only.
6. Uncoated, annealed copper / aluminium, of high conductivity, upto 4 mm<sup>2</sup> size the conductor shall be solid and above 4 mm<sup>2</sup> the conductors shall be concentrically stranded as per IEC: 228.
7. Repaired cables shall not be used.
8. Current ratings of the cables shall be as per IS: 3961.
9. The XLPE insulated cables shall conform to latest revision of IS and shall be read along with this specifications. The Conductor shall be stranded Aluminium/Copper circular/ sector shaped and compacted. In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation.
10. The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.
11. Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.
12. Cables shall be supplied in non returnable wooden drums as per IS: 10418.
13. Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.
14. The product should be coded as per IS: - 7098 Part-I as follows:-

Aluminium Conductor	A
XLPE Insulation	2X
Steel round wire armour	W

Steel strip armour	F
Steel Double round wire armour	WW
Steel Double strip armour	FF
Non-magnetic (Al.) round wire armour	Wa
Non-magnetic (Al.) strip armour	Fa
PVC outer sheath	Y

#### 4) Core Identifications:

Two core	:	Red and Black
Three core	:	Red, Yellow and Blue
Four core	:	Red, Yellow, Blue and Black
Single core	:	Green, Yellow for earthing.

Black shall always be used for neutral.

#### 5) Inspection

1. All cables shall be inspected by the contractor upon receipt at site and checked for any damage during transit.

#### 6) Joints in Cables

1. The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoid cable jointing.
2. This apportioning shall be got approved by the Owner's site representative before the cables are cut to lengths.
3. Where joints are unavoidable heat shrinkable type joints shall be made.
4. The location of such joints shall be got approved from the Owner's site representative and shall be identified through a marker.

#### 7) Jointing Boxes for Cables

1. Cable joint boxes shall be installed with heat shrinkable sleeve and of appropriate size, suitable for XLPE armoured cables of particular voltage rating.

#### 8) Jointing of Cables

1. All cable joints shall be made in suitable, approved cable joint boxes and the filling in of compound shall be done in accordance with manufacturers' instructions and in an approved manner. All straight through joints shall be done in epoxy mould boxes with epoxy resin.

2. All cables shall be joined colour to colour and tested for continuity and insulation resistance before jointing commence.
3. The seals of cables must not be removed until preparations for jointing are completed.
4. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged.
5. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern.
6. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

#### **9) Cable End Terminations**

1. Cable end termination shall be done in cable terminal box using crimping sockets and proper size of glands of double compression type.
2. Solderless crimping type Aluminium/Cu lugs conforming to IS suitable for cable size evenly crimped with high pressure tool & connected to switchgear terminals with brass/cadmium plated nut bolts in an approved manner.

#### **10) Bonding of Cables**

1. Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armour clamp and gland.
2. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on to the cable conductors.

#### **11) Cable Installation in Cable Trays and Cable Trenches.**

1. Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable.
2. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks.

#### **12) Laying of Cables on Cable Trays**

1. The relative position of the cables, laid on the cable tray shall be preserved and the cables shall not cross each other.
2. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius as recommended by the manufacturers.
3. All cables shall be laid with minimum one diameter gap and shall be clamped at every meter to the cable tray.

4. Cables shall be tagged for identification with aluminium tag and clamped properly at every 20M.
5. Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings.
6. All cable shall be identified by embossing on the tag the size of the cable, place of origin and termination.
7. All cables passing through holes in floor or walls shall be sealed with fire retardant Sealant and shall be painted with fire retardant paint upto one meter on all joints, terminations and both sides of the wall crossings by "VIPER CABLE RETARD".
8. This method may be adopted in places like indoor substations, air-conditioning plantrooms, generator rooms etc. or where long horizontal runs of cables are required within the building and where it is not convenient to carry the cable in open ducts.
9. This method is preferred where heavy sized cables or a number of cables are required to be laid. The cable trays may be either of perforated sheet type or of ladder type.

#### **PERFORATED TYPE CABLE TRAY**

10. The cable tray shall be fabricated out of slotted/perforated MS sheets as channel sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted as specified. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mmX50mmX6mm as two longitudinal members, with cross bracings between them by 50mmX5mm flats welded/bolted to the angles at 1 m spacing. 2mm thick MS perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.
11. Typically, the dimensions details to be considered as per BOQ.
12. The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.
13. The width of the cable tray shall be chosen so as to accommodate all the cables in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 800mm.
14. Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure 3). The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.
15. The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25mmX5mm flats at a span spacing of 1mtr.
16. Flat type suspenders may be used for channels upto 450mm width bolted to cable trays.
17. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mmX50mmX5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the

other end through an effective means, as approved by the Engineer-in-Charge, to take the weight of the cable tray with the cables.

