

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL SYSTEM



**Name of Work:** Supply, Installation, Testing & Commissioning of Electrification work for 16 Aanganwadis at various places in East Zone and West Zone, Vadodara (%Rate Basis).

## SPECIFICATIONS FOR ELECTRICAL WORKS

SR.NO	PARTICULARS
1	General Instructions for Electrical Works
2	Technical Specification for LT Panels.
3	Technical Specification for LDBs & PDBs.
4	Technical Specification for LT Cables & Cable Tray.
5	Technical Specification for Internal Wiring.
6	Technical Specification for Lighting Fixtures.
7	Technical Specification for Data, TV & Telephone wiring.
8	Technical Specification for Earthing System.

## 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 Class A 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.

Civil Contractor shall provide the MOU signed with Electrical contractor (Class A) with Technical bid during bidding process.

### 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 British
HRC	:	High Rupturing
GI	:	Capacity Galvanised
CU	:	Iron Copper
MS	:	Mild Steel
MV	:	Medium Voltage
LV	:	Low Voltage
PVC	:	Polyvinyl Chloride
AMP	:	Amperes
V	:	Volts

KV HV	:	Kilo Volts
KW	:	High Voltage
KVA	:	Kilo Watt
PF Hz	:	Kilo Volt Ampere
KWH	:	Power Factor
XLPE	:	Frequency
ACB	:	Kilo Watt Hour
LED	:	Cross Linked Polyethylene
PLC	:	Air Circuit Breaker
UPS	:	Light Emitting Diode
DP	:	Programmable Logic Controller
IEE	:	Uninterrupted Power Supply
MCB	:	Double Pole
TPN	:	Institute of Electrical Engineers, London
SP	:	Miniature Circuit Breaker
MCCB	:	Triple Pole and Neutral
VCB	:	Single Pole
CT DB	:	Moulded Case Circuit Breaker
DG	:	Vacuum Circuit Breaker
BOQ	:	Current Transformer
SITC	:	Distribution Board
L.O.I.	:	Diesel Generator
ELV	:	Bill of quantity
MP	:	Supply, Installation, Testing and Commissioning
	:	Letter of Intent / Acceptance letter
	:	Extra Low Voltage System
	:	Mega Pixels

CCTV	:	Close Circuit Television Public
PA	:	Address System Fire Alarm Control
FACP	:	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. Low voltage switchgear and control gear
IS: 13947	Low voltage fuses
IS: 9224	Circuit breakers for out protection for household and
IS: 8828	Similar installations Earth leakage circuit breaker
IS: 12640	direct acting indicating analog electrical measuring
IS: 1248	Instruments Current transformers
IS: 2705	Application guide for voltage transformers
IS: 4201	Control switches for voltage up to and indicating 1000 V A.C. and 1200 V D.C.
IS: 6875	

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 up to and including 1100 volts
	Danger notice plates
IS: 2551	Code of practice for earthing
IS: 3043	Guide for safety procedures and practices in electrical work
IS: 5216	Code of practice for fire safety of building: Electrical
IS: 1646	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 conform 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, along with the samples, at least 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.  
Route and particulars of all cables.
- c. Lighting layout plans with conduit routing layout/cable tray for all the floors
- d. along with circuit distribution details.  
External Area Lighting Plan
- e.

#### 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. All the major electrical components like Transformers, DGs, HT MV LT switchgears, DBs, UPS, etc including the external & internal electrical distribution system, earthing systems & various equipments (which is supplied &/or installed by the contractor) shall be maintain for 2 years from the date of virtual completion of work at free of cost.
- b. 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.
- c. 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.

- d. LT Panels shall be approved on site by Engineer in Charge & Electrical Consultant.
- e. Contractor shall submit Shop drawings for approval to Electrical consultant based on tender drawings before execution which shall not be on chargeable basis.
- f. The MCB and MCB DBs must be of same make.
- g. Make of components required to be used by contractor to complete the installation, if by not mentioned anywhere, shall be required to GOT IT APPROVED Client/Architect/Consultant before installation in writing manner.
- h. 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 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.
  - o Handle interlock to prevent unnecessary manipulations of the breaker.
  - o 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.
  - o PLC controller to operate the Motorized 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.  
The tripcommand shall override all other commands.
- 6.4.4

#### 6.5 MINIATURE CIRCUIT BREAKER (MCB)

- 6.5.1 Miniature Circuit Breaker shall comply with IS-8828-1996/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 handle is to be incorporated to check the integrity of the~~ A test handle is to be incorporated to check the integrity of the 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.

