

GENERAL PARTICULARS AND REQUIREMENTS ELECTRICALS

1. GENERAL

These specifications shall be read in conjunction with Condition of Contract, Bill of Quantities and Drawings to cover the Supply, Erection, Testing, and Commissioning of Electrical work.

1.1 Scope of work

The general character and the scope of work to be carried out under this contract are illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the same work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Engineer. The contractor shall supply all labor, materials and equipment as required and specified for supply, Installation, Testing, Commissioning and Handing Over of the complete Electrical System. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings / Documents as being furnished or installed but which is necessary and customary to be performed under this Contract.

The Supply Authority will terminate their supply feeder in the HT metering panel from where the scope of this tender starts including installation of the Metering Panel.

The electrical Work mainly comprises of but not limited to –

- LT Power Distribution
- Light, FAN & Plug Point
- Cables and Wires
- SITC of Section Pillar, PCC Panel etc.
- Earthing System
- Light Design As per Lux Level Requirement & Execute accordingly.
- Get Permission of Concern Authority to Finished Work
- Liasoning Work for Power Supply

For execution of entire system, following are included in the Contractor's scope of

work as well as in the rates quoted by them -

- Prepare Light Design As per Lux Level Requirement, Finalize it with GMC Department Executive & PMC, Execute tender items as per final & approved design. Get Permission of Concern Authority to Finished Work, Get Power Supply from concern Electricity Board and complete Liasoning Work needed for it.
- Prepare Shop drawings / As built drawing and submit in 5 no. of sets.
- List of recommended spares, as installed drawings, operation and maintenance manual for the Electrical work.
- All major Civil / Structural works for Stadium Mast. Minor Civil works like excavation for trenches / underground pipes / conduits pedestal supports, chasing in the wall / ceiling or making hole in the RCC floor / ceiling or in brick wall for piping, Cables, Supports, grouting etc. including making good after completion or any other minor civil works required in connection with the installation of the systems are in Contractors scope.

2 Electrical Operation Considerations

- The design ambient temperature shall be considered as 45°C unless otherwise specified.
- The relative humidity shall be considered as 90%
- The system voltage and frequency variations shall be as given below:
- Voltage $\pm 5\%$ Frequency : $\pm 3\%$
- Combined voltage and frequency variation will not exceed 8%
- Under transient conditions voltage variation may be – 20% or + 10% of nominal voltage, this shall have no consequence on equipment operation
- Seismic Zone : Zone III
- Hot, Arid and Dry Climate.

2.1 Bye-laws and Regulations.

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the Bureau of Indian Standards. Latest Rules of Local Authorities and other statutory boards concerned shall also become applicable to the Installation. The cost of Inspector and approval of statutory authorities as and when required from

commencement of work to completion of work shall be borne by the contractor except the statutory fees for permanent work.

2.2 Shop Drawings / As-Built Drawings

Shop drawings / As-built drawings are to be prepared by the Contractor as stated in Scope of Work.

2.3 Material and Equipment

All materials and equipment shall in general have ISI Mark whichever available. The valid ISI certificate wherever available along with manufactures test certificate to be submitted before or along with dispatch of materials. Make shall be strictly in conformity with the list of approved manufacturers.

2.4 Manufacture Instructions

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project covering points not specifically mentioned in these documents, such instructions shall generally be followed in call cases. The specific requirement should be brought in to the notice of Engineer for their decisions.

3. Inspection and Testing

The Owner may carry out inspection and testing at manufacturer's works for this contract. NO equipment shall be delivered without prior written confirmation from Architect / Engineer. In case factory inspection is carried out, then all traveling and lodging expenses shall be borne by the Owner. However, all expenses related to testing shall be to Contractors account. Tests on site of complete works shall demonstrate the following among others.

That the equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.

That all items operate efficiently and quietly to meet the specified requirements. That all electrical circuits are correctly protected and that protective devices are properly co-ordinate.

The contractor shall provide all necessary instruments and labor for testing shall make adequate records of test procedures and readings shall repeat any tests requested by the Architect / Engineer and shall provide test certificate signed by a property authorized person. Such test shall be conducted on all materials and equipment and tests on completed work as called for by the Architect / Engineer at

contractor's expenses unless otherwise called for.

If it is observed that the installation or part thereof is not satisfactorily carried out. Then the contractor shall be liable for the rectification and re testing of the same as called for by the Architect / Engineer decision as to what constitutes a satisfactory test shall be final.

The above general requirement as to testing shall be read in conjunction with any particular requirements specified elsewhere. All tests shall be carried out by a test house approved by the Architect / Owner.

3.1 Samples

The Contractor shall be required to have samples of various materials to be kept at site after approval by the Architect / Engineer.

4. Measurements

All measurements shall be as specified in Technical Specification or BOQ. In absence of any such method of measurement in the said documents, relevant IS Codes or any other approved standard shall be followed.

4.1 Bidders shall furnish the Technical Data Sheet as specified hereinafter.

TECHNICAL SPECIFICATION ELECTRIC WORK

SR NO 1. LT SWITCHGEAR PANEL

1.1 Scope

This specification covers the design, material, construction features, manufacture, supply, inspection and testing at the manufacturer's works, delivery and performance testing of L.T. Switchgear panel of voltage not exceeding 1000 V AC.

The switchgears would comprise of LT switch boards, power panels, control panels and Distribution Boards (DBs) required for the supply of power to the medium voltage equipment.

1.2 Codes & Standards

The design, construction, manufacture and performance of equipment shall conform

to latest applicable standards and comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

Equipment shall conform to the latest applicable Standards as mentioned. In case of conflict between the Standards and this specification, this specification shall govern.

All components shall be of reputed/ approved make and subject to Client's approval.

1.3 Tests

- A. All tests shall be conducted in accordance with the latest edition of IS:2834 and as applicable for the controls.
- B. Type test certificates for similar capacitor units shall be furnished.

1.4 Constructional Features

- A. Switchgear panel shall be
 - (a) of the metal enclosed, indoor, floor mounted modular type
 - (b) made up of the requisite vertical sections
 - (c) of dust and vermin proof construction
 - (d) provided with a degree of protection
 - (e) easily extendable on both sides by the addition of vertical section after removing the ends covers.
 - (f) provided with a metal sill frame made of structural steel channel section property drilled for mounting the Switchgear along with necessary mounting hardware. Hardware shall be zinc plated and passivated.
 - (g) provided with labels on the front indicating the switchgear designation.
 - (h) provided with cable entry facilities at top and bottom with 3 mm thick removable gland plates and necessary cable glands.
 - (i) of uniform height of not more than 2200 mm
 - (j) of single front execution
 - (k) provided with gaskets all round the perimeter of adjacent panels, panel and base frame, removable covers and doors.
 - (l) provided with busbars running at the top or bottom, as required, all along the length of the switchgear in a separate sheet steel enclosure.

- B. Operating devices shall be incorporated only in the front of the Switchgear.
- C. The switchgear shall be provided into distinct vertical sections each comprising :
 - (a) A completely metal enclosed busbar compartment running horizontally.
 - (b) Individual feeder modules arranged in multi tier formation.
 - (c) Enclosed vertical bus bars serving all modules in the vertical section.
 - (d) A vertical cable alley covering the entire height.
 - (e) A horizontal separate enclosure for all auxiliary power and control buses, as required, shall be located so as to enable easy identification, maintenance and segregation from the main power buses. Tap-off connections from these buses shall be arranged separately for each vertical section.
 - (f) Each vertical section shall be equipped with space heaters which may be located in the cable alley.

Current transformers shall not be directly mounted on the buses. Current transformers on circuit breaker controlled circuits shall be mounted on the fixed portion of the compartment.

In breaker compartments, suitable barriers shall be placed between circuit breakers and all control, protective and indication circuit equipment including instrument transformers. External cable connections shall be carried out in separate cable compartments for power and control cables.

After isolation of power and control connections of a circuit, it shall be possible to safely carry out maintenance in a compartment with the bus bars and adjacent circuits live.

Cable alleys shall be provided with suitable hinged doors. It shall be possible to safely carry out maintenance of cable connections to any one circuit with the bus bars and adjacent live circuits. Adequate number of slotted cable support arms shall be provided for dressing the cables.

The withdraw able chassis housing circuit breakers shall be of the fully draw out type.

1.5 Sheet Metal Work

The switchgear frame shall be fabricated using suitable white CIRCA sheets of thickness not less than 2.5 mm.

Frames shall be enclosed by white CRCA sheet of thickness not less than 2 mm smoothly finished, levelled, and free from flaws. Doors and covers shall be made of white CIRCA sheets of thickness not less than 2mm. Stiffeners shall be provided wherever necessary.

The complete structure shall be rigid, self-supporting, free from vibration, twists and bends.

1.6 Painting

All sheet steel parts shall undergo rust proofing process to include degreasing de-scaling and phosphating process with 7 tanks process. The steel works shall then be painted with the two coats of zinc chromate primer final paint shall be powder coated in approved shade as per relevant IS. Thickness of powder coating shall be 65 microns.

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B

Description

Mode of Payment: The rate shall be for a Unit of One Sq Mtr.

SR NO 2. CIRCUIT BREAKERS

2.1 General

Circuit Breaker shall be :-

- A. of the air break draw out type, electrically operated & mounted along with its operating mechanism on a wheeled carriage moving on guides, designed to align correctly and allow easy movements.
- B. of the shunt trip type
- C. provided with mechanically operated targets to show 'Open', 'Closed', 'Service' and 'Test' positions of the circuit breaker.
- D. provided with mechanically operated, red 'trip' push button, shrouded to prevent accidental operation.
- E. provided with locking facilities in the 'Service', 'Test', and 'Isolated', positions. In test position the breaker will be tested without energising the power circuits. The breaker shall remain fully housed inside the compartment in the test position.

- F. provided with 6 NO and 6NC potential free auxiliary contacts, rated 10A at 240V A.C. and 1A (inductive breaking) at 220 V D.C.
- G. provided with 'red', 'green' and 'amber' indicating lamps to show 'closed', 'open' and 'Auto-trip' conditions of the circuit breaker when breaker operation is controlled by a control switch.
- H. Circuit breaker closing and trip coils shall be rated for satisfactory operation on a control supply system.
- I. Closing and trip coil shall operate satisfactorily under the following conditions of supply voltage variation:
 - (a) Closing coils-85% to 110% of rated voltage
 - (b) Trip coils - 50% to 110% of rated voltage
- J. Conforming to IEC 947 1 & 2.

Circuit breakers shall be provided with the following interlocks.

- K. It shall not be possible to plug-in a closed circuit breaker, or to draw out a circuit breaker in the closed position.
- L. It shall not be possible to operate a circuit breaker unless it is in the fully plugged-in, test, or fully isolated position.

