RRCAT-INDORE

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

CONSTRUCTION & SERVICES DIVISION, RRCAT

ELECTRICAL WORKS

TECHNICAL SPECIFICATIONS

INDEX

(1E) SECTION – 1 : GENERAL REQUIREMENT & PROJECT DATA

1E1 GENERAL CONDITIONS

All works covered by this specification shall be carried out in accordance with the “General conditions of the contract” attached here to.

1E2 SCOPE

This specification includes manufacture, fabrication, assembly, supply, pre dispatch Inspection, delivery at site, erection & commissioning of various items, systems, activities and equipment pertaining to electrical works as per Schedule A {SOQ (A)}, drawings and detailed description. The entire work is required to be carried out as per the phase program finalised by Engineer-in-charge.

1E3 HANDLING AND TRANSPORT FACILITIES AT SITE

The contractor shall be responsible for handling and transport of all the material covered under this contract from manufacturers’ works to the actual site of erection, including loading and unloading of material as required. The contractor shall make his own arrangement for temporary storage of material, equipment and tools & tackles required for execution of works at site.

1E4 SAFETY

No person shall work on any live electric supply line or apparatus and no person shall assist such person on such work, unless he is authorized in that behalf and takes the safety measures approved by the department.

Any work on live system shall be carried out by the authorized person under supervision of departmental person.

All persons employed for the work shall be made aware of the electrical and other hazards and must use appropriate test and safety equipment. All the personal protective equipment (PPE) and safety equipment required for execution of the work will be arranged by the contractor.

1E5 APPROVALS OF ELECTRICAL INSPECTOR

Approval of Central Electricity Authority (CEA) shall be obtained before energisation of installation where ever specified. Contractor shall assist the Department in obtaining the approval from CEA. This shall include submission of documents, drawings, test reports etc. carrying out testing in presence of inspector and modification stipulated by the inspector as per the requirements at the risk and cost of the contractor. However the inspection fees shall be paid by the department.

1E6 COMPLETION & GUARANTEE

After the completion of work the contractor shall submit six sets (Hard copy) of the test certificates, manuals and executed drawings with one compact disc/ pen drive.

The performance of all the equipment and the installation should be guaranteed for a minimum period of one year from the date of completion of work against defective material or workmanship.

The contractor shall furnish the completion certificate & guarantee as per the format given in the technical specification (section 8E).

ABBREVATIONS

1.	SB	-	Switch boards
2.	SW	-	Switches
3.	SC	-	Sockets
4.	FL	-	Fluorescent Lamp
5.	CFL	-	Compact Fluorescent Lamp
6.	MH	-	Metal Halide Lamp
7.	CDMT	-	Ceramic Discharge Metalic Tubuler Lamp
8.	HPMV	-	High Pressure Mercury Vapour Lamp
9.	HPSV	-	High Pressure Sodium Vapour Lamp
10.	LED	-	Light Emitting Diode
11.	HL	-	Halogen Lamp
11.	CF	-	Ceiling Fan
12.	EF	-	Exhaust Fan
13.	WF	-	Wall Mounted Fan
14.	BTS	-	Bus Trunking System
15.	C	-	RJ45 Data Network Point
16.	T	-	RJ11 Telephone Point
17.	PP	-	Power Point
18.	TPMC	-	Three Phase Industrial Plug & Socket+MCB+ enclosure
20.	SPMC	-	Single Phase Industrial Plug & Socket+MCB+ enclosure
21.	TPMCB	-	Three Pole MCB with enclosure
22.	SPMCB	-	Single Pole MCB with enclosure
23.	DPMCB	-	Double Pole MCB with enclosure
23.	NE	-	Neutral/System Earth
24.	EE	-	Equipment earth
25.	LE	-	Lightning Protection Earth
26.	SE	-	Special Earth (For equipment)
27.	PCC	-	Power Control center
28.	MCC	-	Motor control center
29.	MPDB	-	Main Power Distribution Board
30.	EFP	-	Electrical Feeder Pillar(Out door)
31.	PDB	-	Power Distribution Board
32.	MLDB	-	Main Lighting Distribution board
33.	LDB	-	Lighting Distribution Board
34.	EPDB	-	Emergency Power Distribution Board
35.	MTDB	-	Main Telephone Distribution board
36.	TDB	-	Telephone Distribution Board
37.	OTDB	-	Outdoor Telephone Distribution Board

-----x-----

(2E) SECTION-2 : SWITCHBOARDS AND DISTRIBUTION BOARDS

2E1 SCOPE

This specification covers the technical requirements of design, manufacture, testing at manufacturer's works, supply, installation, testing and commissioning at site of Power Control Centre, Switch Boards, Power / Lighting Distribution Boards suitable for 3 phase, 4 wire 415 V, 50 Hz system and Telephone Distribution Boards.

2E2 STANDARDS AND CODES

Unless otherwise specifically mentioned in the document, the design, manufacture, testing and performance of all cables shall conform to the latest edition of the following standards & codes:

IS: 8623/1993 (Part-1&2) Reaffirmed in 2004	:	Specification for low Voltage switchgear and control gears assemblies. (Part-1 Requirement for type tested and partially type tested assemblies. Part-2 Particular requirement for Bus-bar trunking system.)
IS : 13947(Part-I to V) 2003	:	Low-voltage Switchgears and control gears. Part-1 - General Rules Part-2 - Circuit Breakers Part-3 - Switches, Disconnectors, SDF, FCU Part-4 - Contactors and Motor starters. Part-5- Control circuit devices and switching elements.
IS : 12640 (Part-1 &2)	:	Part-I Residual current operated circuit-breakers for house hold and similar Uses : Circuit breakers without integral over-current protection (RCCB's) Part-II Residual current operated circuit-breakers for house hold and similar Uses : Circuit breakers with integral over-current protection(RCVO's).
IS : 2705	:	Part-1 Current Transformer : General requirement. Part-2 Current Transformer : Measuring Current Transformers. Part-3 Current Transformer : Protective Current Transformers. Part-4 Current Transformer : Protective Current Transformers for special purpose applications.
IS : 13779	:	ac Static Watt hour Meters, Class1 and 2 - Specification.

2E3 SWITCHBOARDS / DISTRIBUTION BOARDS

2E3.1 GENERAL CONSTRUCTION FEATURES

The Switchboards shall be designed, manufactured and equipped with Components/ accessories indicated in the SOQ (A) in accordance with this specification and applicable standards. The switchboard shall be floor/Wall mounted / free standing totally enclosed. The design shall include all provisions for safety of operation and maintenance personnel. Adequate cooling arrangements shall be made. The doors, frames and outer body of Cubical type switch boards shall be fabricated out of minimum 2.0 mm thick CRCA sheet steel. The partitions shall be fabricated out of minimum 1.6mm and gland plates with 3 mm thick CRCA sheet steel. Stiffening shall be provided in the frame work wherever required. General construction shall employ the principle of compartmentalization and segregation for each circuit. Operating levers, handles shall not be mounted at a height maximum 1800 mm and minimum 250mm above the FFL. Cable entries for various feeders shall be either from top or bottom through cable alleys located in between two circuit sections. Separate gland plate for each cable shall be provided. The cable support arrangement shall be provided for dressing / clamping the cable in the cable alley or rear cable chamber. The panel builder shall have type test certificates for Short Circuit and Heat run test from NABL accredited laboratory in respect of panels of similar design and equivalent ratings.

2E3.2 SWITCHGEAR CUBICLES

All edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. Cut outs shall be turned in shape and shall be devoid of sharp edges.

Structures, buses and control wiring troughs shall be so designed and arranged as to make future extensions readily feasible. Access to the circuit breaker operating mechanism shall be through compartment doors provided with hinges and key type / Screw Driver operated locks, so arranged as not to expose any live parts or circuits. All compartment doors shall be so constructed that they will not seize in the event of fire within the switchgear.

Instruments shall be mounted on front doors. All doors shall have neoprene/PUF/EPDM gaskets wherever required.

All inter-compartments openings shall be provided with PVC bushes. The different materials used in the making of switchgear units, such as bus insulation, bus supports etc. shall not support combustion. The integrated base frame of the switchgear panel shall be designed in such a way that it shall be strong enough for manual shifting of the panels at site.

LED type Indicating lamps protected by HRC fuses for switchgear status like ON/OFF/Trip and phase indications R,Y,B shall be used.