#### 4) ELECTRICAL POWER AND CONTROL WIRING CONNECTION : Terminal for both incoming

- 1. 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
- 3. aluminium conductor (XLPE) cables. 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.

9. Identification ferrules shall be fitted 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.

#### 5) 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.

#### 6) 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.

#### 7) 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.

#### 8) 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.

12. 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) laminated sheet. However, black engraved perspex sheet name plates shall also be acceptable. Engraving shall be done with square groove cutters.

4. Name plate shall be fastened by countersunk screws and not by adhesives.

#### 9) 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.  
The said letters, the figures and the sign of skull and bones shall be painted in signal red colour
7. as per IS: 5-1978.  
The danger plate shall have rounded corners. Location of fixing holes for the plate shall be
8. decided to suit design of the Panels.  
The danger notice plate, if possible, be of ISI certification mark.
- 9.

#### 10) EARTHING

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

#### 11) PAINTING

12. 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).

13. The shade of colour of panel inside/outside shall be as per BOQ confirming to IS Code No.5.

#### 12) 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.

### 13) 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.

### 14) 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.  
The CTs shall conform to relevant Indian Standards. The design and construction shall be dry
3. type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be
4. easily accessible for testing and terminal connections.  
The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.
- 5.

### 15) POTENTIAL FREE CONTACTS

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

### 16) 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.

### 17) 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.

### 18) 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.

19) 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.  
Positioning, aligning, fixing, assembling, and installation of LT panel issued free of cost by Client
4. after carrying out proper cleaning and inspection.  
Site supervision, testing for proper functioning / operation, and pre-commissioning tests.
- 5.

20) COMMISSIONING & 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.

21) 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.

22) MODE OF MEASUREMENT:

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

### 3 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-13947-1991.

#### 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 conform 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. 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 COMPRISE 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 confirm 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 suffices 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:
  - o Measurement of the fault current value.
  - o Comparison of the fault current with a reference value.
  - o The RCCB should have a torroidal transformer which has the main conductors of primary (P - N) which check the sum of the current close to zero.
  - o 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
- o core balance torroidal transformer. Its accuracy should be  $\pm 5\%$ . It should
  - o operate even in case of neutral failure. It should trip at a present leakage current
  - o within 100 mA Its enclosure should be as per IP 30. Its mechanical operation life
  - o should be more than 20,000 operations. It should provide full protection as
  - o envisaged by IE rules - 61-A, 71 - ee, 73 - ee, 1985 and also rule 50 of IE rule 1956.
  - o It should conform to all national and international standards like IS: 8828-1993,
  - o IS: 12640-1988, BS 4293 - 1983, CEE 27 (International commission Rules for the approved of electrical equipment).
  - o
  - o

#### 4) EARTHING

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

#### 5) 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.

#### 6) 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.

#### 7) 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

#### 8) 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.

9) 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.  
The distribution boards shall have circuit chart tagged on the door for future maintenance.
4. 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.

10) MODE OF MEASUREMENT:

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

4 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 F
Steel strip armour	WW
Steel Double round wire armour	
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 manufactures' 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. ~~for continuity and insulation resistance~~ Prior to laying of cables, the cores shall be tested

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-ohm
  - Duration 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.



## 5 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 ITS 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 m2
Earth	1.5 m m2

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 m2
Earth	1.5 m m2

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

Phase / Neutral	4.0 m m2
Earth	1.5 m m2

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

### 6 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 :

- IS 3646 - 1960 Code of practice for interior illuminator.
- (B) IS 1913 - 1969 General and Safety requirements for Electric lighting fittings.

(C) Indian Electricity Act and Rules issued thereunder.