18. The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.
19. The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.
20. The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc. and paid for accordingly

#### **LADDER TYPE CABLE TRAY**

21. The ladder type of cable tray shall be fabricated of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a center to center spacing of 250cm.
22. Alternatively, where specified, ladder type cable trays may be fabricated out of 50mmX50mmX6mm (minimum) angle iron for longitudinal members, and 30mmX6mm flat for rungs.
23. Typical details of fabrication and dimensions of both the types of trays are shown in figure 4A,B,C and D.
24. The maximum permissible loading, jointing of channel sections, width of the cable tray, provision of elbows, bends, reducers, horizontal tee/ cross junctions etc. suspension of cable tray from the ceiling slab; painting and measurement of the cable tray shall be as per sub-clauses (ii) to (x) below clause 2.6.11.2, except that the overall width of one cable tray may be limited to 800mm.

#### **13) Laying of Cables in Ground**

1. Cable trench shall be dug to the minimum depth of 1 mtr and the width shall dependent on the no of cables to be kept with the layer of brick in between two cables.

#### **EXCAVATION OF TRENCHES :**

2. The trenches shall be excavated in reasonably straight lines.
3. Wherever there is a change in direction, suitable curvature shall be provided.
4. Where gradients and changes in depth are unavoidable, these shall be gradual.
5. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench.
6. The bottom of the trench shall be levelled and shall be made free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 100 mm in depth.
7. Prior to laying of cables, the cores shall be tested for continuity and insulation resistance. The cable drum shall be properly mounted on jacks, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum and the spindle is horizontal.
8. Cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire drum length shall be laid in one stretch.

9. However, where this is not possible the remainder of the cable shall be removed by 'Flaking' i.e. by making one long loop in the reverse direction.
10. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted off the rollers beginning from one end by helpers standing about 10 meters apart and laid in a reasonably straight line.
11. Cable laid in trenches in a single tier formation shall have a cover of clean, dry sand of not less than 150 mm. above the base cushion of sand before the protective cover is laid.
12. In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 300 mm shall be provided over the initial bed before the second tier is laid.
13. Finally the cables shall be protected by second class bricks before back filling the trench. The buried depth of uppermost layer of cable shall not be less than 750mm.
14. **Back Filling** : The trenches shall be back filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 300 mm. Unless otherwise specified, a crown of earth not less than 50 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

#### **14) Route Marker**

1. Route marker shall be provided along straight runs of the cables not exceeding 30 meters also for change in the direction of the cable route and underground joints.
2. Route marker shall be of cast iron painted with aluminium paint.
3. The size of marker shall be 100 mm dia with "Cable" and voltage grade inscribed on it.

#### **15) Testing of Cables**

1. Cables shall be tested at works for all routine tests as per IS including the following tests before being dispatched to site by the project team.
  - a) Insulation Resistance Test.
  - b) Continuity resistance test.
  - c) Sheathing continuity test.
  - d) Earth test.(in armoured cables)
  - e) Hi Pot Test.
2. Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing.
3. On completion of cable laying work, the following tests shall be conducted in the presence of the Owner's site representative.

- f) Insulation Resistance Test( Sectional and overall)
- g) Continuity resistance test.
- h) Sheathing continuity test.
- i) Earth test.

4. All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules.

5. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests.

6. All tests shall be carried out in the presence of the Owner's site representative, results will be noted and signed by all present and record be maintained.