2.2 Operating Mechanism

- A. Power operated mechanism shall be of the motor wound spring charging stored energy type. The closing action of the circuit breaker shall charge the tripping spring ready for tripping. Speed of closing of contacts shall be independent of the speed with which the handle is operated. All stored energy mechanisms shall be provided with mechanical indicators to show the 'charged' and 'discharged' conditions of the spring.
- B. Circuit breakers provided with stored energy operating mechanisms shall be provided with the following interlocks. The circuit breaker shall not close unless the spring is fully charged. Shocks, vibrations, or failure of springs shall not operate the breaker or prevent intended tripping.
- C. Power operated mechanism shall be provided with a universal motor suitable for operation on DC. control supplies with voltage variation from 85% to 110% rated voltage, designed to enable a continuous sequence of closing and opening operation as long as power is available and at least one opening

operation on power supply failure, provided with emergency manual charging facilities, provided with facilities for remote panel Closing & opening operations.

- D. The control scheme will be as follows for remote control:
- E. All spare potential free contacts of all ACBs, MCCBs and contactors in main LT panel shall be wired up to the terminal block of individual module.
- F. Spring charging time for power operated mechanism shall not exceed 15 seconds. Power operating mechanism shall be provided with the following additional features. Closing of the circuit breaker shall automatically initiate recharging of the spring ready for the next closing stroke. The motor shall be mechanically decoupled as soon as the emergency manual charging handle is coupled. The circuit breaker mechanism shall make one complete closing operation once the control switch has been operated and the first device in the control scheme has responded even though the control switch is released before the closing operation is complete provided there is no counter trip impulse. Closing controls shall be so arranged that only one closing operation of the circuit breaker shall result from each close initiating impulse, even if the breaker trips while the initiating device is held in the 'close' position. An electrical anti pumping relay shall be provided on the circuit breaker chassis for this purpose, in addition to the mechanical anti pumping feature incorporated in the circuit breaker.

2.3 Protection Coordination

The circuit breaker shall be provided with microprocessor based overload, short circuit and earth fault protection releases, each with a wide setting range integrated in one module.

The microprocessor based trip units shall be provided with following features:-

- A. designed to withstand tough industrial environments i.e. high ambient temperatures, switching surges, electromagnetic interferences, vibrations and switching areas.
- B. reliably self-powered by built in current transformers.
- C. Motor setting shall be provided with 20 m sec delay to eliminate nuisance tripping caused by high peaks during motor start. It shall also provide single

phasing protection.

- D. LED display indication of each of over load, short circuit and earth fault.
- E. Integrated test button to check the healthiness of trip unit electronics and associated CT circuits without tripping the breakers.
- F. Alarm display for microprocessor fault.
- G. Query feature to indicate tripping cause upto 48 hours after instant of tripping without back up supply.
- H. Other features such as switchable zone scheme memory, opto-coupled outputs for remote signaling of a trip cause, switchable thermal memory, over temperature indication, communication capability.

It shall be the responsibility of the VENDOR to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers/fuses/motor starters. to provide satisfactory discrimination.

2.4 Moulded Case Circuit Breaker

MCCB shall be capable of breaking short-circuit currents up to levels as specified in Bill of Quantities / Drawing.

Moulded case circuit breakers shall be made of insulating case and cover made of high strength, heat resistant and flame-retardant thermosetting insulating material conforming to IEC 947 Part 2 of 1989, BS 3871, 1965 or other applicable standards.

The switching mechanism shall be quick make/quick-break type with double break contact system utilizing a trip free toggle mechanism. The handle position shall give positive indication of whether the breaker is ON (top), OFF (down) or TRIP (midway). For overload protection, three bimetal magneto-thermal release and electromagnetic releases for short circuit protection to be provided. The magneto-thermal release shall be variable and direct acting. All releases shall operate on a common trip bar so that all phases are disconnected in the event when fault occurs even on only one of them. The tripping mechanism shall be of an inverse time characteristics to prevent tripping on temporary overloads and shall not be affected by normal variation in ambient temperature.

The terminals shall have sufficiently large dimensions to accept links or cable lugs of suitable sizes. These shall be of a reputable manufacturer.

2.5 Switches /Miniature Circuit Breakers (MCB)

- A. Switches/MCBs shall be hand operated, air break, quick make, quick break type conforming to applicable standards.
- B. The switch shall be protected by fuse and the MCB shall be provided with overload/short-circuit protective device for protection under overload and short-circuit conditions. The switch action shall be trip free to inhibit closing under fault conditions. All brass parts shall be electroplated and all steel parts cadmium plated and all contacts silver plated. The minimum breaking capacity of MCBs shall be 10 kA r.GI. at 415V/220V D.C.
- C. Switch shall have provision for locking in both fully open and closed positions. MCBs shall be provided with locking facility.
- D. The connections between switch and fuse shall be insulated and all live connections shall be shrouded.
- E. Miniature circuit breakers shall be as specified elsewhere or approved. Each miniature circuit breaker shall be provided with spring-washer at each cable termination.

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B

Description

Mode of Payment: The rate shall be for a Unit of One No.

SR NO 3 CABLE TRAYS & RACEWAYS

3.1 Scope

This specification covers the design, manufacture, testing at works, inspection and delivery at site of cable trays.

3.2 General

It is proposed that cables to be laid in the basement and vertical service shafts but not within lift shafts) will be laid on suitable cable trays.

Power and data wiring to Workstation receptacles shall be through conduits up to the

nearest wall. It shall drop to FFL concealed in ceiling or boxed in an aesthetically pleasing enclosure. Wiring up to workstation shall run in raceways.

3.3 Constructional Features

3.3.1 Material

The cable trays are to be manufactured from 2mm thick cold rolled sheet steel. The same shall be shaped and cut using power driven dies/ cutters/ presses to the specified sizes and bolted/ together to form a standard length of cable tray and its accessories.

3.3.2 Finishing

The manufactured trays and all the accessories should undergo seven tank treatments and should be hot-dip galvanized as per BS-2629 The zinc coating of 60 microns has to be uniformly guaranteed The trays will be tested for this at site at random and the contractor should make available at site Alcometer (or approved equivalent meter) for carrying Out the test at site. The owners reserve the right to at random inspect the trays being manufactured at the manufactures factory.

The width of the cable trays is specified in the schedule of quantities. The other details will be as shown in the drawings.

GI coupler plates with GI Jointing hardware is to be included in the rates of the contractor.

In case of GI perforated tray of width 150mm the height of the side walls shall be 50mm.

The following accessories are also to be supplied and installed by the contractor and the cost of the same is to be included in the rates for straight lengths to be quoted in the schedule of quantities.

Couple plates and hardware (as stated above).

- (a) Vertical elbow up
- (b) Reducer
- (c) Horizontal Tee
- (d) Horizontal Cross Piece
- (e) Horizontal Elbow
- (f) Vertical Elbow Down

- (g) Providing cold galvanized paint touch up at site wherever trays, accessories and supports are cut/ drilled after hot dip galvanizing.

3.3.3 Bends

The trays should have radius so as to enable a bending radius of 12 x Dia. of largest cable to be laid in the tray.

3.3.4 Supporting Steel Work For Trays

Supporting structural steel members to be made from 50mm x 50mm x 6mm GI. angles, 50mm x 6mm GI. flats for trays of width 600mm & above and 40mm x 40mm x 6mm GI. angles, 40mm x 6mm GI. flats for trays of width less than 600mm and GI. channels duly hot dip galvanized. In general on horizontal runs cable trays of width > 600mm & above will be supported at every 1 Mtr. and trays of smaller width be supported at 1.2 Mtr intervals. In vertical runs the trays should be supported at every 1 Mtr interval. Every horizontal bend will also be given an extra support.

3.3.5 Measurement

The installed trays and accessories will be measured at the central axis of the tray and bends. Bends, reducers, elbows, coupler plates, hardware & steel supports will not be measured separately.

3.3.6 Floor Raceway

Floor raceway of hot dip galvanised / aluminium sheet of 14 g / 2.0 mm shall be used and the dimensions for the same shall be as per the BOQ. The raceways shall be as per the make specified in the tender, The raceways shall be free of any sort of welding edges or other sharp edges to protect cutting of wires during pulling. The raceways shall be laid with use of junction boxes fabricated from 14 g hot dip GI as per drawing.

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B

Description

Mode of Payment: The rate shall be for a Unit of One Rmtr.

SR NO 4 EARTHING

4.1 Scope

This specification covers the supply, installation testing and commissioning of the Earthing system.

4.2 Standards

- A. IS 62305 2010 - Code of Practice for the protection of buildings and allied structures against lightning
- B. IS: 3043 (1987) - Code of Practice for earthing
- C. Indian Electricity Rules 1956
- D. Indian Electricity Act 1910
- E. CEIG Regulations

4.3 General Requirement

Complete earthing system comprising earth electrodes in conjunction with earth grid shall be provided for the substation and control room for achieving a safe step and touch potential.

The exact location of Earth Bus/conductor, earth electrodes and earthing points on the equipment shall be determined at site in consultation with the contractor. Any change of methods, routing and size of conductor shall be subject to approval by the contractor.

4.3.1 Details of Earthing System:

- A. Main Earth Grid - 50 x 6mm GI Flat
- B. Power Transformer Neutral - 50 x 6mm Cu. Flat
- C. Transformer Body - 50 x 6mm GI Flat
- D. Equipment to Main Grid - 25 x 6mm CI Flat
- E. DBs/Junction Boxes - 8 SWG GI Wire
- F. Lightning Protection - 1 x 70 mm Cu flexible

4.3.2 Earth Electrodes in Earth Pits

Plate Earthing

Plate electrodes of G.I. shall be 600 x 600 x 6mm. thick and of copper shall be 600 x 600 x 3mm. thick unless otherwise specified.

Earth bus is a Copper/G.I. strip or flat of specified size interconnecting all earth electrodes. This will be laid throughout the length of electrical shaft (2 nos. per shaft).

Chemical Earthing Electrode

Supplying & erecting earth pit of minimum bore dia.150mm size approved make

Earthing Electrode consisting Pipe-in-Pipe Technology as per IS 3043-1987 made of corrosion free G.I.Pipes having Outer pipe dia of 50mm having 80-200 Micron galvanising, Inner pipe dia of 25 mm having 200-250 Micron galvanising, connection terminal dia of 12mm with constant ohmic value surrounded by highly conductive compound with high charge dissipation.

Length of Pipe : As per mentioned in BOQ

Back filling Compound : As per mentioned in BOQ or Required to achieve desire resistance level.

4.3.3 Artificial Treatment of Soil

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by adding sodium chloride, sodium carbonate, copper sulfate, salt and soft coke or charcoal in suitable proportions.