- 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) GENERAL REQUIREMENTS :

Tube Light with integral/ non-integral driver 20-22 Watts, Surge - 4KV, IP-20 LED indoor fittings with LEDs of wattage 0.2 Watt to 0.5 Watt assembled on single MCPCB, with housing used as a heat sink shall be made of thick sheet Steel conforming to IS: 513/CRCA polyester powder coated and high U.V. & corrosion resistance with diffuser and/or Polycarbonate optics with company mark/name 120 to 300 V, Power Factor more than 0.9, THD < 10 %, CCT 4000 K to 6500K, Uniformity ratio >0.7, Luminaire efficacy > 100 lumens/watt, LED driver efficiency > 85 %

LED Lamps integral type, cool white with PC diffuser suitable for B22 LAMP holder 5 to 8 watts LED indoor fittings with LEDs of wattage 0.2 Watt to 0.5 Watt assembled on single MCPCB, with housing used as a heat sink shall be made of thick sheet Steel conforming to IS: 513/CRCA polyester powder coated and high U.V. & corrosion resistance with diffuser and/or Polycarbonate optics with company mark/name 120 to 300 V, Power Factor more than 0.9, THD < 10 %, CCT 4000 K to 6500K, Uniformity ratio >0.7, Luminaire efficacy > 100 lumens/watt, LED driver efficiency > 85 %

LED Panel Light with provision for Plane front frame with translucent cover fixed to housing complete 24 watts, 300 x 300 mm, Surge-4 KV LED indoor fittings with LEDs of wattage 0.2 Watt to 0.5 Watt assembled on single MCPCB, with housing used as a heat sink shall be made of thick sheet Steel conforming to IS: 513/CRCA polyester powder coated and high U.V. & corrosion resistance with diffuser and/or Polycarbonate optics with company mark/name 120 to 300 V, Power Factor more than 0.9, THD < 10 %, CCT 4000 K to 6500K, Uniformity ratio >0.7, Luminaire efficacy > 100 lumens/watt, LED driver efficiency > 85 %

LED Panel Light with provision for Plane front frame with translucent cover fixed to housing complete up to 36 watts, 600 x 600 mm, Surge- 4KV LED indoor fittings with LEDs of wattage 0.2 Watt to 0.5 Watt assembled on single MCPCB, with housing used as a heat sink shall be made of thick sheet Steel conforming to IS: 513/CRCA polyester powder coated and high U.V. & corrosion resistance with diffuser and/or Polycarbonate optics with company mark/name 120 to 300 V, Power Factor more than 0.9, THD < 10 %, CCT 4000 K to 6500K, Uniformity ratio >0.7, Luminaire efficacy > 100 lumens/watt, LED driver efficiency > 85 %

### 4) 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.

### 5) 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.

#### 6) 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.

#### 7 TECHNICAL SPECIFICATION FOR DATA, TELEVISION & TELEPHONE WIRING.

##### 1) GENERAL DESCRIPTION

1. The work shall cover the supply and installation of the TV, Telephone and Computer data points including laying of Cables in 19/20 mm dia PVC Conduit.

##### 2) SCOPE

##### TELEPHONE CABLES AND WIRES:

1. The type of cables and the services shall be as follows:
2. Indoor – Multipair PVC sheath armoured / un-armoured as specified 0.6 mm tin Cu. Cable.
3. Outside -- Multipair PVC sheath armoured / jelly filled as specified 0.6 mm tin Cu. Cable.
4. All multi core cables and wires shall be of tinned copper conductor of not less than 0.6 mm dia and shall be colour coded twisted pairs with rip cord.
5. The conductor resistance shall be less than 150 ohms per KM and the insulation resistance between the conductors not less than 50 mega ohms and the nominal capacitance of about 0.1 microfarad per kilometre.



6. Cables laid underground or locations subject to dampness and flooding shall be filled with polyethylene compound and shall have sufficient protection against moisture and water ingress.

7. All armouring shall be of galvanized steel wires and protected against corrosion by an outer sheath of PVC in the case of indoor cables and polyethylene in the case of outdoor cables. Outer sheathing must be fire retarding and anti-termite.

8. All un-armoured single core cables and inner sheath of armoured cables shall be provided with ripcord.

#### TELEPHONE TAG BLOCKS:

9. The telephone tag blocks shall be suitable for the multi core telephone cables and shall have two terminal blocks, cross connect type. All incoming and outgoing cables shall be terminated on separate terminal blocks and termination shall be silver soldered. The cross connecting jumpers shall be insulated wires of same diameter and screw connected.