## **16) WORKMANSHIP**

- 1. Cables shall be laid in the routes marked in the drawings. Where the route is not marked, the Contractor shall mark it out on the drawings and also on the site and obtain the approval of the CLIENT AND/OR ITS ARCHITECT before laying the cable.
- 2. Procurement of cables shall be on the basis of actual site measurements and the quantities shown in the schedule of work shall be regarded as a guide only.
- 3. Cables shall be laid on walls, cable trays, inside shafts or trenches.
- 4. Saddling or support for the cable shall not be more than 500 mm apart. Plastic identification tags shall be provided at every 30 m.
- 5. Cables shall be bent to a radius not less than 12 (twelve) times the overall diameter of the cable or in accordance with the manufacturer's recommendations whichever is higher.
- 6. In the case of cables buried directly in ground, the cable route shall be parallel or perpendicular to roadways, walls etc unless marked on drawing by architect / consultant.
- 7. Cables shall be laid on an excavated, graded trench, over a sand or soft earth cushion to provide protection against abrasion.
- 8. Cables shall be protected with brick or cement tiles on all the three sides as shown on drawings. Width of excavated trenches shall be as per drawings.
- 9. Back fill over buried cables shall be with a minimum earth cover of 750 mm to 1000 mm. The cables shall be provided with cables markers at every 10 meters and at all loop points.
- 10. All cables shall be full runs from panel to panel without any joints or splices.
- 11. Cables shall be identified at end termination indicating the feeder number and the Panel/Distribution board from where it is being laid.
- 12. Cable termination for conductors up to 4 sq.mm. may be insertion type and all higher sizes shall have compression type lugs.

13. Cable termination shall have necessary brass glands. The end termination shall be insulated with a minimum of six half-lapped layers of PVC tape. Cable armouring shall be earthed at both ends.
14. In case of cables entering the buildings. It would be done duly only through pipes. The pipes shall be laid in slant position, so that no rainwater may enter the building.
15. After the cables are tested the pipes shall be sealed with M. seal & then tarpaulin, shall be wrapped around the cable for making the entry watertight.
16. Testing : MV cables shall be tested upon installation with a 500 V Meggar and the following readings established:
  - 16.1 Continuity on all phases.
  - 16.2 Insulation Resistance.
  - 16.3 between conductors.
  - 16.4 all conductors and ground.
  - 16.5 All test readings shall be recorded and shall form part of the completion documentation.
  - 16.6 Cable joints shall be done as per regular practice and check shall be carried out for loose connections and leakages. Insulation cutting shall be done properly taking care that no area of the conductor remains exposed. Crimping shall be done with the help of hydraulic tool. Proper insulation tape shall be applied at the cable and lug joint.
17. Format for cable testing certificate :
  - a. Drum no. from which cable is taken : \_\_\_\_\_
  - b. Cable from \_\_\_\_\_ to \_\_\_\_\_
  - c. Length of run of this cable \_\_\_\_\_ mtr
  - d. Insulation resistance test
    - between core 1 to earth \_\_\_\_\_ mega-ohm
    - between core 2 to earth \_\_\_\_\_ mega-ohm
    - between core 3 to earth \_\_\_\_\_ mega-ohm
    - between core 1 to core 2 \_\_\_\_\_ mega-ohm
    - between core 2 to core 3 \_\_\_\_\_ mega-ohm
    - between core 1 to core 3 \_\_\_\_\_ mega-ohmduration used: \_\_\_\_\_
  - e. High voltage test: Voltage Duration
    - between core and earth
    - between individual cores

18. The cable shall be laid side by side in trench with brick covering on all the three sides.
19. The trench shall be such that sharp bends shall be avoided while laying the cable.
20. The bedding of fine sand under the cable shall be not less than 6 mm. The trench shall be terminated in Manholes with specified size of R.C.C. hume pipes as shown in drawing. Cable markers shall be provided through out the route of cable at 10 mtrs distance.

21. The trenches shall be refilled after the cable are laid and the Ground level shall be done as per original after pressing the same. The cables shall be checked for insulation resistance and continuity tests shall be carried out.

## **17) MODE OF MEASUREMENT:**

### **17.1 Mode of Measurement for Cable Trench & Cable Tray.**

The cable laying shall be measured in rmt. The trenches dug and refilled shall be measured in cu. Mtr. The bricks and sand bedding shall be measured in rmt. The cable trays shall be measured in rmt.

### **17.2 Mode of Measurement for Cable and Cable End Terminations.**

The cables shall be measured in rmt and terminations on unit basis.

## **7 TECHNICAL SPECIFICATION FOR INTERNAL WIRING.**

### **1) SYSTEM OF WIRING**

1. The system of wiring shall consist of PVC insulated copper stranded conductor flexible FRLS wires in metallic / non metallic (Rigid heavy/Medium Duty ISI -marked fire retarded PVC Conduits of minimum 2mm Wall thickness and Sizes of conduits shall be 25 mm dia. conduits for both mains and point wiring and shall be concealed or surface mounted above false ceiling as called for.