4.3.4 Resistance to Earth

The resistance to each earthing system shall not exceed 1.0 ohm.

4.3.5 Earthing Station

Plate Electrode Earthing

- A. Earthing electrodes shall consist of a galvanized iron plate not less than 600mm x 600mm x 6mm thick or copper plate not less than 600mm x 600mm x 3mm thick, as called for in the schedule.
- B. The plate electrode shall be buried as far as practicable below permanent moisture level but in any case not less than 2.5 mtrs. below ground level.
- C. Earth Electrode shall not be installed in proximity to a metal fence. It shall be kept clear of the building foundations and in no case shall it be nearer than 2 mtrs. from the outer face of the wall.
- D. The earth plate shall be set vertically and surrounded with 150 mm. thick layer of charcoal dust and salt mixture. 20mm.G.I. pipe shall run from the top edge of the plate to the ground level.

- E. The top of the pipe shall be provided with funnel and a mesh for watering the earth through the earth. The main earth conductors shall be connected to the electrode just below the funnel, with proper terminal lugs and check nuts. The funnel over the G.L pipe and earth connections houses in a masonry chamber, approximately 350mm. length x 300mm. wide and 300mm. deep. The masonry chamber shall be provided with a cast iron cover resting over a C.I. frame embedded in masonry.

4.4 Earthing Layout

Earthing conductors in outdoor areas shall be buried at least 600mm below finished grade level unless stated otherwise.

Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, etc. it shall be laid minimum 300 mm below and shall be re-routed in case it fouls with equipment structure foundations.

Tap-connections from the earthing grid to the equipment/structure to be earthed shall be terminated on earthing terminals of the equipment/structure, if the equipment is available at the time of laying the grid, otherwise "earth riser" shall be provided near the equipment foundation, pedestal for future connections to the equipment earthing terminals.

Earthing conductors along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable cleating at intervals of 750 mm. Earthing conductors along cable trenches shall be cleated to the wall nearer to the equipment.

Cable trays and supports shall be connected to the earth mat at every 30 meters interval. Wherever it passes through walls, floors, etc. GI sleeves shall be provided for the pasGMCE of the conductor.

Earthing conductor around the building shall be buried in earth at a minimum distance of 2000 mm from the outer boundary of the building.

4.5 Jointing

Earthing connections with equipment earthing pads shall be bolted type. Contact surface shall be free from scale, paint enamel, grease, rust or dirt. Two bolts shall be

provided for making each connection. Bolted connections, after being checked and tested shall be taped with PVC tape.

Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B

Description

Mode of Payment: The rate shall be for a Unit of One No.

SR NO 5 WIRING

5.1 Point Wiring

5.1.1 Scope

Providing specified size of FRLS insulated, copper conductor, 1.1kV grade, ISI marked of required color coding of approved make both for supply and earthing and drawing these wires through already laid Medium duty PVC conduits with fish wire, ferruling by coding tags as per relevant drawings and duly connecting with lugs, complete finishing, removing debris from site; testing the installations for safety and beneficial use.

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

The wires shall be 650 / 1100 V, PVC insulated, FRLS unarmored with stranded copper conductors, unless otherwise specified. The wires shall conform to IS:694.

The minimum area of conductors shall be 1.5 sq. mm for light fittings; 2.5 sq.mm for receptacles rated 6 A receptacles and 4 sq.mm for 16 A and above.

The wires shall be coated red, yellow, and blue for R, Y, B phase and black for neutral. Unless otherwise specified, external lighting cables shall be of 1.1 kV grade, 3C, PVC insulated and armoured type fed from main distribution boards.

Lugs:

Copper lugs of required size and type.

Glands:

Glands at terminating end of required size and type.

Other Material:

Rubber grommet, bush, harnessing material, etc.

5.1.3 Drawing of Wires

Wires shall be drawn with adequate care. Correct color coding as per shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral may be looped only within circuit. For lighting load or single phase distribution wires of two different phases shall not be drawn in single pipe. Lead wires of sufficient extra length shall be provided and shall be terminated in the terminals of accessories only, with correct type of and correct size of tugs.

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to burrs I sharp edges.

5.1.4 Testing:

Insulation resistance test:

All wiring shall be tested with 500V meggar between phases, phase-neutral and to Earth. IR value shall not be less than 1 M-ohm.

Polarity test:

Polarity test shall be carried out for ensuring correct polarity plug and switch.

5.1.5 Table No- I

Colour Code for Wires

Type	Colour
Phase	Red, Yellow, Blue
Neutral	Black
Earth	Green

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B

Description

Mode of Payment: The rate shall be for a Unit of One No.

SR NO 6 SWITCHES & SOCKETS

6.1 Switches

The switches shall be single pole, single or two way as shown in respective internal

lighting drawings. They shall be of moulded type rated for 250 volt, and of full 6 / 16 A capacity. They shall be provided with insulated dollies and covers.

The switches shall be rocker operated with a quite operating mechanism with bounce free snap action mechanism enclosed in an arc resistant chamber. The switches shall have pure silver and silver cadmium contacts. The switches shall be flush modular type. The make of the switches shall be as indicated in the drawings or BOQ or make of material or as suggested and approved by the client. The switches installed in outdoor area shall be industrial, metal clad type, and shall be provided in weather proof enclosures, complete with weather proof gasket covers.

6.2 Sockets

Each socket shall be provided with control switch of appropriate rating. The sockets shall be moulded type, rated for 250 volts, and either of full 6 A or 16 A capacity, as mentioned on the drawings.

Sockets shall be of three pin type, the third in being connected to earth continuity conductor. The socket shall be flush modular type. The sockets installed in machine room, plant room or wet / damp area shall be metal clad weather proof type. The finishing and make of all the sockets shall be same as light switch. The socket shall have fully sprung contacts and solid brass shrouded terminals to ensure positive electrical connections.

The sockets shall be provided with automatic shutters, which open only when earth pit of the plug inserts in the socket.

The socket shall be provided with three pin plug top suitable to the socket and of the same make as socket.

6.3 Boxes

The boxes for switches and sockets shall be 18 gauge galvanised sheet steel as manufactured by the switch manufacturer and suitable to accommodate grid type switches. The size of enclosure boxes shall be chosen to accommodate the number of switches to be installed at the particular location.

Separate screwed earth terminal shall be provided in the box for earthing purpose. All boxes shall have adequate no. of knock out holes of required diameter for conduit entry. Switch boxes to receive switches, socket outlets, power outlets, Telephone outlets, fan regulators, etc. shall be fabricated to the approved shape and size to accommodate all the devices without overcrowding. Outlet boxes to receive ceiling fan shall be fitted with adequately sized rod I hook to fix ceiling fan. The boxes shall be of minimum depth of 65 mm.

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B

Description

Mode of Payment: The rate shall be for a Unit of One No.

SR NO 7 CONDUITS

7.1 Scope

Providing specified rigid PVC conduit and laying I erecting in RCC work, such as slab, beam, column before casting, surface, wall, ceiling, etc including entries through wall as per requirement and as per approved method of construction. The scope also includes supply and installation of accessories for the PVC pipes of same make as that of pipe; such as spacers, saddles, couplers, bends, inspection or non-inspection type elbows, tees, junction boxes of required ways and resin I adhesive to make all joints rigid, duly finishing, removing debris from site. Hardware like sheet metal screws of specified sizes, washers, raw/ PVC/ fill type plugs, wooden gutties.

7.2 Material

All conduits, fittings & accessories shall be rigid PVC conduit as indicated in the BOQ and shall comply with IS:9537. All pipes shall have ISI mark on each length of conduit. The minimum size of conduit shall be 20 mm.

The conduits shall be uniformly circular in cross section. The nominal length of conduit used shall be 3 or 4 meter. Joints shall be avoided as far as possible in the conduits. The interior of conduit shall be free from obstruction which might interfere with ready introduction I withdrawal of maximum no. of cables permitted. The ends of conduits shall be reamed and filed to remove rough edges and inside surface shall be smooth and free from burrs and other defects. All conduits shall be provided with approved type of fish wire.

7.3 Method of Construction

7.3.1 General:

Work shall be done in co-ordination with civil work to suit final approved layout. Conduit shall be duly clamped and size of conduit shall be correct depending on number of wires to be drawn. Separate pipe shall be used for each phase in single phase distribution and also for wiring other utilities like data, telephone. TV cabling, etc, for which distance between pipes shall be not less than 300mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with color coding. (For visual identification). Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 425m, in such manner so as to facilitate drawing of wires. All bending of conduits shall be done in approved manner without changing the cross-section.

Table No. 2. Colour Coding for Conduits in Wall Entry

Conduit for	Colour
Light / Power Circuit	Black
Security wiring	Blue
Fire Alarm wiring	Red
Low Voltage circuits	Brown

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B

Description

Mode of Payment: The rate shall be for a Unit of One Mtr.

SR NO 8 TESTING AND COMMISSIONING

8.1 General

The testing and commissioning for all electrical equipment at site shall be according to the procedures laid down below:

All electrical equipment shall be installed, tested and commissioned in accordance with the latest relevant Standards and Codes of Practices published by Indian Standards Institution wherever applicable and stipulations made in relevant general specifications.

The testing of all electrical equipment as well as the system as a whole shall be carried out to ensure that the equipment and its components are in satisfactory

condition and will successfully perform its functional operation. The inspection of the equipment shall be carried out to ensure that all materials, workmanship and installation conform to the accepted design, engineering and construction standards as well as accepted codes of practice and stipulations made in the relevant general specifications.

All tests shall be carried out by the contractor using his own instruments, testing equipment as well as qualified testing personnel. The results of all tests shall be conforming to the specification requirements as well as any specific performance data guaranteed during finalization of the contract. Test sheets shall be prepared & submitted to contractor for approval within 1 month of award.

8.2 Preparation of the Plant for Commissioning

After completion of the installation at site and for the preparation of plant commissioning, the contractor shall carry out check and testing of all equipment and installation in accordance with the agreed standards, Codes of Practice of Indian Standards Institution and specific instruction furnished by the particular equipment suppliers as well as contractor.

Checking required to be made on all equipment and installations at site shall comprise, but not be limited to the following. The following checks shall be made on all equipment and installations at site:

Physical inspection for removal of any foreign bodies, external defects, such as damaged insulators, loose connecting bolts, loose foundation bolts etc-

Check for grease, insulating/lubricating oil leakage and its proper quantity
Check for the free movement of mechanism for the circuit breakers, rotating part of the rotating machines and devices.

Check for tightness of all-cable, busbar at termination/joints ends as well as earth connections in the main earthing network.

Check for clearance of live busbar and connectors from the metal enclosure.
Check for proper alignment of all draw out device like draw out type circuit-breakers. Continuity check in case of power cables
Checking of all mechanical and electrical interlocks including tripping of breakers using manual operation of relay.