10. The tag blocks shall be mounted inside fabricated sheet steel boxes with removable hinged covers and shall be fully accessible. The enclosure shall be painted with 2 coats of red oxide and stove enamelled.

#### TELEPHONE OUTLET SOCKET:

11. Telephone outlet socket shall be of the same make as that of the switches and accessories. The outlet sockets shall consist of 2 A 2 Pair polyethene connector in M.S.I / PVC boxes with switch plate of the same make as that of switches and telephone socket. The telephone outlet socket unless and otherwise specified shall be jack type and not pin type.

#### COMPUTER WIRES:

12. The computer wires shall be of 4 pair enhanced Cat 6 category and shall be of the makes as specified in the tender.

#### COMPUTER DATA OUTLET SOCKETS:

13. The computer sockets shall be of e Cat 6 category and of the make specified in the tender. The sockets shall be installed in the plates of the modular switches range to be used. The sockets shall be crimped using crimping tool with the Cat 6e wire.

14. For clean room application the plates shall be of SS 316 with no sharp edges.

#### TELEVISION WIRING & SOCKETS:

15. The Co-axial cable shall be of wide band type with operation capability upto 500 MHz.as of Delton type.

16. The Co-axial cable shall comprise of inner conductor of solid bare copper insulated with Foam PE & Secondary Conductor made of poly-Aluminium film bonded Aluminium braids and having coverage of 65%, overall sheathed with black PVC Insulation.

17. Twisted cables shall be electrolytic grade annealed copper conductor insulated with PE insulation twisted in to pairs with colour combination bunched together in concentric layers

so as to minimize cross-talk & wrapped with FR PVC taps and sheathed with FR PVC or HFFR outer jacket suitable for indoor telephone wiring and conforming to C-DOT S/WS-113/ IEC 60189-2, UL-1581 SECTION 1080.

18. The ageing resistance of the co-axial cable shall comply with DIN 47252, Part 2, i.e. max. 5% increase in attenuation at 200 MHz. measured by artificial ageing (14 days at 80 deg. C)

### 3) WORKMANSHIP

1. All cables shall be on cable racks and neatly stitched together.
2. The connection at the tag blocks shall be silver soldered so as to achieve minimum contact resistance.
3. The final branch connections with single pair cables in conduits and the maximum number of cables in each conduit shall be as follows:

Conduit diameter	Inch	mm.	Max. No. of cables
	3/4"	20	
	1"	25	2 Nos. single pair
	1 1/4"	32	6 Nos. Single pair
	1 1/2"	40	12 Nos. Single pair
			18 Nos. single pair

4. The tag blocks shall be mounted inside fabricated sheet steel boxes with removable hinged covers and shall be fully accessible. The enclosure shall be painted with 2 coats of red oxide and stove enamelled.

### 4) MODE OF MEASUREMENT

1. The wires, conduits and raceways shall be measured in rmt whereas the outlet sockets, junction boxes and tag blocks shall be measured in units.

## **Technical Specification for Solar System:**

~~This technical specification for a 50 kWp Battery-less (On-Grid) Solar Power Plant is reorganized for maximum clarity, following industrial tender standards.~~

### ~~1. Solar PV Modules and Array~~

~~The Solar PV modules are the primary generation source and must meet stringent quality and durability standards.~~

- ~~**Technology:** Crystalline Silicon (Mono or Multi) using high-power cells.~~
- ~~**Total Capacity:** 50 kWp (50000 Wp).~~
- ~~**Module Efficiency:** Electrical conversion efficiency must be  $\geq 12\%$ .~~
- ~~**Power Tolerance:** Rated output power must not vary more than  $\pm 5\%$  from the average rating.~~
- ~~**Certification Standards:**~~
  - ~~**Design Qualification:** IEC 61215 / IS 14286.~~
  - ~~**Safety Qualification:** IEC 61730 Part I & II.~~
  - ~~**Corrosive Atmosphere:** IEC 61701 (for high-corrosion environments).~~

- **Environmental Resilience:** Satisfactory operation in humidity up to 100% and temperatures between  $-10^{\circ}\text{C}$  and  $+65^{\circ}\text{C}$ . Modules must withstand wind gusts up to **200 km/h**.
- **Performance Warranty:**
  - $\geq 90\%$  of peak watt capacity at the end of **10 years**.
  - $\geq 80\%$  of peak watt capacity at the end of **20 years**.
- **Construction:** High transmissivity, low-iron tempered glass front for superior light transmission and a tough multi-layered polymer backsheet for high-voltage insulation.