Insulating mats or any insulated flooring of 1100V grade as per relevant IS shall be supplied and laid all along the panel.

2E3.3 AIR CIRCUIT BREAKER

Air Circuit Breakers shall be complete with the following :

(a) Circuit Breaker Carriage shall have 3 positions (isolate, test , service) with draw out mechanism and LED indications
(b) Safety shutters with interlock mechanism
(c) Arrangement for pad locking on the doors
(d) Manual/Electrically operated Spring Charging Mechanism with mechanical ON/OFF indication as well as electrical On/Off /Trip indication
(e) Microprocessor based release with inbuilt over load, short circuit & earth fault protection having communication facility over standard protocol
(f) 6 NO+ 6 NC auxiliary contacts for purchaser's use
(g) Current Transformers as specified in the SOQ(A)
(h) ACB terminals shall be suitably brought out for aluminum bus bar termination as per relevant IS

2E3.4 MOULDED CASE CIRCUIT BREAKER

Moulded case circuit breaker (MCCB) shall be rated for 415V and service breaking capacity as indicated in the SOQ(A). Microprocessor based release shall be provided with inbuilt over load (40% to 100%), short circuit & earth fault protection having communication facility over standard protocol. The MCCB feeders shall comprise the operating handles with door interlock feature, phase barriers and spreaders for terminals. This also includes tinned copper links for achieving safe clearances wherever required.

2E3.5 MINIATURE CIRCUIT BREAKER (MCB)

MCB shall have following features -

1. Low power consumption
2. Finger Safe terminals
3. Dual termination facility
4. Contact material - Silver graphite or better
5. DIN Rail mounting
6. Inbuilt Short circuit and Over Load Protection

Nominal Voltage, service breaking capacity, rated current, tripping curve and number of poles shall be as indicated in the SOQ(A).

2E3.6 RESIDUAL CURRENT CIRCUIT BREAKER (RCCB/ELCB)/RCBO

RCCB/ELCB/RCBO shall be suitable for the protection against leakage of current in electrical circuit. Number of Poles, rated voltage & current, Service breaking capacity and Sensitivity shall be as indicated in the SOQ(A). The RCCB/ELCB/RCBO shall be with following features -

1. Simple and robust operating mechanism
2. Test button for regular inspection
3. Electronic Release (Voltage Dependent) having precise sensitivity to residual faults
4. Provision to accommodate in TPN distribution boards and DIN Rail mounting
5. Enhanced immunity against nuisance tripping

6. Low power consumption
7. Finger Safe terminals
8. Dual termination facility
9. Contact material - Silver graphite or better
10. Inbuilt over load, short circuit for RCBO

2E3.7 POWER/CONTROL CONTACTOR

Air break type power/control contactor suitable for 240V/415V, 50 Hz. Number of Poles, rated voltage & current, coil and insulation voltage, rated impulse withstand voltage and utilization category shall be as indicated in the SOQ(A).

The contactor shall have the following features -

1. Enclosed construction
2. Terminal Marking
3. Simple and robust operating mechanism
4. Coil Voltage indication
5. Terminals suitable for Aluminium/Copper Lugs
6. Low power consumption

2E3.8 TRANSFER SWITCHES

2E3.8.1 AUTOMATIC TRANSFER SWITCH (ATS)

240V/415V, 50 Hz, air break type automatic transfer switch with Number of Poles, rated current, Service breaking & Making capacity and utilization category shall be as indicated in the SOQ(A).

The automatic transfer switch shall have the following features -

1. Double Break and High speed transfer
2. Smooth making and breaking
3. Indication through flag indicator
4. Advance neutral - makes first & breaks last
5. Phase separator
6. Sufficient space for termination of aluminum cables and busbars.
7. Load and Line reversibility
8. Provision of arc chutes

2E3.8.2 MANUAL TRANSFER SWITCH (MTS)

240V/415V, 50 Hz, air break type automatic transfer switch with Number of Poles, rated current, Service breaking & Making capacity and utilization category shall be as indicated in the SOQ(A).

The manual transfer switch shall have the following features -

1. Double Break & High speed transfer
2. Smooth making and breaking
3. Indication through flag indicator
4. Advance neutral - makes first & breaks last
5. Phase separator

6. Load and Line reversibility
7. Handle with door interlock and padlock facility
8. Provision of arc chutes
9. Sufficient space for termination of aluminum cables and busbars

2E3.9 MOTOR STARTERS

2E3.9.1 DOL

Totally enclosed Corrosion resistant powder Coated Dust & Vermin Proof metallic Enclosure with IP 54 protection class direct on line starter (DOL) with all components and prewired. The starter shall have following features :

1. Functioning over wide Voltage range
2. Terminal Block
3. Deep Drawn Sheet Metal Casing
4. Wall/Panel Mounted type
5. Gasketted Cover
6. Rugged Construction
7. Single Phasing & Over Load Protection
8. Push Button for ON-OFF

2E3.9.2 STAR-DELTA

Totally enclosed Corrosion resistant powder Coated Dust & Vermin Proof metallic Enclosure with IP 54 protection class star-delta starter with all components and prewired. The starter shall have following features:

1. Functioning over wide Voltage range
2. Terminal Block
3. Deep Drawn Sheet Metal Casing
4. Wall/Panel Mounted type
5. Gasketted Cover
6. Rugged Construction
7. Single Phasing & Over Load Protection
8. Push Button for ON-OFF with timer

2E3.9.3 SOFT STARTER

Soft starter shall have built-in electronic overload relay (EOL). The output signal relays shall be programmable type. Soft starters shall be equipped with a port for communication.

The Soft starters shall have following features:

1. Utilisation Category AC-3
2. Protection against overload & single phasing
3. Ambient temperature compensated (-50 to 55 DegC)
4. Deep drawn / fabricated sheet steel enclosure duly phosphatised and powder coated

5. Suitable for use with standard 3-phase squirrel cage motors or as mentioned in SOQ(A)
6. Current reduction during motor starting and stopping
7. Solid state soft starter will be suitable for standard 3ph at 220V to 600V AC, 50Hz
8. Soft Start and Soft stop by multiple choices, including torque control both at start or Stop phases
9. Operator interface by display, keypad and Indication
10. Starting current 100-400% In extensible up to 500%
11. Acceleration ramp time 1-30 sec extensible up to 90sec
12. Deceleration ramp time 1-30 sec extensible up to 90sec
13. Bypass By external contactor while motor is full protected by ASTAT XT

2E3.10 BUS BARS

The 3 phase, 4 wire,415 V heat shrinkable PVC sleeved bus bars shall be of Tinned Copper/ Aluminium (as mentioned in SOQ(A)) and of adequate cross section having current density 1.6/1.0 A per sq. mm respectively. The neutral conductor shall be same as phase conductor.

In case of bus-bar ratings 800A or above separate control bus shall be provided. The control bus will be realized through solid/wired conductors all along the length of the panel. The control bus shall be fed by 415/240V control transformer of KVA rating as given in SOQ (A) duly protected by HRC fuses on primary side and MCB at secondary side.

The ground bus shall be continuous along the switchboard. Material of ground bus shall be tinned copper/Aluminium (same as main bus). Grounding terminals shall be provided at each end of the ground bus to connect grounding cables or Strips. Continuity with enclosure should be provided. The non-current carrying metal parts of equipment within switchgear cubical shall be permanently grounded through the ground bus.

2E3.11 CURRENT TRANSFORMER

The dry type epoxy moulded current transformers shall be suitable for metering / protection as specified in SOQ(A). They shall be capable of continuous operation at the temperature prevailing inside the switchboard enclosure.

2E3.12 METERING

Installation of all the meter will be as per SOQ(A). All The meters shall be be provided with HRC FUSE protection. Wiring of meters will be done by suitable size FRLS PVC flexible copper wires. Marking and ferruling will be done and marked properly in the relevant drawing. Unless otherwise specified SOQ(A.

2E3.12.1 MULTUFUNCTION METER - Fully Solid State Multifunction meter with plugin module and communication module suitable to read harmonics of system and ready to connect with SCADA system in single and three phase power with following features :

1. High resolution and clear display

2. High accuracy, Robust construction and Low power consumption and electromagnetically compatible for Panel mounting.
3. Password protection for setup parameters
4. Measure and display power factor, L-L & L-N voltage and currents, KVAR,KVA, KW reading of the system
5. User selectable default display page
6. Accuracy class 1.0 (0.5S & Cl0.2S option) as per IEC standards
7. Turbo key for one touch operation & setup with Built-In Phase Selector Switch - 3 phase meters
8. User programmable - Delta /Star /2ph /1ph & PT, CT ratios Primary & Secondary
9. Color coded analog load bar indicators for Full Scale
10. Terminal Block cover

All the accessories required shall be in the scope of this Item.