### **2) GENERAL DESCRIPTION**

1. Prior to laying and fixing of conduits, the contractor shall mark the conduit route, carefully examine the working drawings prepared by him and approved by the Consultant indicating the layout, satisfy himself about the non interference in the route, sufficiency of number and sizes of conduits, location of junction boxes, sizes and location of switch boxes and other relevant details.
2. Any discrepancy found shall be brought to the notice of the Owner's site representative.
3. Any modifications suggested by the contractor should get written approval before the actual laying of conduits is commenced.
4. In laying of conduits it is important that not more than two right angle bends are provided for each circuit without a pull box.
5. No junction box shall be provided in the entire length of conduit run for drawing of wires.
6. Only switch outlets, lighting fixture outlets, equipment power outlets and socket outlets shall be considered for drawing of wires.

### **3) LIGHTING & POWER WIRING**

1. All final branch circuits for lighting and appliances shall be single conductor/ stranded/ flexible wires run inside conduits.

2. The conduit shall be properly connected or jointed into sockets, bends, and junction boxes.
3. Branch circuit conductor sizes shall be as shown in the schedule of quantities and or drawings.
4. All circuits shall preferably be kept in a separate conduit up to the Distribution Board. No other wiring shall be bunched in the same conduit except those belonging to the same phase.
5. Each lighting branch circuit shall not have more than ten outlets or 800 watts whichever is lower. Each conduit shall not hold more than three branch circuits.
6. Flexible cords for connection to appliances, fans and pendants shall be 650/1100 V grade (three or four cores i.e. with insulated neutral wire of same size) with tinned stranded copper wires, insulated, twisted and sheathed with strengthening cord. Colour of sheath shall be subject to the CLIENT AND/OR ARCHITECT'S approval.
7. Looping system of wiring shall be used. Wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors.
8. No such joints shall be made unless the length of the sub-circuit, sub-main or main is more than the length of the standard coil.
9. Control switches shall be connected in the phase conductors only and shall be 'ON' when knob is down. Switches shall be fixed in 3 mm. thick painted or galvanized steel boxes with cover plates as specified. Cadmium plated brass screws shall be used.
10. Power wiring shall be distinctly separate from lighting wiring. Conduits not less than 25 mm. and wires not less than 1.0 sq.mm. copper shall be used.
11. Every conductor shall be provided with identification ferrules at both ends matching the drawings.

#### **4) TESTING**

1. The entire installation shall be tested for:
  - Insulation resistance.
  - Earth continuity.
  - Polarity of single pole switches.
2. All the wiring switch board, outlet points shall be done in a concealed manner in wall & slab in PVC conduit of minimum 25 mm dia. (medium gauge) & with 650v / 1100v grade PVC insulated flexible copper conductor wire.
3. The switches should be modular with moulded cover plates, blank plates for outlet boxes.
4. The accessories, connectors, sockets, should be fixed with brass chrome / cadmium plated machine screw. For fan points the rates should be with hum -free type 300 W regulators as required to complete the point wiring.
5. The wiring shall be as per IS: 732 and IS: 4648. The wiring shall be done in a looping manner so as to avoid junction boxes at any place.

6. All the looping shall be done only in the switchboard and outlet points. The size of the wire shall be as per the specification. Colour code shall be strictly followed.

7. The size of wires shall as follow as per BOQ and as per clients requirements:

8. Light, fans, exhaust fan, 5 Amp. On board plug point, two way light points, bell point etc from switch to outlet.

Phase / Neutral	1.5 m m <sup>2</sup>
Earth	1.5 m m <sup>2</sup>

9. From D.B. to switch board – lighting / 5 A socket etc – i.e. circuit mains part of point wiring

Phase / Neutral	2.5 m m <sup>2</sup>
Earth	1.5 m m <sup>2</sup>

10. From D.B. to 16A power point etc – i.e. circuit mains part of point wiring

Phase / Neutral	4.0 m m <sup>2</sup>
Earth	1.5 m m <sup>2</sup>

11. Separate pipes shall be laid for off wires and circuit mains.

12. Circuit mains of same phase shall be drawn in one pipe with prior permission/discussion with the consultant.

13. Separate phase, neutral and earthing wire of sizes recommended by consultant shall be drawn for each and every circuit mains.

14. Mains for lighting and on board plug points shall be of one-size higher wires than those used in off.

## 5) COMPUTER WIRING :

1. Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc., shall be installed in flexible conduits. Otherwise rigid conduits shall be used. No flexible extension shall exceed 1.25 m.