### 1.1 Identification and Traceability (RFID)

Each module must include an RF identification tag (RFID) containing:

1. Manufacturer Name (Module and Cells).
2. Month and Year of Manufacture.
3. Country of Origin.
4. I-V Curve data.
5. Peak Wattage,  $I_{\text{m}}$ ,  $V_{\text{m}}$ , and Fill Factor (FF).
6. Unique Serial Number and Model Number.

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## 2. Module Mounting Structure (MMS)

- **Material:** Hot-dip Galvanized MS angles (Minimum size **50mm x 50mm x 6mm**).
- **Galvanization:** Minimum thickness of **120 microns**.
- **Fasteners:** All nuts and bolts must be high-quality **Stainless Steel**.
- **Design Criteria:**
  - Designed for simple mechanical installation without on-site welding.
  - Must withstand wind speeds of **200 km/h**.
  - Allows for easy replacement of any individual module.
- **Foundation:** Fixed and grouted in **PCC (1:2:4)** concrete columns.
- **Ground Clearance:** Minimum **500 mm** from the ground level to the lowest part of the module.

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## 3. Solar Power Conditioning Unit (PCU / Inverter)

Since this is a battery-less system, the PCU acts as an On-Grid Inverter.

- **Function:** Converts DC electricity from the array into high-quality AC power.
- **Capacity:** **50 kW** nominal output.
- **Protections:** Integrated electronic protections against over-voltage, short-circuits, and grid fluctuations.

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## 4. Junction Boxes (DCDB)

- **Enclosure:** Dust, vermin, and waterproof made of FRP / Thermo Plastic (**IP65** for outdoor).
- **Components:** Copper bus bars of proper sizes, cable glands, and appropriate rating **blocking diodes**.
- **Function:** Facilitates group array isolation and provides test points for quick fault location.

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## 5. AC Distribution Board (ACDB)

- **Placement:** Located between the PCU and the Load Point.
- **Metering:** Equipped with an AC Voltmeter and Ammeter.
- **Protection:** Includes MCBs of suitable ratings for connection to the load and auxiliary control room loads (fans, lighting).

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## 6. PV Grade Cables and Accessories

- **Standard:** Conforming to **IEC 60189 / IS 694 / IS 1554** (650V / 1.1kV grade).

- **Conductor:** ~~PVC insulated, PVC sheathed Copper conductor.~~
- **Efficiency:** ~~Cable sizing must ensure total electrical energy loss is  $\leq 3\%$ .~~
- **Minimum Size:** ~~No conductor smaller than 4 sq. mm shall be accepted.~~
- **Management:** ~~All wiring must be in a casing-capping system or conduits. Armored cables are mandatory for underground burial.~~

## 7. Earthing and Lightning Protection

- **Earthing:**
  - ~~Array structure grounded using GI pipe electrodes (4.5m long, 10mm diameter).~~
  - ~~Masonry enclosures with cast iron covers for earthing pits.~~
  - ~~Array structures and lightning conductors connected via 25mm x 5mm GI strip.~~
- **Lightning Protection:** ~~Integrated system to reduce over-voltage to tolerable levels during atmospheric disturbances.~~
- **Safety: Danger Notice Plates** (200mm x 150mm) in English and local language at the PV Yard and Control Room.

Sr. No	Component	Specification Summary
1	<b>Solar Array</b>	50000 Wp (Using 330Wp+ Modules)
2	<b>Inverter</b>	50 kW On-Grid PCU (1 Unit)
3	<b>Mounting</b>	Hot-dip Galvanized MS (120 Micron)
4	<b>Voltage Grade</b>	1.1 kV (Copper Cables)
5	<b>Grounding</b>	GI Pipe Electrodes as per IS:3043

## 1. Solar PV Modules & Traceability

The system shall utilize high-efficiency crystalline silicon modules. Each module must be designed to withstand extreme environmental conditions while maintaining peak performance.