Checking of alarm and annunciation circuits by manual actuation of relevant relays like Buchholz relay in case of transformer.

Check and calibrate devices requiring field adjustment calibration like

adjustment of relay settings etc.

Check proper connection to earth network of all non-current carrying parts of the equipment and installation.

Tests reports for all meters are to be furnished.

The tests that shall be carried out on the equipment shall include but not be limited to the following:

8.3 Low Voltage Switchgear (up to 1000V AC or 1200V DC)

Insulation resistance test with 1000V megger for main circuits. The minimum value of insulation resistance shall be 1 mega ohm.

Insulation resistance test with 500V megger for control metering and relaying circuits. The minimum value of insulation resistance shall be mega ohm. Relay operation test by primary & secondary injection method.

Functional tests of control circuit.

Checking of settings of all relay / releases as per single line diagram/specification.

ON/OFF operation of breakers both manually and electrically in "Test" as well as "Service" positions.

8.4 Cables

Insulation resistance test with 2,500 V megger for high voltage power cables rated above 1.1 KV grade and 1,000 V megger for cables rated up to 1.1 KV grade.

All cables of 1.1 KV and all HV cables shall be subjected to high voltage test after joining and terminating but before commissioning as per relevant standards.

In each test, the metallic sheath/screen/armor should be connected to earth.

Continuity of all the cores, correctness of all connections as per wiring diagram, correctness of polarity and phasing of power cables and proper earth connection of cable glands, cable boxes, armor and metallic sheath, shall be checked.

Power frequency withstand test.

Operational tests to know the correct functioning of all devices associated with the transformer

8.5 Earthing System

Tests to ensure continuity of all earth connections.

Tests to obtain earth resistance of the complete network by using earth tester.

The test values obtained shall be within the limits.

All documents / records regarding test data, oscillo graphs and other measured values of important parameters finalized after site adjustment shall be handed over to the Contractor in the form of test reports for their future use and reference.

All Checks/tests etc. to be carried out in presence of contractor's representative.

SR NO 9. GI POLE

Supplying & erecting Galvanized iron pipe post "B" class 88.9 mm O.D 6 mtr. Long duly painted with two coats of aluminum paint complete with metallic base- plate of 300 mm x 300 mm x 4mm thick for using as a compound light pole with approx. weight 47 Kg.

DETAILED TECHNICAL DATA SHEET FOR GI POLE

GI POLE

- Height of POLE : 6 Mtr
- Raw material : B CLASS GI PIPE
- Approx Weight : 47 Kg
- No. of section : ONE
- Metal protection treatment : HOT DIP GALVANIZED As Per BS

729 or Equivalent. Both Internally &

externally

- Thickness of Galvanization : As per IS 2629 / IS 2633 / IS 4759
- Terminal box power control : Sheet metal box of suitable size in 2mmThick to accommodate required

MCB

Thickness of Galvanization : Average 85 Microns
Outer Diameter : 88.9 mm

(TEST TO BE CARRIED OUT AT OEM END / FACTORY)

Dynamic Loading as per Prevailing at Site

- Max. wind speed : 180 Kms Per Hour as per IS 875-1987 Part III
- Max. gust speed time : 3 seconds
- Height above ground level (These above two levels are measured) : 6 Mtr
- Factor of Safety for wind load : 1.25
- Factor of Safety for other load : 1.15 (as per TR No. 7)

(Test report shall be produced)

Foundation Details

- size of foundation : As per Manufacturer's design
- Design safety Factor : As per IS :456
- Considered Wind pressure (Kg. /Sq. mm) : As per IS :875-1987
- Considered Wind speed (KM. /hrs.) : As per IS :875-1987
- Average Soil bearing capacity : As per site requirement
- Number of foundation bolts : 4 Nos.

(Test report shall be produced)

LUMINARIES

- Type : LED, OUTDOOR
- Quantity : As Per Light Design

(Test report shall be produced)

EARTHING

- Earthing : Suitable size earth termination shall be provided to connect with the proposed earth pit.
- No. of connection : ONE
- Final length : 150 Cm

General

- The POLE, Foundation and electrical drawing should be approved before commencement of work
- All safety measures shall be adopted while execute (E & C) the work

GUARANTY & WARRANTY

- One-year GUARANTY & WARRANTY certificate shall be provided by the Manufacturer of POLE and free service for first year shall be provided as when required for attending the breakdown etc

- For Light Fixtures there are two years of warranty from the dispatch date of materials.
- **MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B**
- **Description**
- **Mode of Payment: The rate shall be for a Unit of One No.**

SR NO 10. LED LIGHT

10.1 CODES & STANDARDS: -

IEC 60529 Classification of degree of protections provided by enclosures (IP Codes)

EN 55015, CISPR15 Limits and methods of measurement of radio disturbance characteristic of electrical lighting and similar equipment.

IEC 62031 LED modules for general lighting-Safety requirements

IEC 61547-EMC Immunity requirement

IEC 60598-2-1 Fixed general purpose luminaries

IEC 60598-1 Luminaries - General requirement and tests

IEC 61000-3-2 Electro Magnetic compatibility (EMC)- Limits for Harmonic current emission — (equipment input current ≤ 16 A per phase.

IEC 60068-2-38 Environmental Testing: Test Z- AD: composite temperature/ humidity cyclic test

IEC 61347-2-13 Lamp control gear: particular requirements for DC or AC supplied electronic control gear for LED modules.

IS 10322 Specification for the luminaries

IS 4905 Method for random sampling

LM 79 LED luminary photometry measurement.

LM 80 Lumen Maintenance

IEC 62384 DC or AC supplied electronic control gear for LED modules performance requirements

IEC/ PAS 62612 Self-ballasted LED lamps for general lighting services- Performance requirements

10.2 ENVIRONMENTAL CONDITIONS: -

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

- (i) Maximum ambient air temperature: **50° C**
- (ii) Minimum ambient air temperature: **10° C**
- (iii) Max. Relative humidity: **90%**
- (iv) Average Rainfall: **55 inches**
- (v) Atmosphere: **Dusty and Heavy chemical smoke at times in certain areas.**
- (vi) Coastal area: The equipment shall be designed to work in coastal area in humid, salt laden and corrosive atmosphere.

10.3 CONSTRUCTIONAL FEATURES:

10.3.1 General:

- a) Luminaries shall be made of die cast aluminum/ extruded Aluminum body with powder coated finish having safety.
- b) Heat sink used should be aluminum extrusion having high conductivity. Heat sink should be integrated within luminaries and efforts shall be made to keep the overall outer dimensions
- c) optimum such that it permits sufficient heat dissipation through the body itself so as to prevent abnormal temperature inside the luminaries and consequential damage to cover, gasket material, LEDs, lenses and drivers.
- d) LED must be mounted on Metal core PCB with suitable large area surface by means of fins to dissipate the conduct heat. The fins must be exposed to ambient flowing air.
- e) All luminaries shall be provided with toughened glass of min. 0.8 mm thickness of sufficient strength. UV stabilized Poly carbonate material is also acceptable. High efficiency prismatic diffuser/Lens under the LED chamber to protect the LED and luminaries shall be provided.
- f) The minimum IK protection of optic cover shall be IK 05. The test material certificate shall be provided.
- g) Suitable number of LED lamps shall be used in the luminaries. The manufacturer shall submit the proof of procurement of LEDs from OEMs at the time of testing.
- h) Suitable reflector/ lenses may also be provided to increase the illumination uniformity and distribution.

- i) The electrical component of the LED and LED driver must be suitably enclosed in sealed unit to function in environment conditions mentioned earlier.
- j) The connecting wires used inside the luminaries, shall be low smoke halogen free, fire retardant e-beam cable and fuse protection shall be provided in input side.
- k) Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.
- l) The equipment should be compliant to IEC 60598-1, IEC 62031 and IEC/PAS 62612 depending on the type of luminary.
- m) The LED Module(s), Driver gear, etc. shall be designed in such a way so that temperature of heat sink shall not exceed 70° C.
- n) All the material used in the luminaries shall be halogen free and fire retardant confirming to standard.
- o) The infrastructure for Quality Assurance facilities to verify/ test/ prove above specifications must be available at the manufacturing facility. The compliance shall be indicated clearly in the tender itself.
- p) All fasteners must be of stainless steel.
- q) All glands inside/ outside luminaries must be metallic
- r) Heat sink must be thermally connected to MCPCB/ LED light source.

10.3.2 High power and high lumen efficient LEDs suitable for following features shall be used:

- a) The working life of the lamp at junction temperature of 85° C (max) at operating current shall be more than 50,000 working hours of accumulative operation and shall be suitable for continuous operation of 24 hours per day. These features shall be supported with datasheet.
- b) Adequate heat sink with proper thermal management shall be provided.
- c) Lumen maintenance report as per LM 80 guidelines shall be produced for the power LEDs used.
- d) Thermal management shall be in such a way that LED soldering point temperature shall not go beyond 75° C.
- e) The LED luminaries shall be free of glare.

10.3.3 LED DRIVER specification used for light:

- a) Current waveform should meet relevant nation and international standard.

- b) LED Driver shall withstand, withstand voltage up to level mentioned elsewhere in tender and restore once normal working when normal voltage is applied.
- c) The life of the driver should more than 25000 Hrs.
- d) Maximum Temperature rise $\leq 30^{\circ}\text{C}$ @ 45°C T_{amb} . With safety margin of 10°C .
- e) The control gear should be compliant to IEC 61347-2-13, IEC 62031 and IEC 62384 as per the requirements.
- f) The driver of the luminaries should have Short Circuit, Over Voltage, over current, over temperature, Under Voltage, String Open protections.

10.3.4 The electronic components used shall be as follows:-

- a) The protective cum adhesive coating used on PCBs should be cleared and transparent and should not affect colour code of electronic components or the product code of the company.
- b) The construction of PCBs and the assembly for components for PCBs should be as per IS standards.

10.4 Illumination Level:

The luminaries shall be so designed that the illumination level shall be evenly distributed and shall be free from glare. The lux distribution curve/ graph/ spatial distribution shall be submitted.