2E3.12.2 VOLTMETER/AMMETER/ PF METER / FREQUESNCY METER

Fully Solid State meters with following features :

1. True RMS measurement
2. User programmable CT & PT ratios
3. Wide Control Voltage range
4. High accuracy, Robust construction and Low power consumption and electromagnetically compatible for Panel mounting
5. Terminal Block Cover

All the accessories required shall be in the scope of this Item.

2E3.12.3 ELECTRONIC ENERGY METER

The instantaneous start type, low power consumption, 240/415V, 50Hz. electronic Energy meter based on digital technology ensures superior & drift free long term performance and reliability with following features :

1. High resolution and clear display
2. Tamper proof design
3. Maximum Demand recording with time stamping
4. High accuracy, Robust construction and Low power consumption and electromagnetically compatible for Panel mounting.
5. Accuracy irrespective of mounting position and connection polarity
6. Accuracy maintained under wide voltage and current fluctuations
7. LED indication provided on front for Meter Calibration, Reverse Indication, Phase available indication of each phase, Neutral interchange, magnetic influence and Load Earthing
8. Meter works accurately under load earth condition
9. Starting current 0.4% of basic current
10. Ambient temperature -10 to 60ºC
11. Overload range 400% of basic current (min.)
12. Power consumption Less than 1.0 watt
13. LED or LCD Display for reading

2E3.13 PANEL WIRING

Stranded copper conductors, FRLS PVC insulated color coded wires shall be used for panel wiring - for power wiring 1100V grade and for control wiring 650 V grade.

Recommended minimum sizes of conductors in the Panel are as follows :-

Control circuit	-	1.5 sq. mm.
Earthing circuit	-	1.5 sq. mm.
CT Circuit	-	2.5 sq. mm.

PVC troughs shall be provided for inter panel wiring. All wiring shall be neatly bunched and duly covered.

Wiring shall be color coded as follows :

Phase	- RED/YELLOW/ BLUE,
Neutral	- BLACK
Ground	- GREEN
Control	- Grey/White

2E3.14 TERMINAL BLOCKS & FERRULES

Each terminal block shall be one piece moulded, barrier type, complete with washers, identification strips and shall have adequate continuous current rating. At least 10% spare terminal blocks shall be provided for control wiring. Ferruling and labeling shall be provided as per wiring diagram.

All auxiliary contacts shall be wired and brought out to the terminal blocks. Wiring between components within switchgear cubicle shall be done through the terminal block only. CT wiring shall be done through terminal blocks with shorting facility.

2E4 INSPECTION AND TESTING

The inspection and testing shall be carried out at works of the fabricator/Manufacturer in presence of Departmental representatives. The stage inspection will be carried out after fabrication but before powder coating and final inspection on completed panel.

2E4.1 INSPECTION

The inspection shall include the following, but not limited to -

i) Appearance and construction
ii) Dimensional check
iii) Mounting and Feeder arrangement
iv) Door alignment, gaskets etc
v) Operational checks of switchgear and control gear logic etc

2E4.2 TESTS

The testing shall include the following, but not limited to -

i) Insulation resistance

The insulation resistance shall be measured with 1000 Volts insulation tester, both before and after high voltage power frequency test between phases, phase-neutral and phase-earth in respect of power circuits & Bus-bars. The control wiring shall be tested with 500V insulation tester.

ii) High voltage power frequency test

This test shall be carried out between phase & earth as per relevant IS.

If the result of inspection and tests are not satisfactory, the defects shall be rectified and tests shall be repeated to entire satisfaction of engineer-in-charge at the risk and cost of the contractor. The inspection and tests result shall be submitted for approval of engineer-in-charge.

Copy of test certificates for all bought out items and calibration certificates of testing equipments shall be submitted.

2E5 DRAWINGS

The following shall be submitted for approval of engineer-in-charge before taking up the fabrication.

a) Complete assembly drawings of the switchgear showing plan, elevation
b) Sectional view indicating bus-bar arrangements, cable supporting arrangement and clearances
c) Single line diagram
d) Schematic control diagrams indicating control, interlocks, relays, and instruments

The following shall be submitted on delivery of panels:
a) 6 Nos. of installation and operation manual including wiring diagram
b) 6 Nos. of all approved drawings
c) Reproducible drawing on Compact Disc

2E6 PAINTING

All steel work shall undergo minimum seven tank metal pre treatment process before Powder coating. The colour shade shall be as per SOQ(A)/ approved fabrication drawing.

2E7 LABELS

Engraved PVC/black anodised labels shall be provided on all the compartments.

2E8 DANGER PLATE

Danger plate as per relevant IS will be provided on front and back of Panel. This is must to fix danger plate on Busbar chamber.

2E9 INSTALLATION TESTING AND COMMISSIONING :

The installation of the Electrical Panels (over the trench/floor) has to be carried out by providing required supporting system fabricated out of MS channels/angles. Anti rust treatment shall be provided to the supporting system. Minor civil works for the installation of the panels including chipping of concrete, fixing of channels, grouting, finishing etc. along with supply of all required materials shall be in the scope of this item. Modification of trench covers is also included.

Visual inspection, all the routine tests shall be repeated after the completion of installation of Panel including Insulation resistance, operational checks of switchgear & control-gear and logic testing.

2E10 PREFABRICATED POWER/LIGHT DISTRIBUTION BOARDS

Supply, installation, testing & commissioning of type tested prefabricated distribution boards made out of CRCA Sheet Steel. The Distribution boards shall have double/Single door arrangement duly gasketted, earth bolts. Cable and wire dressing including ferruling and stenciling shall be done as per departmental instructions. All the materials required for installation will be supplied by the contractor.

2E11 TELELPHONE DISTRIBUTION BOARD

Supply, installation testing and commissioning of telephone distribution board fitted with hinged, gasketted lockable door incorporating connection/ disconnection modules with mounting frame and other accessories. Telephone distribution board shall be fabricated out of CRCA sheet steel (1.6mm thick for indoor and 2mm thick for outdoor installation). All steel work shall undergo metal pre treatment process before Powder coating. Before taking up the fabrication of TDB the drawing shall be got approved. All the materials required for installation will be supplied by the contractor. The colour shade shall be as per SOQ(A)/approved fabrication drawing. Engraved PVC/black anodised labels shall be provided.

Incase of outdoor installation the distribution boards shall be provided with canopy on the top. MS frame work required for installation of the DB shall be fabricated using MS angles/channels and provided with anti rust treatment. Excavation, back filling and PCC required for installation of the MS Frame work including supply of all materials except MS frame work is in the scope of this item.

----x-----

(3E) SECTION – 3: POWER, CONTROL CABLES & TELEPHONE CABLES

3E1 SCOPE

This specification deals with the requirements of supply, installation, testing, and commissioning of armoured / unarmoured Aluminum / copper conductor power / Control / telephone cables.

3E2 STANDARDS AND CODES

Unless otherwise specifically mentioned in the document, the design, manufacture, testing and performance of all cables shall conform to the latest edition of the following standards & codes:

IS : 7098 (Part-I)	:	Cross linked polyethylene insulated PVC sheathed cable for working voltage and including 1100 Volts.
IS:1554 (Part-I)		PVC Insulated (heavy duty) electric cables :For working voltages upto and including 1100V
IS : 8130	:	Conductors for insulated electrical cables and flexible cords.
IS : 10810	:	Method of tests for cables.
ASTM-D-2843	:	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	:	Standard method for measuring the minimum oxygen concentration to support E3 candle like construction plastics.
IEC-754 (Part-I)	:	Test on gases evolved during combustion of electric cables.
SS:4241475	:	Flammability testing of cables.
ASTM-D1248	:	Insulation on conductor of Telephone cable
GR/CUG-01/03 Aug,2003 (amended Up to date)	:	Specification for Telephone cable.