### 1.1. Technical Parameters & Data Sheet

The bidder must furnish the following data for the proposed modules:

Parameter	Specification Requirement
<b>Module Make &amp; Country</b>	Any MNRE approved / IEC 61215 certified
<b>Module Type</b>	Mono / Multi Crystalline Silicon
<b>Peak Power (<math>P_{max}</math>)</b>	$\geq 330$ Wp per module
<b>Electrical Efficiency</b>	$\geq 12\%$
<b>Frame Material</b>	Corrosion-resistant material (Electrolytically compatible)
<b>Junction Box</b>	Weather Resistant HDPE (IP55/IP65) with Cable Glands

Parameter	Specification Requirement
Operating Temperature	-10°C to +65°C
Wind Resistance	Up to 200 km/h
Max Temp. Rise	Over Max Ambient (to be specified by bidder)

## 1.2. Identification and RFID Requirements

As per ISO 9000 series, each module must contain an **RFID tag** embedded inside the laminate with the following data:

- Name of Manufacturer (Module & Cells).
- Month/Year of Manufacture and Country of origin.
- Unique Serial Number and Model Number.
- **I-V Curve** for the module.
- Peak Wattage, \$I\_m\$, \$V\_m\$, and Fill Factor (FF).
- IEC Qualification Certificate details and name of the issuing Test Lab.

## 2. Module Mounting Structure (MMS)

The structure must be robust enough to support the modules for 25 years without site welding.

- **Material:** Hot-dip Galvanized MS angles (Min **50mm x 50mm x 6mm**).
- **Galvanization:** Minimum **120 microns** thickness.
- **Foundation:** Legs grouted in **PCC (1:2:4)** concrete columns.
- **Ground Clearance:** Minimum **500 mm** from the lowest part of the module.
- **Hardware:** All nuts, bolts, and washers must be high-grade **Stainless Steel**.
- **Design:** Calculated based on site Latitude/Longitude for maximum energy output.

## 3. Power Conditioning Unit (PCU) & Distribution

### 3.1. PCU (Inverter)

- **Rating:** 50 kW (Battery-less / On-Grid).
- **Function:** Converts DC to AC and synchronizes with the grid.
- **Protection:** Built-in protection for over-voltage, short-circuit, and anti-islanding.

### 3.2. AC Distribution Board (ACDB)

- Installed between PCU and Load point.
- Includes **MCBs** of suitable ratings.
- Equipped with **AC Voltmeter and Ammeter** for output monitoring.

## 4. Junction Boxes & Cabling

- **Junction Boxes:** FRP/Thermoplastic construction, dust/waterproof (**IP65** outdoor, **IP21** indoor). Includes blocking diodes and copper bus bars.
- **Cables:** 650V/1.1kV grade PVC insulated copper cables (IS 694/1554).
- **Energy Loss:** Sized to ensure total DC/AC cable loss is **< 3%**.
- **Installation:** Casing-capping for internal wiring; armored cables for underground burial.

## 5. Earthing & Safety Protection

- **Earthing:** GI pipe electrodes (**4.5m long**, 10mm dia) as per **IS:3043**.
- **Conductors:** 25mm x 5mm GI strips for array structures; tinned copper strips for the control room.
- **Lightning Protection:** Dedicated system to neutralize atmospheric surges.

- **Signage:** Red **Danger Plates** (200mm x 150mm) at the PV yard, Control room, and Battery room.

## 6. Commissioning & Logistics

- **Scope:** Includes supply, installation, testing, and commissioning in the presence of VMC personnel.
- **Tools & Display:** A maintenance tool kit and a **3ft x 3ft Display Board** (showing the circuit diagram) must be provided.
- **Insurance:** Ex-factory insurance coverage until successful commissioning and acceptance.
- **Warranty:** Output peak capacity  $\geq 90\%$  at 10 years and  $\geq 80\%$  at 20 years.