2. Conduits run on surfaces shall be supported on metal 12 mm. thick G.I. pressure saddles which in turn are properly screwed to the wall or ceiling. Saddles shall be at intervals of not more than 500 mm.

3. Fixing screws shall be with round or cheese head and of rust-proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building.

4. Unseemly conduit bends and offsets shall be avoided by using fabricated mild steel junction/pull through boxes for better appearances.

5. No cross-over of conduits shall be allowed unless it is necessary and entire conduit installation shall be clean and neat in appearance.

6. Conduits embedded into the walls shall be fixed by means of staples at not more than 500 mm. intervals. Chases in the walls shall be neatly made and refilled after laying the conduit and brought to the finish of the wall but the building Contractor will do final finish.

7. Conduits buried in concrete structure shall be put in position and securely fastened to the reinforcement and got approved by the CLIENT AND/OR ITS ARCHITECT, before the concrete is poured.
8. Proper care shall be taken to ensure that the conduits are neither dislocated nor choked at the time of pouring the concrete suitable fish wires shall be drawn in all conduits before they are embedded.
9. Where conduit passes through expansion joints in the building, adequate expansion fittings shall be used to take care of any relative movement.
10. Inspection boxes shall be provided for periodical inspection to facilitate withdrawal and removal of wires. Such inspection boxes shall be flush with the wall or ceiling in the case of concealed conduits. Inspection boxes shall be spaced at not more than 12 meters apart or two 90° solid bends or equal.
11. All junction and switch boxes shall be covered by 6 mm clear plate. These junction boxes shall form part of point wiring or conduit wiring as the case may be including the cost of removing the cover for painting and re-fixing. No separate charges shall be allowed except where specially mentioned.
12. Conduits shall be free from sharp edges and burrs and the threading free from grease or oil. The entire system of conduits must be completely installed and rendered electrically continuous before the conductors are pulled in. Conduits should terminate in junction boxes of not less than 32 mm. deep.
13. An insulated earth wire of copper rated capacity shall be run in each conduit.

**The point definition shall be Conduiting and wiring from D.B. to S.B. and there from to final outlet point including switches and accessories, junction boxes, fan boxes, zarri work with cement –sand etc of approved make.**

## **6) CONDUCTORS**

1. All PVC insulated copper conductor flexible FRLS wires shall conform in all respects to Standards as listed under sub-head Indian Standards and shall be IS approved and ISI marked.

## **7) BUNCHING OF WIRES**

1. Wires carrying current shall be so bunched that the outgoing and return wires are drawn into the same conduit.
2. Wires originating from two different phases shall not run in the same conduit. All wires shall have ferrules for identification.
3. Lighting and power circuits shall be separate. Each Power/ Light Circuit's Neutral shall be individual per Circuit and shall not be looped from any other Circuit.

## **8) LOAD BALANCING**

1. Balancing of circuits in three phase installation shall be as planned by the Consultants in the tender drawings and shall be checked by the contractor before the commencement of wiring and shall be strictly adhered to.

## **9) COLOUR CODE OF CONDUCTORS**

1. Colour code shall be maintained as indicated by the Consultant for the entire wiring installations. Red, yellow, blue shall be for three phases, black for neutral and green with yellow band shall be for earthing.

## 10) WORKMANSHIP

### Drawing Conductors

1. The drawing and jointing of PVC insulated copper conductor wires shall be executed with due regard to the following precautions.
2. While drawing wires through conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors.
3. There shall be no sharp bends. Wire reel stands to be used for pulling of wires to avoid kinks.
4. Care shall be exercised while drawing the wires from reels, by taking appropriate measures to ensure that wires are not spread on ground, causing dust and dirt accumulation on the new wires.
5. Maximum permissible number of 1100 volt grade PVC insulated wires that may be drawn into rigid non metallic or PVC Conduits are given below:

Size of wires Nominal Cross Section Area (Sq. mm.)	Maximum number of wires within conduit size(mm)				
	20	25	32	40	50
1.5	7	12	16	--	--
1.5	5	10	14	--	--
4	4	8	12	--	--
6	3	6	8	--	--
10	--	4	5	6	--
16	--	3	3	6	6
25	--	--	2	4	6
35	--	--	--	3	5

6. Insulation shall be removed by insulation stripper only. Few Strands of wires shall not be cut/reduced for convenience in connecting into terminals.
7. The terminals shall have sufficient cross sectional area to take all strands and it's connecting brass screws shall have flats ends.
8. All looped joints shall be connected through terminal block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. All light points shall be terminated through a connector.
9. Only licensed wiremen (Before doing the work or before appointing him on site contractor has to submit his wiring licence to Owner) and cable jointers shall be employed to do jointing work.