3E3 TECHNICAL PARAMETERS

3E3.1 FOR POWER AND CONTROL CABLES

i)	Power system details	:	415 V +/-10%, 3 phase, 4 wire solidly earthed.
ii)	Frequency	:	50 Hz.
iii)	Size of cable, conductor & quantity	:	As per SOQ(A)
iv)	Core identification	:	As per IS
v)	Conductor	:	Stranded Aluminium/Copper conductor
vi)	Rated voltage	:	1100 Volts
vii)	Insulation	:	XLPE/PVC (As per SOQ(A))
viii)	Maximum conductor temperature at rated current.	:	As per IS
ix)	Maximum conductor temperature during short circuit under hot condition	:	As per IS
x)	Inner sheath	:	Extruded PVC
xi)	Filler material	:	The filler shall be non hygroscopic and compatible with other materials of cable construction. Hollow tubes should not be used as fillers.
xii)	Armouring	:	Single layer galvanized steel round wire/ flat strip armoured.
xiii)	Overall serving (outer sheath)	:	Anti rodent and anti termite extruded black FRLS grade PVC sheath (Type ST-2) as per SOQ(A).

3E3.2 FOR TELEPHONE CABLES

i)	Conductor	:	Each conductor shall consist of a solid round wire of annealed high conductivity copper, smoothly drawn, nominally circular in section, uniform in quality and resistance and free from defects.
ii)	Insulation	:	Each conductor shall be insulated with polythene insulating grade material. The polythene shall conform to ASTM-D1248 Type II or III, Class A, Category 4 or 5 and meet the parameters.
iii)	Pairing	:	Two Insulated conductors shall be twisted together with uniform lay to form a pair. The length of the lay of any pair is kept different from that of adjacent pairs.
iv)	Cable Core	:	10 pairs shall be stranded to form a group called unit. Each unit shall have an open helical lapping of polypropylene / polythene tape.
v)	Filling	:	The cable shall be filled with a suitable water resistant compound which is compatible with the insulation, Binder and Tapes. Filling compound used is homogeneous and uniformly mixed material containing an anti-oxidant.
vi)	Core Wrapping	:	After application of water resistant filling compound at least one closed helical or longitudinal application of polyester tape will be provided over the cable core.
vii)	Screen (Moisture Barrier)	:	An aluminum tape coated with polythene / co-polymer on both sides shall be applied over the cable core with an overlap as per standards.
viii)	Sheath	:	The cable will be sheathed with polythene conforming to the standards and containing a suitable anti-oxidant system.
ix)	Bedding and Armouring	:	(a) Bedding: Two close helical lapping of polythene tape is applied over the sheath to provide sufficient mechanical protection. (b) Armour: Armouring is provided in two layers of galvanised steel tape both applied helically in the same direction with overlap as per standards.
x)	Jacket	:	The cable is jacketed with specially formulated solid black polythene material of thickness as per standards.
xi)	Length Tolerance	:	As per standards

3E4 Installation of LT Power/Control Cables/Telephone and Fiber Optic cables

3E4.1 IN GROUND

Power Cables / Control Cables / Telephone cables / HDPE Pipe (for OFC) shall be laid at a depth of 900mm below ground level including excavation in all types of soil / murrum / soft rock, sand bedding, cables covered on top & sides by baked / over burnt bricks, sand cushioning all around, back filling, leveling, consolidation, removal / disposal of excess earth within the radius of 500 m, providing cable identification tags at terminations as well as entry and exit of trenches / Pipes and at regular interval along the straight runs.

3E4.2 ALONG WALL/TRENCH

Power cables / Control Cables / Telephone cables/ HDPE Pipe (for OFC) on existing pre-fabricated Trays / MS Supports along wall / Slab / beam / in cable trench including all necessary accessories and materials such as G.I. saddle and clamps. Cable identification tags shall be provided at specified intervals and at both ends as required.

3E4.3 THROUGH HUME PIPE

Power Cables / Control cables / Telephone Cables / HDPE Pipe (For OFC) shall be laid through existing RCC / GI / MS / HDPE pipe. Sealing the pipe ends after cable pulling is included in this item.

3E5 CABLE ROUTE MARKER

Supply and installation of GI /CI / MS cable route marker mounted on 900 mm long 38 mm NB class B G.I pipe / 50X50x5 mm MS angle in ground over the cable with base concrete (300X300X150 mm) or as per instructions of Engineer-In-charge. LT cable / HT cable / Telephone cable / OFC / Cable St. Joint shall be marked on the route markers as required at site.

3E6 END TERMINATION OF LT POWER CABLE

Supply, installation, testing and commissioning of end termination of Power / Control cables using single / double compression brass cable glands {as per SOQ (A)}, crimping type lugs with inhibitor compound and all jointing materials as required. Earthing of cable gland with suitable size of GI strip / wire as required is including in this item.

3E7 END TERMINATION OF TELEPHONE CABLE

Supply, installation, testing and commissioning of end termination of Jelly filled Telephone cable including thorough cleaning and pairing as per standards. Dressing of pairs and connection in module by insertion tool including ferruling and labeling shall be in the scope of this item. Cable shall be mounted / supported safely at the entry of the distribution board.

3E8 TESTING

3E8.1 AT MANUFACTURERS WORKS

The cables shall be subjected to tests, to be witnessed by departmental engineer in accordance with relevant standards to prove the design and general qualities of the cables as below:

a. Routine tests on each drum of cables

b. Acceptance tests on drums chosen at random for acceptance of the lot

c. Type tests Certificates shall be submitted for particular size & design of cable

3E8.2 AT SITE

After installation at site Power and Control cables shall be subjected to insulation resistance and continuity test while Telephone cable shall be tested for continuity.

----x-----

(4E) SECTION - 4: WIRING INSTALLATION

(POWER / LIGHT / COMMUNICATION SYSTEM)

4E1 SCOPE

This specification covers supply, installation, testing and commissioning of power, light and communication wiring with plug-socket, switches, Electronic fan regulators, Geyser, various types of Fans, Luminaires and communication outlets etc. as detailed in SOQ(A). The nominal levels for installation of items shall be as follows :

a.	Power outlets for Split and Cassette type AC	- 1800mm above FFL
b.	Power outlets for Windows AC	- 1250mm above FFL
c.	Switch Boards	- 1250mm above FFL
d.	RJ11 Telephone outlets	- 450mm above FFL
e.	RJ45 Network Outlets	- 1250mm above FFL
f.	Luminaires if mounted on wall	- 2400mm above FFL
g.	Ceiling fan	- 2400mm above FFL

As per site requirements the levels may change with approval of Engineer-In-Charge.

4E2 STANDARDS AND CODES

The design, manufacture, erection, testing and commissioning shall comply with, but not limited the latest issue of the following standards and rules :-

IS - 9537 (Part-II)	:	Specification for rigid steel conduit for electrical Installations.
IS - 9537(Part-III)	:	Specification for insulating materials conduit for electrical Installations.
IS - 14927	:	Specification for UPVC trunking for electrical Installations.
IS - 694	:	PVC insulated cables with copper conductors for voltages upto 1100Volts
IS - 732	:	Code of practice for electrical wiring installation (System voltage not exceeding 650Volts)
IS - 1646	:	General code of practice for fire safety of bldg. electrical installation
IS - 3043	:	Code of practice for earthing
ASTM-D-2843	:	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	:	Standard method for measuring the minimum oxygen concentration to support E3 candle like construction plastics.
IEC-754 (Part-I)	:	Test on gases evolved during combustion of electric cables.
SS:4241475	:	Flammability testing of cables.
IS:3646 (part-1 to 3)	:	Code of practice of interior illumination: General

requirements and recommendations for building interior (Part -1)
Code of practice of interior illumination: Schedule of illuminations and Glare Index (Part - 2)
Code of practice of interior illumination: Calculation of coefficients of utilization by the BZ methods(Part-3)

- Indian Electricity Rules-1956, Indian Electricity Act 2003 as amended up to date.

- Local statutory authority's rules & regulations.

4E3 SURFACE PVC CASING-N-CAPPING

Supply and installation of rigid PVC heavy duty, fire resistant casing-n-capping with double locking arrangement to be fixed using galvanised screws at ends, nominal interval of 450 mm along horizontal and 600 mm along vertical runs.
The casing-n-capping shall include bends, elbow, tees, junction boxes and accessories as per site requirement.

4E4 REINFORCED FLEXIBLE PVC CONDUIT

Supply and installation of reinforced flexible heavy gauge PVC conduit, to be installed by providing proper GI clamp and saddles as per site conditions. Both ends will be fixed properly by PVC gland compatible to the conduit. All the accessories and materials required for fixing of reinforced flexible PVC conduit will be in the scope of this item.