GENERAL DATA SHEET

Sr. No.	Parameter	Value/Detail
4.1.1	Rated Supply Voltage	230 V ~, 50 Hz
4.1.2	Input supply voltage range	120-270 V
4.1.3	Expected Input Frequency	50 Hz +/- 3%
4.1.4	Working Temperature	+5° to +50° C
4.1.5	Working Humidity	10% - 90% RH

4.1.6	UGMCE hours	Dusk to dawn
4.1.7	Power Factor	≥ 0.90
4.1.8	Index of Protection Level	IP 66 as per IEC 60529.
4.1.9	Surge Protection	4 KV
4.1.10	LED Chip efficacy	≥ 120 lm/ W
4.1.11	Driver Efficiency	$> 85\%$
4.1.12	Junction Temperature of LED	$< 85^{\circ}$ C
4.1.13	Rated Life @ L70	50,000 burning hours at 35° C ambient
4.1.14	Nominal Correlated Colour Temperature	5000° K to 6000° K
4.1.15	Dispersion Angle	Minimum 120°
4.1.16	Tilting angle	Adjustable
4.1.17	Maintenance factor of	0.85
4.1.18	Colour Rendering Index	≥ 85
4.1.19	Total Harmonic Distortion	$< 10\%$ (EMI/ EMC Certification)
4.1.20	LED MAKE	Cree/ Osram/ Nichia/ Philips Lumileds

Particulars and Details to be submitted by the bidder:

In order to properly assess and due diligence on submissions, the Bidder should provide following information on the quality and photometric of proposed luminaries.

1. **General Description**
2. **Electrical specifications**
3. **LED chip and driver information**
4. **Photometric information to be submitted**

10.5 TESTS & CERTIFICATES:

Tests are classified as:–

Type test

Acceptance test

、 Routine test.

The luminaries' should be tested as per IEC 60598-2-3: 2002 standards and following test reports should be submitted: -

- (i) Heat Resistance Test
- (ii) Thermal In SITU Test
- (iii) Ingress Protection Test
- (iv) Drop Test
- (v) Electrical/ Insulation Resistance Test,
- (vi) Endurance Test,
- (vii) Humidity Test,
- (viii) Electrical and Photometric Measurements Test Report (IES LM 79)
- (ix) LED Lumen Maintenance Test Report (IES LM 80)
- (x) Vibration test as per ANSI

10.5.1 Type Test: -

Type test certificates for both the luminaries' shall be provided with the technical-bid.

10.5.2 Acceptance Tests: -

These tests are carried out by an inspecting authority at the supplier's premises on sample taken from a lot for the purpose of acceptance of a lot. Acceptance tests shall not be carried out from particular size from the lot on which type tests have already been conducted. Recommended sampling plan is given below.

Sample size and criteria for conformity

The luminaries shall be selected from the lot at random. In order to ensure randomness of selection, procedures given in IS 4905-1968 (Reaffirmed 2001) may be followed.

10.5.3 Routine Tests:

These tests shall be performed by the manufacturer on each complete unit of the same type and the results shall be submitted to the inspecting agency, prior to offering the lot for acceptance test. The firm shall maintain the records with traceability.

Method of Testing: -

Visual and Dimensional Check:

The unit shall be checked visually for all dimensions as per approved design and

drawing.

General workmanship should be good; all the components properly secured and sharp edges shall be rounded off. Check the marking and quality of the workmanship visually. Check the rating and make of electronic/ electrical items.

Checking of documents of purchase of LED

Check Document of purchase of LED lamps of approved sources viz. NICHIA/ OSRAM/ PHILIPS LUMILEDS/ CREE.

Resistance to humidity test

This is carried out by suspending the painted panels in corrosion chamber maintained at 100% RH and temperature cycle of 42 to 48° C for 7 days and examining it for any sign of deterioration and corrosion of metal surface.

Insulation resistance test

The insulation resistance of the unit between earth and current carrying parts shorted together shall not be less than 2 MΩ when measured with 500 V megger.

HV test

Immediately after insulation resistance test, an AC voltage of 1.72 KV rms (1500 + 2 x rated voltage) of sine wave form of 50 Hz shall be applied for one minute between the live parts and frame. There shall not be any kind of break down, flashover or tripping of supply.

Over voltage protection

The LED Driver Shall be cut off once voltage exceeds 288 V AC. It shall be reconnected when supply comes within limit.

Surge protection

It shall withstand a surge of 4 KV at the input terminals for all types.

Reverse polarity

The Luminaries' shall withstand polarity reversal. It shall be operated with reverse voltage for Min. 1 minute at maximum value of voltage range. At the end of this period, the supply shall be made correct polarity and Luminary shall operate in a normal way.

Temperature rise Test:

Temperature rise Test shall be conducted at 100 V ~ with full load. The temperature rise shall be recorded by temperature detectors mounted at the specified reference points on the body of semiconductors, capacitors and other components as agreed between purchaser and manufacturer. The maximum-recorded temperature under worst conditions shall be corrected to 55° C and compared with maximum permissible temperature (for power devices at junction). Under loading conditions as specified above, the corrected temperature of the power devices shall have a safety margin of minimum 10° C.

Temperature at junction shall not exceed 100° C when corrected to 55° C. The Luminaries' shall also be subjected for short time rating after continuous loading to ensure the temperature rise is within the permissible limit. The maximum temperature rise of the electronics devices on the PCBs shall be in limit for industrial grade components suitable for 85° C environment. In case of exceeding limit, use of MIL-grade component shall be considered keeping RDSO informed.

Ra (Colour Rendering Index) measurement test

The lumen is the unit of luminous flux, which is equal to the flux emitted in a solid angle of one steradian by a uniform point source of one candela.

The initial reading of the chromaticity co-ordinates x & y shall be within 5 SDCM (Standards Deviation for Colour matching) from the standardised rated value as per Annex: D of IEC 60081- 1997.

The initial reading of the general colour-rendering index (Ra) shall not be less than the rated value decreased by 3.

The lumen maintenance of the lamp shall not be less than 80% of the initial lumen after 20,000 burning hours and 70% of the initial lumen after 50,000 hours. The initial lumen will be taken after 100 hours aging.

Photometric test shall be conducted as per Annexure: B of IEC 60081-97.

The lumen maintenance test shall be done as per Annexure: C of IEC 60081-97.

Fire retardant Test

Fire Retardant test shall be conducted as per IEC 60332-1 of the wire used in the luminaries.

Test for IP 65 protection

This test shall be conducted as per IEC 60529.

Environmental tests (Prototype Test)

The Luminary shall meet the following tests as prescribed in IEC-60571.

- (i) Dry heat test.
- (ii) Damp heat test
- (iii) Test in corrosive atmosphere
- (iv) Combined dust, humidity and heat test

Reliability Test

The reliability can only be determined in actual service. However, the following tests shall be carried out on the prototype to simulate as close as possible, the service conditions.

There shall be no failure during this test.

- (i) The light unit shall be mounted in an oven maintained at 45° C.
- (ii) The light will be operated at the specified maximum voltage and at 45° C for a period of 100 hours.

10.5.4 Photometry Test: -

The test shall be carried out for Total Luminous Flux, Luminous Intensity Distribution, Electrical Power, Luminous Efficacy (calculation), Color Characteristics– Chromaticity, CCT & CRI etc. as per IES LM 79.

Life Test

The lumen maintenance & life test shall be done as per IES LM 80 for LEDs.

Endurance Test

The Luminaire shall be kept “ON” with input voltage of 250 V ~ for 200 hours. After this the Luminaire is subjected to 20,000 cycles of “ON” and “OFF”, each cycle consisting of 3 seconds “ON” and 10 seconds “OFF” period. Luminaire should survive this test. Test is to be continued for 20,000 cycles, followed by

performance test.

Safety:

The Luminaire shall comply with the safety requirements as per IEC 61195.

All Tests defined for acceptance other than LM 79 and LM 80 are allowed to carry out at Manufacturer works.

10.6 MARKING:

The following information shall be distinctly and indelibly marked on the housing:

Year of manufacture/ Batch Number/ Serial Number

Name of Manufacturer (Engraving only, stickers not allowed)

Rated watt and voltage

Input frequency

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B
Description

Mode of Payment: The rate shall be for a Unit of One No.

SR NO 11. SPECIFICATIONS FOR MEDIUM AND HIGH VOLTAGE
CABLES AND ACCESSORIES

1.0 SCOPE

This specification along with data sheets covers requirements for design, manufacture, testing at works and supply of Flame Retardant PVC/XLPE cables and cable jointing / terminating accessories for medium and high voltage systems.

2.0 STANDARDS

The cables and cables jointing & terminating accessories shall comply with the latest edition of the following standards as applicable:

IS: 1554	PVC insulated (heavy duty) electric cables.
IS: 7098	Cross-linked polyethylene insulated PVC sheathed.
IS: 8130	Conductors for insulated electric cables and flexible cords.
IS: 5831	PVC insulation and sheath of electric cables.
IS: 3975	Mild steel wires, strips and tapes for armouring of cables.
10810(Part 41)	Methods of test for cables: Mass of zinc coating on steel

	armour.
IS: 209	Specification for zinc.
IS: 3961(Pt-2)	Recommended current ratings for cables: Part - 2 PVC Insulated and PVC sheathed heavy-duty cables.
IS: 10418	Drums for electric cables.
IS: 10462 (Pt-I)	Fictitious calculation method for determination of Dimensions of protective coverings of cables: Part - I Electrometric and thermoplastic insulated cables.
IS: 10810 (Pt-58)	Oxygen Index test.
IS: 10810 (Pt 61)	Flame Retardant test.
IS: 10810 (Pt 62)	Fire resistance test for bunched cables.
IS: 13573	Joints and terminations for polymeric cables for working Voltages from 6.6 KV up to and including 33 KV.
IEC: 60332-3	Tests on electric cables under fire conditions.
IEC: 60502	Extruded solid dielectric insulated power cables for rated Voltages from 1 KV. up to 30 KV.
IEC: 60540 & 60540A	Test methods for insulation and sheaths of electric Cables.
ASTM: D2863	Standard method of test for flammability of plastics using oxygen index method.
ICEAS-61-402 NEMA-WC5	Thermoplastic insulated wire and cable for transmission and distribution of electrical energy.
ICEA S-66-524 NEMA-WC7	Cross-linked thermosetting polyethylene insulated wire and cable for transmission and distribution of electrical energy.

- 2.2 The cables and accessories shall also conform to the provisions of Indian Electricity Rules and other statutory regulations, as applicable.
- 2.3 In case of any contradiction between various referred standard/ specification/data sheet and statutory regulations, the following order of priority shall govern:
- Statutory Regulations, Data Sheets, Job Specifications
- This Specification Codes and Standards

3.0 GENERAL CONSTRUCTION

- 3.1** The cables shall be suitable for laying in trays, trenches, ducts, and conduits and for underground-buried installation with uncontrolled backfill and possibility of flooding by water and chemicals.
- 3.2** Outer sheath of all PVC and XLPE cables shall be black in colour and the minimum value of oxygen index shall be 29 at $27 \pm 2^\circ \text{C}$. In addition suitable chemicals shall be added into the PVC compound of the outer sheath to protect the cable against rodent and termite attack.
- 3.3** All cables covered in this specification shall be flame retardant (FR) unless specified otherwise in the data sheet. The outer sheath of PVC and XLPE cables shall possess flame propagation properties meeting requirements as per IS-10810 (Part-62) category AF.
- 3.4** Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing /engraving shall be legible and indelible.
- 3.5** The overall diameter of the cables shall be strictly as per the values declared by the manufacturer in the technical information subject to a maximum tolerance of $\pm 2 \text{ mm}$ up to overall diameter of 60mm and $\pm 3 \text{ mm}$ for beyond 60mm.
- 3.6** PVC / Rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand meter length. In addition, ends of the cables shall be properly sealed with caps to avoid ingress of water during transportation and storage.