10. Before entrusting cable jointing work to any technician, or before appointing Cable Jointers or Wiremen on Site, Contractor has to submit such Technicians' / Wireman's / Cable Jointer's licence to Owner.
11. All wires and cables shall be embossed with the manufacturer's label with ISI mark and shall be brought to site in original packing. For all internal wiring. PVC insulated wires of 1100 volts grade (FRLS) shall be used.
12. The sub-circuit wiring for point shall be carried out in loop system and no joints shall be allowed in the length of the conductors.
13. No wire shall be drawn into any conduit until all defective work of conduit installation of any nature that may cause injury to wire is completed.
14. Care shall be taken while pulling out the wires so that no damage occurs to conduits/wire itself, the conduits shall be thoroughly cleaned of moisture, dust , dirt or any other obstruction.
15. The minimum size of PVC insulated copper conductor wires for all sub-circuit wiring for light points shall be minimum 1.0 sq.mm copper. Separate neutral to be pulled for each circuit.
16. Conduits shall be kept at a minimum distance of 100 mm. from the pipes of other non-electrical services. And maintain minimum 300 mm distance between telephones, TV & Computer piping.
17. Separate conduits/raceways shall be used for following points as applicable and as requirements of site conditions:
  - 17.1 Normal lights and 5 A 3 pin sockets on lighting circuit.
  - 17.2 Separate conduit shall be laid from D.B. to switch board.
  - 17.3 Power outlets - 15 A 3 pin 20 A/30 A, 2 pin scraping earth metal clad sockets.
  - 17.4 Emergency lighting.
  - 17.5 Telephones.
  - 17.6 Fire alarm system.
  - 17.7 Public address system & Music system.
  - 17.8 For all other voltages higher or lower than 230 V.
  - 17.9 T.V. Antenna.
  - 17.10 Water level guard.

## **11) FISH WIRE**

1. To facilitate subsequent drawing of wires in the conduit, GI fish wires of 1.0 mm (14 SWG) shall be provided along with the laying of recessed conduit.

## **12) MODE OF MEASUREMENT**

1. The items shall be measured on unit basis or on mtr basis as per BOQ.

## **8 TECHNICAL SPECIFICATION FOR LIGHT FIXTURES & ACCESSORIES.**

## **1) SCOPE :**

1 The scope of work shall cover the supply, installation and testing of various types of LED light fixtures.

## **2) STANDARDS :**

The following standards and rules shall be applicable :

- (a) IS 3646 - 1960 Code of practice for interior illuminator.
- (b) IS 1913 - 1978 General and Safety requirements for electric lighting fittings.
- (c) Indian Electricity Act and Rules issued there under.

1 All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the relevant British Standard Code of Practice in the absence of Indian Standard.

## **3) DRAWINGS AND DATA:**

As per of the proposal the bidder furnish relevant descriptive and illustrative literature on lighting fixtures and accessories and following drawings/ data for the respective lighting fixtures :-

- i) Dimensional Drawings.
- ii) Mounting details cable entry facilities and weights.
- iii) Light distribution diagrams (Zonal & Isokandora)
- iv) Light absorption and utilisation factors.
- v) Lamp output V/S temp. curves.

## **4) WORKMANSHIP:**

- The fixture shall be installed on wall / ceiling as directed and as per manufacturer's instruction, with necessary accessories for surface, concealed, suspended from ceiling, bracket mounting etc.
- The job also includes connection of fixture with respective outlet point with heat resistant wires through heat resistance sleeve and PVC connector. The exhaust fan shall be installed complete with M.S. angle iron mounting frame/ ring, G.I. louvers, wire mesh and plug at the end of the cord including wiring & earthing etc. Proper earthing shall be provided to the fixtures.

## **5) MODE OF MEASUREMENT:**

The unit rate shall be considered for fitting one fixture. The rate shall include following

- 1 All fixing accessories, mounting bracket, ballast condensers and control gear wherever applicable.
- 2 Supplying and fixing Ball and socket joints wherever required.
- 3 Earthing of fittings.
- 4 Electrical connections to fittings/fans from the junction box/ceiling rose.
- 5 Installation and interconnection of Electronic regulators for ceiling fans.
- 6 Supplying and fixing 300 mm. GI down rod for ceiling fans.