4E5 M.S. CONDUIT

Supply and installation of Stove enameled ERW M.S. conduit including all bends, sockets, tees, junction boxes etc. shall be rust free. All conduits accessories shall be threaded type. The thickness of the conduit shall be 16 SWG minimum.

4E5.1 SURFACE INSTALLATION

ERW MS Conduit pipes shall be fixed by heavy gauge galvanised M.S. saddles secured to M.S. galvanised flats. The width of flats shall suit the total number of conduits to be run. The conduit pipes shall be individually fixed using galvanised screws at nominal interval of 450 mm.

All necessary bends in the system including diversion shall be done by bending pipes or by inserting normal or inspection type normal bends or by fixing M.S. inspection boxes duly painted whichever is more suitable and approved by engineer-In-charge.

16SWG bare copper earth wire shall run all along the conduit duly fixed using

scrap type copper clamps at regular intervals. The item includes overhangs required for the termination of earth wire on both ends.

4E5.2 CONCEALED INSTALLATION

The conduit for concealed wiring in slab or in RCC wall shall be tied to the reinforcement bar by M.S. wires at suitable places to hold the conduits rigidity. Grooves in the brick wall will be cut by using electromechanical cutter before plastering of the walls in coordination with the other working agencies. It includes repairing the cut after installation of conduits. All necessary bends in the system including diversion shall be done by bending pipes or by inserting normal or inspection type bends or by fixing M.S. inspection boxes duly painted. The junction / inspection boxes and switch board shall be applied with crude oil and temporarily blocked by jute or any protective cover after installation to protect from chocking of conduits / boxes during the slab casting.

The conduit of each circuit or section shall be cleaned and checked before conductors are drawn in. Minimum 18 SWG G.I. fish wire shall be laid through the conduit to enable to pull the wires.

16SWG bare copper earth wire shall run all along the conduit duly fixed using copper wire/clamp at regular intervals. The item includes overhangs required for the termination of earth wire on both ends.

4E6 WIRING

Supply and pulling of multi-stranded copper wires / CAT-6 Cable / 0.5ATC Telephone wire conforming to relevant standards in existing concealed / surface M.S. Conduit pipes / PVC Casing-n-Capping / Reinforced PVC flexible conduit. Tapping or joints in the wire shall be avoided. Termination and interconnection at both ends along with supply of required material is included in this item.

Wiring shall be color coded as follows:

Phase	- RED/YELLOW/ BLUE,
Neutral	- BLACK
Ground	- GREEN
Control	- GREY/WHITE

Maximum permissible number of multi-stranded copper wire in a conduit shall be as per relevant IS.

Single core FRLS PVC insulated, 1100V grade multi-stranded copper conductor wires shall be used as per SOQ(A).

4E7 LUMINAIRE

4E7.1 FLUORSCENT LUMINAIRE- Recess or Surface type (as indicated in SOQ(A))HF Fluorescent Luminaires pre-wired with lamp holders and lamps.

FRAME - The Luminaire channel shall have a single piece construction made of white powder coated CRCA sheet steel. Polycarbonate lamp holder brackets shall be slide-in-type. For recess type luminaire there shall be provided proper fixing arrangement (swing out brackets) in false ceiling.

REFLECTOR - Type of louvers will be as per SOQ(A). Louvers shall be fixed on the luminaire by preferably four stainless steel clips and can be suspended on the spring during re-lamping. Unless otherwise specified the High-efficiency mirror optic reflector of high quality aluminum with diffuse lamellae designed for high optical efficiency and widespread light distribution in case of mirror optics luminaire.

In case of batten type luminaires there shall be provision to mount powder coated / stove enameled reflectors.

WIRING – Wiring shall be done by heat resistant wire. End termination and dressing of wire will be done properly.

ELECTRONIC BALLAST – The ballast shall be FCC Class B EMI Rating Compact light weight, high frequency standard electronic ballast suitable for TL-D/TL Fluorescent lamps. Ballast shall be flicker free, rapid ignition and protected against excessive mains voltage. The ballast shall have following features:

1. Operating voltage -180-270V, 50 Hz
3. Power factor > 0.95
4. Earth leakage current <0.5 mA
5. Ignition time (ts) 0.15 sec < ts<0.4 sec
6. Overvoltage protection
7. THDI less than 10%
8. Low power loss

Electro Magnetic BALLAST – Ballast incorporates coil and connector assembly, low loss, silicon laminations are wounded with super enameled copper wire with class F insulation on specifically designed glass filled nylon bobbin. Complete assembly is varnished and enclosed in CRCA canister and sealed with specially formulated polyester resin. The ballast shall have following features:

1. Proper inter layer insulation.
2. Rugged electrical and mechanical construction.
3. Withstand capacity up to 5KV.
4. Operation voltage 240V +/- 10%
5. Suitable for ambient temperature 50 Deg.C
6. Low power loss

LAMP – Tri-phosphor Fluorescent double ended tubular Lamp with Colour Rendering Index better than 80Ra, Correlated Colour Temperature as per SOQ(A), long life suitable for voltage range 220 - 240V, base G13.

All other features of luminaire will be as per SOQ(A).

4E 7.2 COMPACT FLUORSCENT LUMINAIRE **-** Recess or Surface type Luminaire pre-wired with lamp holders and lamps (as indicated in SOQ(A)) suitable for use with compact fluorescent lamps.

FRAME - Housing made out of white powder coated CRCA sheet steel accommodating all electrical accessories pre-wired upto a terminal block. Polycarbonate lamp holder brackets shall be fixed properly. For recess type luminaire there shall be provided proper fixing arrangement (swing out brackets) in false ceiling.

REFLECTOR - A reflector assembly made out of high purity aluminum sheet, electrochemically brightened and anodized fitted with painted aluminium lamellae. Stainless steel spring clips for fixing of the reflectors to the housing.

WIRING - Heat resistant wiring will be done as per standard. End termination and dressing of wire will be done properly.

ELECTRONIC BALLAST – The ballast shall be FCC Class B EMI Rating Compact light weight, high frequency standard electronic ballast suitable for Compact Fluorescent lamps. Ballast shall be flicker free, rapid ignition and protected against excessive mains voltage. The ballast shall have following features:

1. Operating voltage - 220-264V with tolerance of +/-10%, 50 Hz
2. Ignition time (ts) <0.5 sec
3. Max temperature
4. Hum and noise level inaudible.

Electro Magnetic BALLAST – Ballast incorporates coil and connector assembly, low loss, silicon laminations are wounded with super enameled copper wire with class F insulation on specifically designed glass filled nylon bobbin. Complete assembly is varnished and enclosed in CRCA canister and sealed with specially formulated polyester resin. The ballast shall have following features:

1. Proper inter layer insulation.
2. Rugged electrical and mechanical construction.
3. Withstand capacity up to 5KV.
4. Operation voltage 240V +/- 10%
5. Suitable for ambient temperature 50 Deg.C
6. Low power loss

LAMP: Lamp shall be of high Lamp Efficacy, Lower energy costs Long Life, Trichromatic Phosphors, Colour Rendering Index better than 80Ra, Correlated Colour Temperature as per SOQ(A), Voltage Rating 220 - 240V.

All other features of the luminaire will be as per SOQ(A).

4E 7.3 HALOGEN LUMINAIRE - Halogen Luminaire shall be pre-wired general purpose flood light with lamp suitable for quick and easy lamp replacement through front window and rear access for mains connection through terminal box.

FRAME - Compact, light weight and corrosion resistant pressure die-cast aluminium housing with heat resistant toughened glass fixed in aluminium

retaining frame which can be hinged with the housing for lamp replacement. The retaining frame shall be powder coated in black color. Terminal block shall be heat resistant nylon-6 grade. MS Mounting brackets of luminaire shall be powder coated.

REFLECTOR - High purity textured aluminium reflector electromechanically brightened and anodized.

LAMP – The lamp shall be double ended, linear tungsten halogen lamp with R7S base, High Efficacy, Long Life, Correlated Colour Temperature 3000K, Colour Rendering Index 100Ra, Voltage Rating 220-240V.

All other features of the luminaire will be as per SOQ(A).

4E7.4 BULK HEAD LUMINAIRE **-** Surface mounting type Bulk head luminaire suitable for outdoor application complete with 9/11/18W Compact fluorescent lamp and other accessories.