## Executive Summary: 50 kWp On-Grid Solar Power Plant

Sr. No.	Component	Detailed Specifications
1	Solar PV Modules	50000 Wp (Total Capacity)
	(a) Module Make	Any MNRE approved or IEC 61215 (Revised) certified
	(b) Individual Rating	330 Wp or higher per module (or equivalent)
	(c) Quantity	Quantity depends on individual module wattage
2	Mounting Structure	Custom-designed as per available site footprint (Hot-dip Galvanized)
3	PCU (Inverter)	50 kW On-Grid Inverter (1 No.); must meet tender design specifications
4	Cabling	PVC Copper cables with surface/recessed casing-capping (As per site requirement)
5	Transmission & Wiring	Transmission, Distribution, and Point Wiring (As per site requirement)
6	Control & Protection	1 Set (Includes monitoring, control, and integrated protection devices)
7	Metering	1 No. (AC Side) Generation Meter for performance tracking
8	Spares & Hardware	1 Set (Includes required fuses, screws, terminals, etc.)

## Key System Features

- **Grid Interaction:** This is a battery-less, on-grid system designed to export excess power back to the grid (if net metering is applied).
- **Safety Compliance:** Includes standard protection against over-voltage, short-circuits, and lightning.
- **Durability:** Module mounting structure is designed to withstand local environmental loads and wind speeds up to 200 km/h.

## **List of Makes: Electrical**

1	LT PANELS	CPRIAPPROVEDPANELBUILDER50KA SHORTCIRCUITWITH STHANDSTRENGTH.
2	DISTRIBUTION BOARDS	LEGRAND/ SCHNIEDER / HAGER / ABB
3	MEDIUM VOLTAGE CABLE	DIACAB/AVOCAB/POLYCAD /FINOLEX / RRKABLE / KEI / HAVELLS / GLOSTER/ALLCAB
4	CABLE TRAY ( ALL TYPE )	PROFAB / PRECISION / THINKTRECK / UNIVERSAL / INDIANA / KEW
5	LT SWITCHGEAR (ALL RANGE)	ASPERSPECIFIEDPANELDISCRIPTIONIN BOQ. MODEL AS PER SPECIFIED IN BOQ ABB/SIEMENS/SCHNEIDER/LEGRAND
6	LT MCCB	SIEMENS / SCHNEIDER / LEGRAND / ABB
7	LTMCB,ELCB	LEGRAND / SCHNEIDER / HAGER /ABB
8	LT SFU	SIEMENS / SCHNEIDER / C&S / L&T / ABB / STANDARD / HPL
9	LT CONTACTORS	SIEMENS / SCHNEIDER / L&T / ABB / C&S / INDOASIAN / LEGRAND
10	CHANGE OVER SWITCH	HPL / ABB /L&T/ INDOASIAN / C&S
11	METERS (ANALOG)	ENERCON / CONZERVE / SCHNEIDER / SECURE/ABB/MECO/IMP/RISHABH/ AUTOMATIC/ELECTRIC/NIPPEN
12	INDICATING LAMP	SIEMENS/SCHNEIDER/L&T/BINAY/ABB / KAPPA/ PRECIFINE/ TEKNIC / C&S
13	ELECTRIC TIMER	SIEMENS / L&T / LEGRAND/CONSERVE / EAPL/Thorn
14	ROTARY SWITCH	SIEMENS/SCHNEIDERELECTRIC/KEYCEE/ SALZER
15	PUSHBUTTONANDPUSHBUTTON SET	SIEMENS / SCHNEIDER ELECTRIC / L & T / BINAY / ABB / MG / BCH / RAAS CONTROL
16	SELECTOR SWITCH	KEYCEE / SALZER / L&T
17	ANNUNCIATOR	PROTON / EAPL
18	LUGS	DOWELL'S / 3D / JAINSON / COMET / HMI
19	BIMETALLIC LUGS	ISMAL / HMI
20	CABLE GLAND	JAINSON / 3D / COMET / HMI
21	PVC CONDUITS AND ACCESSORIES	PRECISION / NIHIR / POLYCAB
22	CASING CAPING	PRECISION / NIHIR / POLYCAB / MODI
23	MODULARSWITCHES, SOCKETS & OTHER ACCESSORIES	MK-WRAPROUND/LEGRAND-MYRIUS/ HAVELLS – CRABTREE-ATHENA
24	KEYTAGPANELWITHCONTROL SWITCH	MK/LEGRAND
25	METAL CLAD SOCKET WITH MCB	MDS / SIEMENS
26	PVC TAPE	STEEL GRIP
27	PVC JUNCTION BOX	SINTEX /CLIPSAL/NIHIR/PRECISION