## **9 TECHNICAL SPECIFICATION FOR EARTHING SYSTEM.**

### **1) GENERAL DESCRIPTION**

1. All the non-current carrying metal parts of the electrical installation and mechanical equipments shall be earthed properly.
2. The metal conduits, trucking, cables armour and sheath, electric panels' boards, lighting fixtures, ceiling and exhaust fan and all other parts made of metal shall be bonded together and connected by means of specified earthing system.
3. An earth continuity conductor shall be installed with all the feeders and circuits and shall be connected from the earth bar of the panel boards to the conduit system, earth stud of the switch box, lighting fixture, earth pin of the socket outlets and to any metallic wall plates used.
4. All the enclosures of motors shall be also connected to the earthing system.

### **2) SCOPE OF WORK**

1. The scope of work shall cover supply, laying, installation, connecting, testing and commissioning of:
  - 1.1 Earthing station.
  - 1.2 Earthing Aluminium/copper strips from earthing station to equipotential bar.
  - 1.3 Earthing Aluminum / copper strips / wires from equipotential bar to lay feeder mains and circuit to connect power panels, DBs, switchboards etc.
  - 1.4 Bonding of Non-current carrying parts, and metallic parts of the electrical installation.

### **3) STANDARDS**

1. The following standards and rules shall be applicable:
  - 1) IS: 3043 - 1987 Code of practice for Earthing.
  - 2) Indian Electricity Act and Rules

All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the British Standard Codes of Practice in absence of Indian standard.

#### **4) TYPE OF EARTHING STATION**

##### **PLATE EARTHING STATIONS**

1. The equipment neutral earthing shall be with Cast Iron plate earthing station, Cast Iron Earth plate shall be 30 x 30 x 0.35 mm for earthing.
2. The earth resistance shall be maintained with suitable soil treatment.
3. The resistance of each earth station should not exceed 1 ohm.
4. The earth lead shall be connected to the earth plate through Hot Dip G.I. bolts.
5. The earthing conductors shall be of copper strip in case of GI earthing.
6. G.I. pipe with funnel of approved quality shall be used for watering the earthing electrodes / stations.
7. The block masonry chamber with chequered plate shall be provided for housing the funnel and the pipe for watering the earthing electrodes / stations.
8. The hardware and other consumables for earthing installation shall be of copper/bras in case of copper earth plate and shall be hot dip galvanised iron material in case of G.I. earth plate.,
9. Test link / test pit cover through chequered plate.

##### **PIPE ELECTRODE EARTH STATION**

1. The earth station shall be as shown on the drawing and shall be used for equipment earth grid and/or street light pole earthing.
2. The earth electrode shall be 150 cms long 1.5 cms dia class "A", Galvanised iron pipe.
3. The earth resistance shall be maintained with a suitable soil treatment as shown on the drawing.
4. The resistance of each earth station should not exceed 1 ohm.
5. The earth lead shall be fixed to the pipe with a nut and safety set screws. The clamp shall be permanently accessible.

6. The earthing grid and the earthing conductor shall be hot dip Galvanised iron strips of the size as shown in the drawing.
7. G.I. pipe with funnel of approved quality shall be used for watering the earth electrode \ station.
8. The block masonry chamber with chequered plate shall be provided for housing the above referred funnel and pipe.
9. The hardware and other consumables for earthing installation shall be hot dip Galvanised iron material as shown on the drawing.

#### **CHEMICAL PIPE-IN-PIPE EARTHING**

1. The substation earthing shall be with copper plate earthing station unless otherwise specified & earthpit of minimum bore dia. 225mm size ASH or approved make Safe Earthing Electrode consisting Pipe-in-Pipe Technology as per IS 3043-1987 made of corrosion free G.I.Pipes.
2. The earthing station shall be as shown on the drawing. The two earth electrodes shall be 80mm & 40 mm dia GI pipes plate. The earth resistance shall be maintained with a suitable crystalline conductive materials and back fill compound.
3. The resistance of each earth station should not exceed 1 ohms.
4. The earth lead shall be connected to the earth pipe through copper/brass bolts.
5. The pipe-in -pipe earth station shall be as shown on the drawing and shall be used for equipment protective earth grid.
6. The earth electrodes shall be galvanized pipes 3.0 long with outer pipe 80 mm dia & inner pipe 40 mm dia. The outer pipe shall be plated with 80-200 microns & inner pipe shall be plated with 200-250 microns with connection terminal dia of 14 mm.
7. Crystalline Conductive material-Mixture of nature minerals and a chemical compound, highly conductive and non corrosive, which prevents the inner pipe from corrosion and dissipates the current evenly.
8. Back fill compound - Moisture retaining compound having 13 times more (Hygroscopic) water retaining capacity than its dry volume & shall be 2 bags of 25 kgs.
9. The earth lead shall be fixed to the pipe with a clamp and safety set screws. The clamps shall be permanently accessible.