3.7 PVC cables

- 3.7.1** All power/control cables for use on medium voltage systems shall be heavy-duty type, 650/1100 V grade with aluminium / copper conductor, PVC insulated, inner-sheathed, armoured and overall PVC sheathed unless specified otherwise in data sheet.
- 3.7.2** The conductors shall be solid for conductor of nominal area up to and including 6 mm^2 and stranded beyond 6 mm^2 . Conductors of nominal area less than 16 mm^2 shall be circular only. Conductors of nominal area 16 mm^2 and above may be circular or shaped as per IS 8130. Cables with reduced neutral conductor shall have sizes as per Table 1 of IS 1554 (Part-1).
- 3.7.3** The core insulation shall be with PVC compound applied over the conductor by extrusion and shall conform to the requirements of type 'A' compound as per IS: 5831. The thickness of insulation and the tolerance on thickness of insulation shall be as per Table 2 of IS: 1554 (Part-1). Control cables having 6 cores and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers shall contrast with the colour of insulation with a spacing of maximum 50 mm between two consecutive numbers. Colour coding for cables up to 5 cores shall be as per Indian standard.
- 3.7.4** The inner sheath shall be applied over the laid-up cores by extrusion and shall be of PVC conforming to the requirements of Type ST-1 PVC compound as per IS: 5831. The minimum thickness of inner sheath shall be as per IS: 1554 (Part-1). Single core cables shall have no inner sheath.

- 3.7.5 If armouring is specified for multicore cables in the data sheet, the same shall be by single round galvanized steel wires where the calculated diameter below armouring does not exceed 13 mm and by galvanized steel strips where this dimension is greater than 13 mm. Requirement and methods of tests for armour material and uniformity of galvanization shall be as per IS - 3975 and IS -10810 (Part 41). The dimensions of Armour shall be as per method (b) of IS - 1554 (Part -1). If armouring is specified for single core cables in the data sheet, the same shall be with H4 grade hard drawn aluminium round wire of 2.5 mm diameter. For mining cables, the size and type of armour shall be such that the combined conductance of armour shall be equivalent to 75 percent of the conductance of the largest conductor of the cable.
- 3.7.6 The outer sheath for the cables shall be applied by extrusion and shall be of PVC compound conforming to the requirements of type ST-1 compound as per IS: 5831. The minimum and average thickness of outer sheath for un armoured cables and minimum thickness of outer sheath for armoured cables shall be as per IS: 1554 (Part -1).
- 3.7.7 If heat resisting PVC cables are specified in the data sheet, the following shall be the requirements:
- It shall be possible to continuously operate the cable at a maximum conductor temperature of 85 ° C. PVC compounds used for HR PVC cables shall be as follows:
- a. Conductor insulation - Type C
 - b. Inner sheath - Type ST 2
 - c. Outer sheath - Type ST 2

3.8 XLPE Cables

- 3.8.1 Power cables for 3.3 KV up to and including 33 KV systems shall be Aluminium/ copper conductor, XLPE insulated, sheathed, armoured and overall PVC sheathed.
- 3.8.2 The conductors shall be stranded and compacted circular for all cables.
- 3.8.3 All cables rated 3.8 / 6.6 kV and above shall be provided with both conductor screening and insulation screening. The conductors shall be provided with non-metallic extruded semi conducting screen.
- 3.8.4 The core insulation shall be with cross linked polyethylene insulating compound dry cured, applied by extrusion. It shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions. It shall conform to the properties given in Table-1 of IS: 7098 (Part -2).
- 3.8.5 The insulation screen shall consist of non-metallic extruded semi-conducting compound in combination with a non-magnetic metallic copper screen. Unless specified otherwise, the copper screen for all the three cores together shall be capable of carrying the single line to

ground fault current value and the duration specified in the data sheet.

- 3.8.6 The conductor screen, XLPE insulation and insulation screen shall all be extruded in one operation by 'Triple Extrusion' process to ensure perfect bonding between the layers. The core identification shall be by coloured strips or by printed numerals.
- 3.8.7 The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of type ST 2 compound of IS: 5831. The extruded inner sheath shall be of uniform thickness. In case of single core cables, there shall be extruded inner sheath between insulation metallic screen and armouring.
- 3.8.8 For multicore cables, the armouring shall be by galvanized steel strips as per method (b) of IS-7098 (Part-2). If armouring is specified for single core cables in the data sheet, the same shall be with H4 grade hard drawn aluminium round wire of 2.5 mm diameter.
- 3.8.9 The outer sheath of the cables shall be applied by extrusion over the armouring and shall be of PVC compound conforming to the requirements of Type ST 2 compound of IS: 5831. The minimum and average thickness of outer sheath for un armoured cables and minimum thickness of outer sheath for armoured cables shall be as per IS: 7098 (Part-2)
- 3.8.10 The thickness of the insulation, inner sheath shall be governed by values given in IS: 7098 (Part-2).
- 3.8.11 Where specified, 1100V grade power cables shall also be XLPE insulated and shall meet the requirement specified in IS-7098 (Part-1).

4.0 CABLE ACCESSORIES

- 4.1 The termination and straight through jointing kits for use on the systems shall be suitable for the type of cables offered as per this specification.
- 4.2 The accessories shall be supplied in kit form. Each component of the kit shall carry the manufacturer's mark of origin.
- 4.3 The kit shall include all stress grading, insulating and sealing materials apart from conductor fittings and consumable items .An installation instruction sheet shall also be included in each kit.
- 4.4 The contents of the accessories kit including all consumable shall be suitable for storage without deterioration at a temperature of 45° C, with shelf life extending to more than 5 years.

4.5 Terminating kits

The terminating kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer / motor. For outdoor terminations, weather shields / sealing ends and any other

accessories required shall also form part of the kit. The terminating kits shall be from one of the makes / types mentioned in the data sheet.

4.6 Jointing kits

The straight through jointing kits shall be suitable for installation on overhead trays, concrete lined trenches, and ducts and for underground burial with uncontrolled backfill and possibility of flooding by water and chemicals. These shall have protection against any mechanical damage and suitably designed to be protected against rodent and termite attack. The inner sheath similar to that provided for cables shall be provided as part of straight through joint. The jointing kits shall be from one of the makes / types mentioned in the data sheet.

5.0 INSPECTION, TESTING AND ACCEPTANCE

The cables shall be tested and inspected at the manufacturer's works. All the materials employed in the manufacture of the cable shall be subjected, both before and after manufacture, to examination, testing and approval by SRE / owner. Manufacturer shall furnish all necessary information concerning the supply to SRE / owner's inspectors. The inspector shall have free access to the manufacturer's works for the purpose of inspecting the process of manufacture in all its stages and he will have the power to reject any material, which appears to him to be of unsuitable description or of unsatisfactory quality. The vendor shall give at least 2 weeks advance notice to the purchaser, regarding the date of testing to enable him or his representative to witness the tests.

5.1 Cables

5.1.1 After completion of manufacture of cables and prior to dispatch, the cables shall be subjected to type, routine, acceptance and special tests as detailed below. SRE/ Owner reserves the right to witness all tests with sufficient advance notice from vendor. The test reports for all cables shall be got approved from the Engineer before dispatch of the cables.

5.1.2 All routine tests, acceptance tests, type tests and additional type tests for improved fire performance shall be carried out as listed in IS: 1554 (Part-1), and IS: 7098 (Part-2) on PVC and XLPE insulated cables respectively.

5.1.3 The test requirements for PVC insulation and sheath of cables shall be as per latest

revision of IS: 5831.

- 5.1.4 Test for Resistance to Ultra Violet Radiation: This test shall be carried out as per DIN 53387 or ASTM-G-53 on outer sheath. The retention value of tensile strength and ultimate elongation after the test shall be minimum 60 % of tensile strength and ultimate elongation before the test. Test certificates with respect to this test (not older than one year) from recognized testing laboratory to be furnished for review by SRE before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by vendor at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided outer sheath remains same.
- 5.1.5 Acceptance tests as per IS-1554 (Part-1) and IS-7098 (Part-2) and the following special tests to be performed on the cables as per sampling plan. These tests are required to be witnessed by SRE/owner before dispatch of cables.
- 5.1.6 Accelerated water absorption test for insulation as per NEMA - WC - 5. (For PVC insulated cables) and as per NEMA WC - 7 (for XLPE insulated cables). Test certificates with respect to this test (not older than one year) from recognized testing laboratory to be furnished for review by SRE before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by vendor at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided type of insulation remains same.
- 5.1.7 Dielectric Retention Test: The dielectric strength of the cable insulation tested in accordance with NEMA WC - 5 at $75 \pm 1^{\circ} \text{C}$ shall not be less than 50 % of the original dielectric strength. (For PVC insulated cables). Test certificates with respect to this test (not older than one year) from recognized testing laboratory to be furnished for review by SRE before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by vendor at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly and once for each order.
- 5.1.8 Oxygen Index Test: The test shall be carried out as per ASTM D2863 or applicable Indian Standard specifications. Sampling to be done for every offered lot/size as per sampling plan.

- 5.1.9 Flammability Test: The test shall be carried out on finished cable as per IS – 10810 (part 61 & 62). Sampling for these tests is to be done randomly once for each order, provided outer sheath remains same. The acceptance criteria for tests conducted shall be as under:

Part-61-The cable meets the requirement if there is no visible damage on the test specimen within 300 mm from its upper end

Part-62-The maximum extent of the charred portion measured on the test sample should not have reached a height exceeding 2.5 m above the bottom edge of the burner at the front of the ladder.

- 5.1.10 Test for rodent and termite repulsion property: The vendors shall furnish the test details to analyze the property by chemical method. Sampling to be done for every offered lot / size as per sampling plan.

5.2 **Cable Accessories**

Type tests should have been carried out to prove the general qualities and design of a given type of termination / jointing system as per IS-13573. The type test certificates from independent testing laboratory shall be submitted before dispatch.