28	WIRES FOR INTERNAL WIRING	FINOLEX / RRKABLE / HAVELLS / POLYCAB / KEI
29	COAXIAL TV CABLE	DELTON / NATIONAL / HAVELLS / RR KABLE / FINOLEX
30	CONNECTORS (COLOURS AS PER PHASE & NEUTRAL)	SALZER / ELEMEX / WAGO / CONNECTWELL/PHOENIX
31	LIGHT FIXTURES	PHILIPS, CROMPTON, LT, HELONIX
32	CEILING FAN , EXHAUST FAN	CROMPTON, HAVELS,ORIENT
33	LIGHTING PROTECTION	MAP WORLD WIDE/ STERLING/INDELEC/EMTERPRISE/OBO/EQUIVALENT
34	ROOF TOP SOLAR POWER PLANT	THOROUGH GEDA'S EMPANELLED AGENCY ONLY
35	MOTOR PUMP SET	KIRLOSKER/ CROMPTON/LUBI
36	MOTOR STARTER	L&T, SIEMENS, GALCO,ALLICO
37	CABLE	FINOLEX/INCAB/AVOCAB/KEI/POLYCAB/RR CABLE

### **List of Makes: Solar System**

1	<del>PCU / Inverter</del>	<del>SMA, ABB India, Hitachi Hi-Rel, Delta Electronics, Schneider Electric, Sungrow, Solaredge, Solis, Growatt</del>
2	<del>PV Modules</del>	<del>Vendors listed in the Latest ALMM Order (Approved List of Models and Manufacturers)</del>
3	<del>LT Switchgear &amp; Enclosures</del>	<del>L&amp;T, Siemens, ABB, Schneider Electric, Hensel Electric, Urja Techniques, Jayesh Electricals, Havells, C&amp;S (Panel must be CPRI approved)</del>
4	<del>Solar DC Cable</del>	<del>LAPP, Siechem, KEI Cables, UniFlex, Cords Cables, Apar, Universal, KEC, Leoni, Suyog Electricals, Polycab</del>
5	<del>AC Cable</del>	<del>LAPP, KEI, Havells, Universal, KEC, GEMSCAB, Suyog Electricals, Apar, Siechem, RR Cable, Polycab</del>
6	<del>Steel Structure (MMS)</del>	<del>ESSAR, TISCO, SAIL, JINDAL</del>
7	<del>Earthing Pit Materials</del>	<del>Ashlok, ERICO</del>



8	<del>String Junction Box (SJB)</del>	<del>Hensel Electric, Trinity Solar, Eaton, Photon</del>
9	<del>Lugs</del>	<del>Dowell, Comet, 3D, HEX</del>
10	<del>Cable Glands</del>	<del>Comet, 3D</del>
11	<del>Optical Fiber Cable</del>	<del>Polycab, RR Cable</del>
12	<del>Lightning Arrestor (ESE)</del>	<del>Erico, Nimbus, AT (Spain), Ingesco, Indelec, Ashlok</del>
13	<del>Bi-Directional Meter</del>	<del>SEMS, EDMT, or any DISCOM Approved Make</del>
14	<del>MCCB</del>	<del>Siemens, ABB, Schneider, L&amp;T</del>

#### Compliance Notes:

- **ALMM Compliance:** For Solar PV modules, the bidder must ensure the specific model is listed in the current ALMM (Approved List of Models and Manufacturers) as issued by MNRE.
- **Grid Synchronization:** The Bi-Directional/Net Meter must strictly follow the local DISCOM (Electricity Board) specifications to ensure successful grid integration.
- **Switchgear Safety:** All LT panels must be sourced from CPRI (Central Power Research Institute) approved vendors to guarantee short-circuit and temperature-rise compliance.

Signature of Contractor

Deputy Executive Engineer

Executive Engineer

Superintending Engineer