FRAME - Made out of single piece die-cast aluminium housing and glass retaining frame, heat resistant glass cover / acrylic cover and wire guard made from powder coated MS.

LAMP - Lamp shall be CFL with inbuilt ballast, High Efficacy, Long Life, Trichromatic Phosphors, Colour Rendering Index better than 80Ra, Correlated Colour Temperature as per SOQ (A), Voltage Rating 220 - 240V.

All other features of the luminaire will be as per SOQ (A).

4E7.5 HIGH DISCHARGE LAMP LUMINAIRE

Efficient low glare recessed / surface mounted Integral / Non integral type HPF luminaires with detachable gear tray, ballast, MH/CDMTT/SON lamp and other accessories. All electrical accessories such as energy efficient, low loss, open construction copper ballast, ignitor and power factor improvement capacitor, etc are pre-wired upto the terminal block and mounted on a removable control gear module for ease of maintenance.

FRAME - Compact, light weight and corrosion resistant pressure die-cast aluminium housing, heat resistant toughened glass covered in aluminium retaining frame which can be hinged with the housing for lamp replacement. The retaining frame shall be of cast aluminium duly powder coated. Terminal block shall be heat resistant nylon-6 grade. Mounting brackets if required, shall be of MS powder coated.

REFLECTOR - High purity stippled aluminium reflector electromechanically brightened and anodized.

MH - High efficacy, long life MH lamp suitable to produce white light, stable color output, polycrystalline alumina (PCA) technology, Colour Temperature as per SOQ (A), Colour Rendering Index better than 80Ra, Voltage rating 220V- 240V.

ELECTRONIC BALLAST – The ballast shall be FCC Class B EMI Rating

Compact light weight, high frequency standard electronic ballast suitable for Compact Fluorescent lamps. Ballast shall be flicker free, rapid ignition and protected against excessive mains voltage. The ballast shall have following features:

1. Operating voltage - 220-264V with tolerance of +/-10%, 50 Hz
2. Ignition time (ts) <0.5 sec
3. Max temperature
4. Hum and noise level inaudible.

Electro Magnetic BALLAST – Ballast incorporates coil and connector assembly, low loss, silicon laminations are wounded with super enameled copper wire with class F insulation on specifically designed glass filled nylon bobbin. Complete assembly is varnished and enclosed in CRCA canister and sealed with specially formulated polyester resin. The ballast shall have following features:

1. Proper inter layer insulation.
2. Rugged electrical and mechanical construction.
3. Withstand capacity up to 5KV.
4. Operation voltage 240V +/- 10%
5. Suitable for ambient temperature 50 Deg.C
6. Low power loss

CDMTT - High Efficacy, Long Life, Color Temperature 3000K, Colour Rendering Index better than 80Ra, Voltage Rating 220 - 240V, base G13, tube shape with two bases.

SON – High Efficacy, Long Life, Color Temperature 2700K, Colour Rendering Index better than 85Ra, Voltage Rating 220 - 240V, base ED37.
All other features of the luminaire will be as per SOQ (A).

4E7.6 STREET LIGHT LUMINAIRE - Integral type, prewired, IP66/65 street lighting luminaire with lamps, suitable for MH / CDM-TT / SON lamps. Control gear compartment will be min IP54. Specially designed pole mounting arrangement facilitates bottom as well as lateral pole mounting. All electrical accessories such as energy efficient, low loss, open construction copper ballast, ignitor and power factor improvement capacitor, etc are pre-wired upto the terminal block and mounted on a removable control gear module for ease of maintenance.

FRAME - Housing made of LM6 high pressure die-cast aluminium. All electrical connections of the control gear module with the rest of the luminaire are click fix and require use of no tools. The lamp compartment consists of a heat resistant toughened, acrylic / curved glass which is sealed to the housing. Suitably designed spigot enables pole entry dia options from 42-70mm O.D.

REFLECTOR - The lamp compartment consists of electrochemically brightened and high texture anodized, high purity POT reflector with a specially designed profile.

MH - High efficacy, long life MH lamp suitable to produce white light, stable

color output, polycrystalline alumina (PCA) technology, Colour Temperature as per SOQ (A), Colour Rendering Index better than 80Ra, Voltage rating 220V- 240V.

CDMTT - High Efficacy, Long Life, Color Temperature 3000K, Colour Rendering Index better than 80Ra, Voltage Rating 220 - 240V, base G13, tube shape with two bases.

SON – High Efficacy, Long Life, Color Temperature 2700K, Colour Rendering Index better than 85Ra, Voltage Rating 220 - 240V, base ED37.

All other features of the luminaire will be as per SOQ (A).

4E7.7 INSTALLATION

The mounting height and location of the luminaire shall be as specified in the drawings or as per instruction of engineer-In-charge. The Luminaire shall be duly supported as per site requirement. Luminaires shall be installed on ceiling / wall / false ceiling / any other structural member including earthing of luminaire. Supply and fabrication of all required material shall be in the scope of this item. Scaffolding / ladders etc. required for installation shall be arranged by the contractor.

4E8 FANS

4E8.1.1 CEILING FAN

Five Star rated as per BEE norms, ceiling fans with AC permanent capacitor single phase induction motor, dry type capacitor rated for 440 V (min), three blades and bearings on both sides. The capacitor canister shall be metallic type. Scope of this item includes assembling of fan parts, supply and connection with 3 core FRLS flexible copper cable from ceiling rose/point to fan connector and supply of all required fixing materials and down rod as per site requirements.

4E8.1.2 FAN HOOK BOX

Minimum 5 inch dia. MS fan hook box with 10mm dia. MS rod having four openings. The rod will have sufficient length for mounting with reinforcement in the slab. The fan hook box shall have two coats of red oxide duly painted with two coats of antirust paint.

All other features will be as per SOQ(A).

4E8.2 EXHAUST FAN

Heavy duty exhaust fan complete with low noise motor, mounting frame, dry type capacitor rated for 440 V (min) and three blades. The capacitor canister shall be metallic type. Provision of G.I gravity louvers or Painted MS hoods with bird screen shall be made as per SOQ (A). Support for fixing of fan, assembly of fan parts and connection with 3 core FRLS PVC flexible copper cable from ceiling rose / socket-plug top to fan including supply of all material shall be in the scope of this item. All other features will be as per SOQ(A).

4E8.3 WALL MOUNTED FAN

Oscillating type wall mounted fan complete with low noise motor, speed regulator, blades, dry type capacitor and three blades. The capacitor canister shall be preferably metallic type. Support for fixing of fan, assembly of fan parts and supply of all mounting material shall be in the scope of this item.

All other features will be as per SOQ(A).

4E 9 SWITCH BOARDS

4E9.1 ENCLOSURE / BOX – Metallic / PVC / Polycarbonate Switch boards complete with mounting plate shall be concealed / partially concealed/surface mounting type as specified in SOQ(A). Size of box shall be decided based on the number of module (switch/socket/fan regulator) to be fixed on the switch-board. Earth termination stud shall be provided in metallic board. Fixing of switch-socket-fan regulator etc. including Interconnection with color coded, suitable size, FRLS flexible copper wires shall be in the scope of this item. Switch shall always be connected in the line side and every socket shall be controlled by a switch.

4E9.2 SWITCH - 240V,50Hz.,6/16 Amps single or double throw piano type modular switch as indicated in SOQ(A).

4E9.3 SOCKET OUTLET - 240V, 50Hz, 6/16 Amps, Five / Six pin type modular socket as indicated in SOQ(A).

4E9.4 ELECTRONIC FAN REGULATOR- The step type, two module electronic fan regulator rated for 240V, 50Hz as indicated in SOQ(A).

4E9.5 COMMUNICATION OUTLET - Communication outlet (RJ11/RJ45) shall be with prefabricated box and plate. The RJ45 outlet shall be compatible with CAT-6 cable and suitable for computer networking. All the tools required for termination in RJ11 and RJ45 will be arranged by contractor.

4E10 MCB OUTLET

The outlet shall be prefabricated M.S Box complete with DP/TP/TPN/FP Miniature circuit breaker (MCB) / Earth leakage circuit breaker (ELCB). All the materials required for fixing of this outlet and provision for incoming and outgoing wires shall be in the scope of this item.

All other features will be as per SOQ(A).