6.0 **PACKING AND DESPATCH**

- 6.1 Cables shall be dispatched in non-returnable wooden or steel drums of suitable barrel diameter, securely battened, with the take-off end fully protected against mechanical damage. The wood used for construction of the drum shall be properly seasoned, sound and free from defects. Wood preservatives shall be applied to the entire drum. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.
- 6.2 On the flange of the drum, necessary information such as project title, manufacturer's name, type size, voltage grade of cable, length of cable in metres, drum no., cable code, and BIS certification mark, gross weight etc. shall be printed. An arrow shall be printed on the drum with suitable instructions to show the direction of rotation of the drum.
- 6.3 Unless otherwise specified, Cables shall be supplied in drum.

A tolerance of plus or minus 3 % shall be permissible for each drum. However overall tolerance on each size of cable shall be limited to $\pm 2\%$. Offers with short /

non-standard lengths are liable for rejection. If non-standard drum lengths are specified in the data sheet, the same shall be supplied.

7.0 CABLE LAYING

7.1 General

- 7.1.1 Cable installation shall include power, control, lighting, fire alarm, telephone and communication cables. These shall be laid in trenches/ cable trays /Duct as detailed in the cable layout drawings. Cable routing given on the cable layout drawings shall be checked in the field so as to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. Any change in routing shall be done to suit the field conditions wherever deemed necessary, after obtaining approval of Engineer-in-charge.

High voltage, medium voltage power and control cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cables trays, as shown on layout drawings/installation standards. Details of cable routes and cable spacing not shown in detail on these drawing shall be determined by the contractor and approved by the engineer- In-charge.

When single core cables are laid in flat formation, the individual cable fixing clamps and spacers shall be of non-magnetic material. As a general practice, the sheath of single core cables shall be earthed at one point to keep sheath at earth potential unless otherwise stated. Single core cables, when laid in trefoil formation shall be braced by suitable clamps at a distance, not exceeding 3 meters along the cable routing.

If straight through joints are required to be provided on single core cables, armour shall be broken at joints as per manufacturer's recommendations. For single core cables, armour shall be earthed at one end for the cable run length as per manufacturer's recommendation.

The Telephone, Communication and Fire alarm cables shall run on instrument trays/ducts/ trenches in the units. Wherever these are not available, cables shall be taken in a separate trench/tray with a minimum spacing of 300 mm from power and control cables

Telephone, fire alarm and plant communication cables shall be directly buried in road berm area, (unless otherwise specified in cable layout drawings). These cables

shall cross power cables preferably at right angles. Street lighting cables shall be laid on the other side of road berm area

- 7.1.2 The lengths indicated in the cables schedule are only approximate. The contractor shall ascertain the exact length of cable for a particular feeder by measuring at site. All cable routes shall be carefully measured. Before the start of cable laying, the contractor shall prepare cable drum schedule and get that approved by Engineer-in-charge to minimize/avoid straight through joints and then the cables cut to the required lengths, leaving sufficient lengths for the terminations of the cable at both ends. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. Extra loop length shall be given for feeder cables where required as per the directions of Engineer-in-charge to meet contingencies

Cables shall be laid in directly buried trench or in RCC trench (underground trench) or in cable tray along pipe sleepers or in over head trays as shown on cable layout drawings.

Overhead trays shall be installed 2700 mm (minimum) above grade level and 300mm above FGL in case cable trays are installed along with pipe sleepers. At road crossings overhead trays shall be installed at 7000 mm (minimum) above grade level or cables shall be routed cable tray culvert/ Electrical road crossings as per layout drawings.

Sufficient care shall be taken while laying cables to avoid formation of twist, sharp bend etc. in order to avoid mechanical injuries to cables. Rollers shall be used for pulling of cables.

Cable installation shall provide minimum cable bending radii as recommended by cable manufacturer.

- 7.1.3 Cables shall be neatly arranged in the trenches / trays in such a manner that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cables within the trenches / trays shall be in line with cable layout drawings. Cable routing between cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45 to the trench wall. Bending radii of pipes shall not be less than 8D. It is to be ensured that both the ends of GI pipe sleeves shall be sealed with approved weather proof sealing plastic compound after cabling. In places where it is not possible, cables shall be laid in smaller branch trenches. Different rows of cable trays in cable cellar below the cutout shall be fixed so that the trays don't obstruct cable entry to the panels.

- 7.1.4 All cables shall be identified close to their termination point by cable tag numbers as per cable schedule. Cable tag numbers shall be punched on aluminium /Lead straps (2mm thick, 20 mm wide and of enough length) securely fastened to the cable and wrapped around it.

Each underground cable shall be provided with cable tags of lead /Aluminium securely fastened every 30 m of its underground length with at least one tag at each end before the cable enters/leaves the ground. In unpaved areas, cable trenches shall be identified by means of cable markers as per installation drawing. These cable markers shall be placed at location of changes in the direction of cables and at intervals of not more than 30 m and also at cable straight through joint locations.

- 7.1.5 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of cables shall be taped with an approved PVC end cap or rubber insulating tape.

- 7.1.6 Each row of cables shall be laid in place and before covering with sand. All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench. Every cable shall be given an insulation test in presence of Engineer-in-charge/Owner before filling the cable trench with sand Any cable which is found defective shall be replaced.

- 7.1.7 Where cables pass through foundation walls, the necessary openings shall be provided in advance for the same by another agency. However, should it become necessary to cut holes in existing structures for example floor slab etc., the electrical contractor shall determine their location and obtain approval of the Engineer-in-charge before carrying out the same.

- 7.1.8 Cables for road crossings shall be taken through ERC (Electrical Road Crossing) as shown in the cable layout drawings.

At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.

- 7.1.9 Wherever cable trench crosses storm water, waste water channel/drain, cables shall be taken through PVC/RCC pipes. Where cables are required to cross drains of depth more than 1200 mm, cables shall be taken over the drain on cable trays supported suitably using ISMC 150/200 sections.

- 7.1.10 Ends of cables leaving trench shall be coiled and capped and provided with protective cover till such time the final termination to the equipment is completed.

7.2 Cables Laid Direct in Ground

Cables shall be laid underground in excavated cable trenches where specified in cable layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables. Cables shall be properly spaced as per installation standards. Maximum number of cable layers in trench shall be preferably limited to 6 layers.

Minimum depth of directly cable trench shall be 750 mm, for medium voltage and 900 mm for HV Cables. The depth and the width of the trench shall vary depending upon the number of layers of cables as per SRE installation Standards. The depth and the width of the trench shall vary depending upon the number of layers of cables as per SRE installation Standards

Cables shall be laid in buried trenches at depth as shown in the cable layout drawings. It is to be ensured by the contractor that the bottom of buried trenches shall be cleared of all rocks, stones and sharp objects before cables are placed. The trench bottom shall be filled with a layer of sand or stone dust. This sand /stone dust shall be leveled and cables laid over it. These cables shall be covered with 150 mm of sand on top of the largest diameter cable and sand shall be lightly compacted. A flat protective covering of 75 mm thick second class red bricks or concrete tiles as per specification shall then be laid and the remainder of the trench shall then be back - filled with soil, rammed and leveled.

7.3 Cables Laid in Concrete Trench

Cables shall be laid in 5 or 6 tiers in concrete trench as shown on layout drawings. Concrete cables trenches shall be filled with sand /stone dust in hazardous area to avoid accumulation of hazardous gases and oil. RCC covers of trenches shall be effectively sealed to avoid ingress of chemical and oil in process area. Removal of concrete covers where required for the purpose of cable laying and reinstating them in their proper position after cables are laid shall be done by electrical contractor.

Minimum depth of RCC cable trench shall be 500mm for all voltage grades with 300mm clearance between the bottoms of the trench cover and top of the cable. The depth and the width of the trench shall vary depending upon the number of layers of cables and bending radius required for cables as per SRE installation Standards

All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water

7.4 Above Ground Cables

- 7.4.1 Cables installed above grade shall be run in cable trays, clamped on walls, ceiling or structures and shall be run parallel or at right angles to beams, walls or columns. Cable routing shall be planned to be away from heat sources such as hot piping, gas, water, oil drainage piping, air-conditioning duct etc. Each cable tray shall contain only one layer of cables as far as possible for power cables. However control cables may be laid in double layer in the cable trays.
- 7.4.2 Individual cable or small group of cables (up to 3 cables) which run along structures / walls etc. shall be clamped by means of 16 SWG GI saddles on 25 x 6 mm saddle bars. Alternatively small group of cables can be taken through 60/100/150 mm slotted channel tray or channel ISMC-75/100. Cables shall be supported so as to prevent Sagging. In general, distance between supports shall be approximately 300 mm for cables up to 25 mm diameter and maximum 450 mm for cables larger than 25 mm dia. to prevent the Sagging of cables.
- 7.4.3 Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of GI saddles / clamps, whereas cables in horizontal run of cable trays shall be tied by means of nylon cords. Distance between supporting angles shall not exceed 600 mm. All cable trays (other than galvanized trays) and supporting steel structures shall be painted before laying of cables. The under surfaces shall be properly degreased, derusted, descaled and cleaned. The painting shall be done with one coat of red oxide zinc chromate primer. Final painting shall be done with two coats of approved bituminous aluminium paint unless otherwise specified.
- 7.4.4 Where cables rise from trench to motor, lighting panel, control station, junction box etc., they shall be taken in GI pipe for mechanical protection up to a minimum of 300 mm above grade for outdoor area. Cable ends shall be carefully pulled through conduit to prevent damage to cable.
- 7.4.5 AH GI Pipes shall be laid as per layout drawings and site conditions. Before fabrication of various profiles of pipes by hydraulically operated bending machine (which is to be arranged by the contractor) all the burrs from the pipes shall be removed. GI Pipes having bends shall be buried in soil / concrete in such a way that the bend shall be totally concealed. For G.I. pipes buried in soil, bitumen coating shall be applied on the buried lengths, Installation of G.I. pipes shall be undertaken well before paving is completed and necessary co ordination with paving agency shall be the responsibility of Electrical Contractor.

Following guide shall be used for sizing of GI. pipe.

- a) 1 cable in a pipe -53% of pipe cross-sectional area occupied by cables.
- b) 2 cables in a pipe -31% of pipe cross-sectional area occupied by cables.

- c) 3 cables in a pipe - 43% of pipe cross-sectional area occupied by cables.
- d) 4 & above cables in a pipe - 40% of pipe cross-sectional area occupied by cables.

7.4.6 After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/bitumen/suitable sealing compound. Alternatively rubber bushes shall be employed for the purpose of sealing.

7.4.7 Fire proofing of end of power cables at least 1 meter at each end as per OISD norms for the refinery and Petroleum industry, shall be carried out as per the recommendation of the paint supplier. Rates for the fire proofing of cables shall be included in the cable installation and no separate payment shall be made for the painting.

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B
Description

Mode of Payment: The rate shall be for a Unit of One Mtr.

SR NO 12. Solderless crimping type Aluminium lugs

Solderless crimping type Aluminium lugs conforming to IS suitable for cable of following size evenly crimped with high pressure tool & connected to switchgear terminals with brass/cadmium plated nut bolts in an approved manner.

(F) 70 Sq.mm.

(H) 120 Sq.mm.

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B
Description

Mode of Payment: The rate shall be for a Unit of One No.

SR NO 13. Heavy duty flange type brass cable gland

Providing and, fixing heavy duty flange type brass cable gland with rubber ring for PVC insulated armoured cable complete with out going tails, insulating tape etc for following size of cables.

(B) 3 & 1/2 core 35/50 Sq. mm

(C) 3 & 1/2 core 70 Sq. mm

(E) 3 & 1/2 core 120 Sq. mm

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B
Description

Mode of Payment: The rate shall be for a Unit of One No.

SR NO 14. TIMER & CONTACTOR

14.1 Programmable Timer Unit

General

Timer input voltage shall be powered by AC 100 - 240 Volts AC (+10% / -15%, 50 hertz), conforms to:

Noise Immunity:	IEC 6100-4-4, 2kV (Power supply line)
Ambient operating temperature:	0°C to 55°C
Humidity:	10% - 90%

The Timer shall have the following programmable features:

- (a) Programmable: With 3 inputs and 1 output conditions per line.
- (b) Basic CPU Input / Output: Minimum 6 inputs and 4 outputs.

All outputs should have a relay switching capacity of 8 Amps at 250 Volts AC with independent common.

The Timer Central Processing Unit (CPU) shall be provided with built-in real-time clock and calendar functions. The real time clock should have an accuracy of ± 15 sec per month. The data of real time clock, calendar, holding bits, holding timers and counter present value shall be held by a non-battery system for a minimum of 48 hours for prolonged power interruptions.

The timer program and system setting data shall be stored in internal EEPROM to prevent loss of setting / program during power failure.

The Timer shall have the following features and functions:

- (a) Front panel LCD display with backlight. Backlight can be automatically cut-off through adjustable settings to save the life span of backlight.
- (b) Input filters settings to prevent noise-related malfunctions such as false triggering of inputs.
- (c) Password protection function to prevent unauthorised modification of Timer programs and settings.

Timer shall incorporate a communication port or infrared port for downloading of program and setting.

Timer shall support communications to host devices such as computers and Personal Digital Assistant (PDA).

The Timer system shall be equipped with the Windows Based software programming tools and drivers for the set-up of communication between Timer and host devices.

The Timer shall be provided with an application software tool running on Windows CE powered PDAs to allow setting of programs and the download / upload of the settings.

All Timer technical details and full communication protocols shall be provided.

The Timer shall have self-diagnostic functions and shall be displayed on the CPU LCD. All errors shall be able to communicate back to host communication port or infrared port.

The timer shall have minimum 16 programmable On / Off period within a year. Weekly timings and minimum 16 programmable calendar timings.

The On / Off switching timing of the timer shall be programmed based on the local sunrise and sunset time. It shall be programmed with at least eight (8) different segments of switching timing as follows:

S/No	From	To	Time On	Time Off
1	10-Jan	31-Mar	1910	0721
2	01-Apr	17-Jun	1903	0708
3	18-Jun	28-Aug	1907	0711
4	29-Aug	15-Sep	1859	0706
5	16-Sep	07-Oct	1853	0701
6	08-Oct	06-Dec	1847	0658
7	07-Dec	23-Dec	1855	0707
8	24-Dec	09-Jan	1903	0715

The timer shall have a Mean Time Between Failure (MTBF) of at least 300,000 hours and a stored programmed calendar year/month/day of equivalent length of time.

The timer shall be protected with an enclosure and a micro surge suppressor to prevent external adverse conditions such as high humidity, pests' infestation or frequent sudden power surges from the incoming power supply.

The size of the timer enclosure box shall measure 125mm(W) x 125mm(L) x 100mm(D) in dimension and rated at **IP 66**. The temperature rating is -40°C to 80°C of the box. The material used shall be Acrylonitrile Butadiene Styrene (ABS) for body, clear PolyCarbonate (PC) for cover.

The micro surge suppressor shall comply fully with the Transient Immunity EMC requirements (Norms EN 61000-4-4 & EN 61000-4-5), while providing effective transient voltage protection to the timer.

The micro surge suppressor shall design and manufactured to the safety standards: CE, UL, VDE, IEC, EN. The housing shall be made of compact plastic according to UL-VO.

V nominal	440 Volts, three-phase
Frequency	50 hertz
Max Operating Voltage	500 Volts (L-L)
Max Surge Current	4.5 KA
EMI / RFI noise rejection	20 dB
Response Time	1 ns

14.2 Electro-Magnetic Contactor

General

The contactor shall be manufactured in accordance with the latest edition of IEC 60158-1 and BS 5424 Part I. This contactor shall be suitable for use in the tropical climate and it is intended to be mounted in an enclosure. They shall be provided with main contacts capable of at least 105 switching operations and at least two auxiliary contacts for remote control (230 Volts, AC). Contactors for lighting control shall be of Utilisation Category AC2, Class 3.

The rated operating current shall be 60 Amps when used on 400 Volts, 50 hertz (rated operating voltage and frequency) and for uninterrupted duty. It shall be suitable for switching on high intensity discharge Mercury or Sodium Vapour lamps with power factor improvement capacitors connected across the incoming circuits of the lamps.

The contactors shall have at least 900 Amps making capacity and 720 Amps breaking capacity to prevent contact welding during switching on and off.

The rated operating magnetic coil voltage shall be 230 Volts $\pm 6\%$, 50 hertz $\pm 1\%$, single-phase. The coil shall be preferably encapsulated type.

Contactor Enclosure Box

The box shall be designed to contain a 60 Amps three-phase contactor. Its size shall be:

LENGTH	WIDTH	DEPTH
190mm - 200mm	190mm - 200mm	130mm - 135mm

The box shall be dust-protected and preferably be constructed of thermoplastic self-extinguishable material. The cover of the box shall be transparent.

Mounting rails or similar attachments shall be provided on the base of the box for easy mounting of a contactor.

The box shall be provided with eight (8) nos. holes on the top side for entry of 16mm² single-core and three (3) holes on the bottom side for entry of 35mm² single-core (box mounted in a vertical position). 11 nos. of entry seals (grommets) are to be provided for the entry holes.

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B

Description

Mode of Payment: The rate shall be for a Unit of One No.

SR NO 15. CAT-6 CABLE

No.	Technical Specification
1.	Category 6 UTP Cable
	<ul style="list-style-type: none"> ➡ Cable should meet or exceeds Category 6/Class E attenuation. ➡ Should meet Cat 6 / Class E NEXT requirements in ISO/IEC 11801 and TIA/EIA 568B. ➡ Should be UL verified as Category 6. ➡ Should have Star filler (No bisector tape) cable construction for improved performance. ➡ Insulation material should be polyethylene. ➡ Performance guaranteed to meet or exceed Category 6/Class E Channel Specifications to 250 MHz. ➡ Category 6/Class E NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT and return loss extrapolated to 250 MHz. ➡ Cable should capable of delivering potentially in excess of 1 Gbps to the workstation in accordance with application standards. ➡ Should support IEEE 802.3 1000BASE-T, TIA-854-A 1000BASE-TX, plus other legacy LANs and applications as well as Video also.
	<p>Electrical / Mechanical Specification:</p> <p>Conductor DC resistance @ 20°C (max): 9.38 Ω /100m</p> <p>DC resistance Unbalance (max): 5%</p> <p>Mutual Capacitance @ 20°C (max): 5.6 nF/100m</p> <p>Nominal Velocity of Propagation: 70%</p> <p>Attenuation at 250 MHz: 32.8 dB</p> <p>Return Loss at 250 MHz: 17.3 dB</p> <p>ACR at 250 MHz: 5.5 dB</p> <p>PSACR at 250 MHz: 3.5 dB</p> <p>NEXT at 250 MHz: 38.3 dB</p> <p>PSNEXT at 250 MHz: 36.3 dB</p> <p>ELFEXT at 250 MHz: 19.8 dB</p> <p>PSELFEXT at 250 MHz: 16.8 dB</p> <p>Minimum Bending Radius: During Installation (50 mm) & After Installation (25 mm)</p> <p>Maximum Pulling Tension: 108 N (11 Kg)</p> <p>Operating Temperature: -15°C to 70°C</p> <p>Gauge: 24 AWG</p>

MODE OF MEASUREMENT: AS PER MENTIONED IN SCHEDULE – B
Description

Mode of Payment: The rate shall be for a Unit of One Mtr.

SPECIAL CONDITION

- (1) Point wiring shall be from the distribution box or fuse board, No sub main shall be measured.
- (2) Samples of materials shall be given to Engineer-in-charge and approval should be taken in writing before its use.
- (3) Fabrication drawing should be get approved from the Engineer-in -charge prior to Manufacturer.
- (4) Pipe laying lay out shall be as per consultants drawings.
- (5) There shall be no junction in wiring out let box shall be used after bond.
- (6) Electrical contractor shall make good the civil work if chased or damaged.
- (7) Electrical Engineer-in-charge opinion shall be final and binding on contractor.
- (8) Qualified labor and supervisors shall work at site.
- (9) Electrical Contractor shall not permit unqualified labor contractor to work at site. He shall observe Govt. rules regarding control of labor. He shall submit test report and carry out tests as required and furnish detailed drawings on completion of work. The responsible authorized person by the contractor should be available at site daily when work is in progress.
- (10) The work shall be carried out during working days between 8.00 A.M. to 6.00 P.M. only. The cable trench should not remain open for more than 24 hours after excavation. If contractor intends to work on holiday or outside working hours specified, he shall take prior permission from the Engineer-in-charge. In that case overtime to the staff shall have to be paid by the Contractor. The Electrical appliance-materials shall bear the ISI mark or declaration indicating manufacture's names and appliances material used having been manufactured in accordance with the manufactures' certificate issued by the Government of Gujarat and confirming to the standard specified by the I.S.I. shall be given by the contractor.
- (11) Cost of all test should be borne by contractor/ Tenderer, carried out for Electrical related equipment in presence of TPI/PMC/SDCB's representative.

The conditions laid down under House Hold Electrical appliances (Quality control Act 1981) shall be followed.

I/We agree to carry out the above work at rates indicated above at _____ percentage above/below the rates indicated above i.e. I/We agree to carry out the above work at a total cost of Rs. _____ .

The Contractor shall provide test report and get the installation approved from Govt. Elect. Authority is required.

CONTRACTORS STAMP AND SIGNATURE.