#### **5) WORKMANSHIP**

## INSTALLATION AND CONNECTION

1. The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case less than 3 M below finished ground level.
2. The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column.
3. The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.
4. 20 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid level of block masonry chamber.
5. Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe.
6. The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing.
7. The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.
8. Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.
9. The earth conductors (Strips / Wires, Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanised Iron clamps and Hot Dip GI screws / bolts. The conductors outside the building shall be laid atleast 600 mm. below the finished ground level.
10. The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.
11. Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.
12. The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

## EARTH LEADS AND CONNECTIONS

1. Earth lead shall be bare copper or Galvanised steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. Galvanised steel buried in the ground shall be protected with bitumen and hessian wrap or polythene faced hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is atleast 8 mm away from the wall surface.
2. The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.
3. Wherever crossing is required, earthing jumper shall be of insulated wires.

## **EQUIPMENT EARTHING**

1. All apparatus and equipment transmitting or utilising power shall be earthed in the following manner. Copper /G.I. earth strips/wires shall be used unless other-wise indicated in the Schedule.

## **6) TEST**

1. The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS: 3041.
2. The following earth resistance values shall be measured with an approved earth megger and recorded.
  - 2.1 Each earthing station
  - 2.2 Earthing system as a whole
  - 2.3 Earth continuity conductors
3. Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 ohm in each case.
4. Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.
5. All tests shall be carried out in presence of the consultant / client.

## **7) MODE OF MEASUREMENT**

1. Provision of earthing station complete with excavation, electrode, watering pipe, soil treatment, masonry chamber with cast iron cover etc. shall be treated as one unit of measurement.
2. The following items of work shall be measured and paid per unit length covering the cost of the earth wires / strips, clamps, labour etc.
  - a) Main equipment earthing grid and connection to the earthing station.
  - b) Connection to the switch board, power panels, DB etc.

3. The cost of earthing the boq items shall become part of the cost of the item itself and no separate payment for earthing shall be made.

## **10 TECHNICAL SPECIFICATION FOR LIGHTNING PROTECTION SYSTEM.**

- ❖ Advanced lightning Protection System– Based on NBC-2016.
- ❖ This system contains three type of system which is done by Mesh Method, Protective Angle Method & Protection Sphere Method.
- ❖ First of all Risk Assessment calculation is done to calculate the risk of Lightning Stroke which concludes whether the lightning Protection System is needed or not.
- ❖ After concluding that the system should be installed, based upon the risk parameters & type of building , Level of Lightning Protection is defined as per the type of loss if lightning Protection Occurs.
- ❖ Based on the risk assessment if protection is necessary, lightning protection is divided into four levels (LPL I to IV) which helps in designing and implementing protection measures for an economical implementation.
- ❖ LPL I provides the maximum protection and is expensive, whereas, LPL IV provides the least protection and is less expensive. Recommended lightning protection level (LPL) for typical buildings is given in NBC Vol-2 ,Table 5 ,Clause (11.3.4) for guidance.
- ❖ Air-termination components installed on a structure shall be located at corners, exposed points edges (especially on the upper level of any facades) in accordance with one or more of the following methods
  - Protection angle method;
  - Rolling sphere method; and
  - Mesh method.
- ❖ The protection angle method is suitable for simple shaped buildings but it is subject to limits of air-termination height indicated in NBC Vol-2 ,Table 6. The mesh method is a suitable form of protection where plane/pitch roof surfaces are to be protected.
- ❖ Mesh is done by 8 mm dia Aluminium Conductor & Mesh size is considered as per given table as per appropriate Level as per Table-6 of Protection and similarly the distance between rods is kept at the edges as per NBC Vol-2 ,Table 7.

Down conductors here used is 8 mm dia Aluminium Conductor to LPS earthing at Ground level