4E11 INDUSTRIAL OUTLET

The outlet shall be prefabricated MS box complete with DP/TP/TPN/FP Miniature circuit breaker (MCB) / Earth leakage circuit breaker (ELCB) and CEE compliant industrial socket with plug-top. Three Phase outlets shall be 5pin type and suitable for 415V and Single Phase outlets shall be 3pin type and suitable for 240V. The socket shall have interlocking arrangement when plug-top connected. All other features will be as per SOQ(A).

4E12 TESTING

Following tests shall be carried out on wiring installation :

1. Insulation resistance Test
2. Earth continuity Test
3. Polarity Test
4. Continuity Test for communication circuits
5. Operational Test
6. Illumination measurement

-----x-----

(5E) SECTION – 5 GROUNDING AND LIGHTNING PROTECTION

5E1 SCOPE

This specification deals with the supply, installation, testing and commissioning of grounding system and lightning protection along with their allied items.

5E2 STANDARDS

The following standards and rules shall be applicable -

IS – 3043 (latest) : Codes of practice for earthing

IS - 2309 (latest) : Code of practice for protection of buildings and allied structures against lightning

Electricity Act 2003 and Indian Electricity Rules

5E3 EARTH STATION

Earth Station means complete with chamber, watering pipe, CI cover etc. including connection earthing strips/wires and marking as per IS and our specifications.

5E3.1 PLATE EARTHING

The item includes excavation in all types of soil, soft rock / murrum, backfilling with alternate layers of charcoal and salt and black cotton soil as per IS. The plate size shall be 600 mm x 600 mm x 3.15 mm (minimum) tinned copper plate / 600 mm x 600 mm x 6.3 mm (minimum) G.I. plate or as specified in SOQ(A). The minimum depth, type of electrode, soil treatment shall be in accordance with Indian standards. Two lengths of 50X5mm thick strip of same material as that of the plate shall be provided from plate to Chamber. Strip shall be connected to plate by welding (GI) / brazing (Copper) besides fixing with nut-bolt. Size of the chamber made out of brick masonry shall be 650mmX650mmX300mm to accommodate the CI cover of nominal size 400X400mm. The chamber will be constructed on base PCC (1:3:6) of size 1000X1000X150mm thick with a cutout of 400X400 in center. Test-Link shall be provided of size 250X50X5mm with holes for connecting conductors. Perforated class B GI pipe of 19mm NB shall be provided with funnel and screen. All other specifications will be as per SOQ(A).

5E3.2 PIPE EARTHING

The item includes excavation in all types of soil, soft rock / murrum, backfilling with alternate layers of charcoal and salt and black cotton soil as per IS. Pipe electrode shall be of G.I. heavy class with minimum 38 mm dia and 2.5 m long or as specified in SOQ(A). Pipe shall be cut at 45 degree angle at bottom end and provided with funnel and screen. There shall be 19mm dia hole all along the pipe. The gap between consecutive holes will be 150 in line and 75mm in cross. There shall be fixed 50X5mm GI strip with 300mm length

at the top of pipe to connect earthing conductors. The minimum depth, type of electrode, soil treatment shall be in accordance with Indian standards. Size of the chamber made out of brick masonry shall be 650mmX650mmX300mm to accommodate the CI cover of nominal size 400X400mm. The chamber will be constructed on base PCC (1:3:6) of size 1000X1000X150mm thick with a cutout of 400X400 in center. All other specifications will be as SOQ(A).

5E3.4 DEEP BORE EARTHING

Deep bore earthing will be done by 6" dia drilling in all types of strata including setting of machine at different locations, providing MS casing as per site requirements (min 3 mtr.) The earth electrode shall comprise 50 mm Nominal bore class B GI pipe with heavy duty coupling thoroughly welded, 5mm thick GI plate welded on the top. Four rows of 19mm dia holes shall be provided in staggered manner all along the length of pipe. The gap between consecutive holes will be 300 in line and 75mm in cross. Pouring mixture of black cotton soil, salt, charcoal and bentonite powder for back filling of the earth pit, masonry work and base PCC work will be as per item 5E3.1 but sizes will be as per site requirements. All other specifications will be as and SOQ(A).

5E4 G.I/COPPER CONDUCTOR :

GI/COPPER conductor of size as indicated in SOQ(A) shall be provided for grounding and lightning protection. In case of underground horizontal installation the depth of conductor shall be minimum 600mm below the finished ground level (FGL). The Earth strip shall be run along the cable ladders / trays by clamping / bolting. The earth strip shall be run on wall / column using MS clamps, saddles at intervals of 450mm. All the joints shall be bolted, welded (GI) / brazed (Copper) and painted with black bitumen paint. All other specifications will be as per SOQ(A).

5E5 SPECIAL PURPOSE GROUNDING CONDUCTOR :

G.I / Copper conductor shall run along the wall duly mounted on epoxy insulator support at nominal interval of 500mm. Set of Brass Nut-Bolts and Spring / plain washer at a nominal interval of 1 mtr. all along the length. The size of strip will be as indicated in SOQ(A).

5E6 SITE TEST :

Earth pit resistance measurements

i) For Individual earth station

ii) For Earthing system as a whole

The values shall be measured with calibrated earth tester and recorded. Marking (Painting) of earth pit number, earth pit resistance value and date of measurement shall be in the scope of this item.

-----x-----

(6E) SECTION – 6 MISCELLENEOUS ITEMS

6E1 SCOPE

The scope of work under this section covers different miscellaneous works required at site i.e Cable Tray / MS Pole / G.I Pipe / Hume pipe / MS Boxes / MS Supports and MS ducts / Road cutting & PCC / Excavation / Removal of electrical items.

6E2 STANDARDS

The following standards and rules shall be applicable -

IS – 2629 (latest)	:	Recommended Practice for Hot Dip Galvanizing of Iron and Steel.
IS – 4759 (latest)	:	Specification for Hot Dip Zinc Coatings on Structural steel and other allied product.
IS - 239 (latest)	:	Specification for Swaged MS Tubular pole

6E3 CABLE TRAY

Fabrication, manufacture, assembly inspection at works, supply and installation of 2 mm thick Galvanized Steel Ladder type / perforated type / high quality steel / MS wire Cable tray & Accessories conforming to latest Indian Standards with coupler plates, bends, reducers, cross joints, tees etc. wherever needed as per site requirements. The cable trays / ladders shall be of standard length suitable to carry power, control and telephone cables. All material of cable trays shall be non-corrosive, hot dip galvanized (Zn 98 grade) in case of MS cable trays. The inside of the cable trays shall have no sharp edges and projections. All runners shall be slotted for clamping the cables. The side members shall have holes for connection of earth strip.

6E4 STREET LIGHT POLE

6E4.1 POLE - Fabrication, supply and installation of nominal bore C class, M.S tubular pole with base plate, welded to the bottom of the pole with M.S webs, suitable hole for cable entry with grommet behind the terminal box at suitable level from the bottom. After welding of base plate, finishing should be done by grinding and removing the burrs. Finished pole should be duly painted with primer followed by two coats of poly urethane based paint, applied through spray gun.

6E4.2 TERMINAL BOX - Supply and installation of weather proof UV resistant non metallic / Metallic (2mm thick CRCA sheet steel) terminal box having provision for entry of 3nos. Al. Ar. power cables up to 4CX10sq.mm with gland, DMC insulators 4 nos, 6 Amp SP (10KA) MCB, 1.5 sq. mm 1100V grade FRLS flexible copper wire should be used for wiring.

6E4.3 FOUNDATION - Excavation in all types of soil, murrum / soft rock, of 1100X1100X1500mm (D) for pole foundation. On bottom 100 mm thick PCC of ratio 1:3:6 then RCC of thickness 300mm above the PCC with 900X900mm size and of ratio 2:3:6 using graded stone aggregate of 20mm max. and 10mm size torr steel mesh. The square of steel mesh will be 150X150mm. The pole should be installed 150mm above the PCC and proper tie up with

reinforcement. A forma of size 1400mm long and 550mm dia. should be used for filling the mixture of cement, sand and metal of ratio1:1.5:3. After removal of forma the foundation external surface plastered by cement mortar of ratio 1:4 for smooth finishing, curing should be done properly and two coat of painting is also required.

6E4.4 INSTALLATION - For cable entry from ground to terminal box minimum two G.I pipes of size 38mm N.B, B class of suitable length should be used proper bending and properly clamped with poles as per drawing. On both ends of pipe should be properly closed by using bushes. For pole earthing 1.5meter long 38mm N.B B class perforated G.I pipe electrode shall be driven into the ground near the pole foundation. 2 nos 10 SWG G.I bare wire shall be connected in between earth electrode and pole and in control box by using proper size of nuts, bolts and washers. It is preferable to connect the G.I wire near base plate, arrangement should be made at the time of fabrication of pole also the G.I wire brought from base plate to control box and then connect the earthing to luminaire by using 1.0 sqmm green colour FRLS flexible copper wire. In case of junction 3 nos. of G.I pipe for cable entry shall be installed. All other specification regarding street light pole will be as per SOQ(A).

6E5 TIMER

Supply, installation, testing and commissioning of timer box suitable for outdoor / indoor installation including FP,10KA, 250V, 50Hz MCB, single / two channel time switch having feature to set ON-OFF with auto and manual options. 4 pole AC-1 power contactor, bypass switches, earthing etc. The box shall be made out of 16SWG MS sheet with arrangement of two earthing bolts and proper mounting arrangement duly painted with synthetic enamel paint after proper cleaning, derusting and primer. All other specification will be as per SOQ(A).

6E6 G.I / HDPE / RCC HUME PIPE

Supply and installation of G.I / HDPE / Hume Pipes as specified in SOQ(A) in ground/ on wall. The item includes jointing / dressing of pipes along with supply of all required material.

6E7 M.S.BOXES AND DUCTS

Fabrication, Supply and Installation of Various sizes MS boxes / Ducts made out of 16 SWG MS sheet as per the site requirement. Sufficient space and clamping arrangement shall be provided for incoming and outgoing cables, complete with anti corrosive treatment by Powder coating / Synthetic enameled paint, earthing bolts etc. The boxes shall be suitable for placing MCBs / Metal clad sockets / telephone modules etc. as per the requirement. All other specification will be as per SOQ(A).

6E8 MS SUPPORTS

Fabrication, Supply and Installation of ISA / MS Strips / MS Channel as specified in SOQ(A) complete with anti corrosive treatment by Synthetic enameled paint. The shape and design will be as per site requirements and instruction of engineer-In-charge.

6E9 ROAD CUTTING AND PCC

Cutting of BITUMINOUS Road / WBM Road / PCC / RCC pathway / Pavement as directed / required at site, back filling, consolidation & compacting of soil, repair of Roads / path way by Providing Cement concrete of 1:4:8 ratio including, consolidation, finishing, curing etc. as directed by Engineer-In-Charge.

6E10 EXCAVATION

Excavation in all types of soils / murrum / soft & hard rock up to a depth as required at site, back filling and disposing of surplus earth within a distance of 500mtrs. as per our specifications as directed by the Engineer in Charge.

6E11 REMOVAL OF ITEM

Dismantling / Removal of switch board / MS boxes / Electrical Panel / DB's / Wires / Cables / Poles / Luminaires etc. The items shall be removed safely and stored as per instruction of Engineer-In-Charge. Preparation of the list of removed / dismantled items and transportation within 2 KM radius is in the scope of this item.

-----x-----

SECTION – 7 (7E) PREFERRED MAKES OF MATERIAL Page 33 to 34

Sr. No.	Description	Preferred makes
1.	LT Power/control cables	CCI / Gloster / Universal Cable / NICCO / Radiant / Polycab / RPG Cable / Ravin Cable / Lapp
2.	Cable glands	Commet /HMI / Hex
3.	Lugs	Dowells / 3D / Hex
4.	Terminal Strip / Connector	Elmax / Wago / Connect well
5.	Cable trays	Elcon / OM industries / Globe / Pragati / Sintex
6.	Cable raceway	Legrand / MK Electric / Schneider electric
7.	Air Circuit breakers	Schneider(Master pact) / Siemens(3WL) / ABB(Emax) / L&T (U-Power)
9.	MCCB	Legrand / Merlin Gerin / Siemens / BCH / L&T / Hager
10.	Switch Disconnector Fuse / Switch Disconnector / HRC fuses	Schneider Electric / Siemens / ABB / L&T
11.	MCB / ELCB / RCBO / Distribution Board	Legrand / Siemens / Schneider Electric / BCH / Hager
12.	Timer	Legrand / Hager/ Schneider Electric / Siemens
13.	Power / Control Air break Contactors	Siemens / Schneider Electric / ABB / BCH / L&T
14.	CT / PT	KAPPA / INDCOIL / Automatic Electric / C&S / Prayog
15.	Analogue Ammeter / Voltmeter / P.F meter	Meco / Automatic Electric / Rishabh
16.	Digital meters	Meco / Automatic Electric / Rishabh / Conzerve
17.	Energy meter / Trivector meter	Universal Electric / HPL Socomac / Datar / Secure / ABB / L&T
18.	Indication Lamps (LED Heavy duty type)	Siemens / L&T / Technik / Schneider Electric
19.	Push Buttons	Siemens / L&T / Technik / Schneider
20.	Selector Switches	Kaycee / Siemens / L&T
21.	PVC (HMS) Conduits & accessories	Precision Plastics / Modi / Presto Plast
22.	Flexible copper Wires	RR Kabel / Finolex / Polycab / Lapp
23.	Modular Switches / Sockets / RJ-11	Anchor (Woods) / legrand (Mosaic) / MK (Wraparound plus) / Hausmann
24.	Switch / Socket / Bell switch / Lamp holder / Ceiling rose (Ordinary)	Anchor / Western / Leader
25.	Modular Electronic Fan Regulator (Step Type)	Anchor (Woods) / legrand(Mosaic) / MK (Wraparound plus) / Hausmann
26.	Bell / Buzzer (with Polycarbonate enclosure)	Vinay / Anchor / Leader
27.	Luminaire(Indoor)	Philips / Keselec / GE / Wipro
28.	Luminaire(outdoor)	Philips / GE / Schreder Electric / Wipro/Bajaj
29.	Fluorescent lamp	Philips / Osram / GE
30.	HID Lamp	Philips / Osram / Venture / GE
31.	Ceiling Fans	Orient / Usha / Bajaj / Khaitan / Havells
32.	Exhaust Fans	Bajaj / Crompton / Almonard / Khaitan

33.	Industrial Switch sockets & Plugs	Legrand / Siemens / L&T / BCH / Schneider Electric
34.	Water Heaters (Geyser)	Crompton / Racold / Spherehot / Bajaj
35.	Cat-6 UTP cable	D-Link / Finolex / AMP
36.	Telephone cable/wire	Delton / Vindhya Telelinks / Finolex / polycab
37.	Telephone Tag Block (TTB) with enclosure.	Krone
38.	Capacitor unit	Universal / Siemens / L&T / EPCOS
39.	Load Manager / Multifunction Meter	Conzerve / L&T / Secure / Ducati / Siemens / HPL Socomec
40.	Motor starter	Siemens / L&T / BCH / ABB / Schnieder Electric
41.	Communication Outlet (RJ-45)	D-Link / AMP / AT&T / Legrand / MK
42.	Phenolic Laminated sheet	Impreglam / Bakelite Hylem
43.	G.I. Pipe	Prakash Surya / TATA / Siddharth
44.	HDPE Pipe	Kasta / Kisan
45.	Astral Timer	Legrand, L&T, Nature
46.	Electric Motor	Kirloskar/Siemens/Crompton greaves/ ABB/Bharat Bijalee/Jyoti
47.	Neon Aviation Luminaire	GE, Bajaj, Crompton, Philips

Signature of Tenderer

SECTION – 8 (8E) CERTIFICATE OF COMPLETION AND GUARANTEE

Electrical installation at: _____

Details to be indicated after completion of work.

Tests

i) Insulation resistance tests on individual equipments & completed & interconnected system.

ii) Earthing resistance of each earth station and interconnected system.

iii) Test results of all equipments.

1 **CERTIFICATES** :

I certify that the installation detailed above has been inspected and tested and that to the best of my knowledge and belief it complies with the latest edition of the Indian Electricity Rules and the relevant I.S. code of practices at the date of contract for the work except as stated below.

2 Details of departures (if any) from the above.

3 6 Sets of completion drawings & test reports and original tracings with CD showing the installation of as actually executed are enclosed duly certified.

4 The installation is guaranteed for a period of twelve months from the date of taking over by the Department against defective materials and workmanship. During the period of guarantee such defects in materials and workmanship will be rectified or replaced free of cost to the Department. The completion certificate for a particular system will be issued by the Department only on its satisfactory commissioning and the guarantee period for that system will start only from the date of the said certificate.

Signature of Contractor

Date: