TECHNICAL SPECIFICATION FOR ELECTRICAL WORK

SECTION	A	:	TECHNICAL SPECIFICATION FOR ELECTRICAL EQUIPMENT
SECTION	B	:	TECHNICAL SPECIFICATION FOR WIRING SYSTEM

1.0. SCOPE

This specification covers the supply of materials, fabrication and erection, testing and commissioning of Electrical Switch boards, wiring system, light fittings and other associated items required for successful completion of the work. Any equipment, device, component or work not specifically mentioned in this specification but considered essential for proper design and operation shall be included by the tenderer in his offer. Applicable provisions and conditions of contract shall govern the work under the Section.

2.0. GENERAL

2.1. The power supply system in the building shall be made available at 415/240 Volts, 50 Hz. A.C. 3 phase 4 wire, earthed neutral from local Electric Supply Authority.

2.2. All supply and installation work shall be carried out as per specification and in accordance with the construction drawings and shall conform to requirements called for in the Indian Electricity Rules 1956 with its latest amendment, Indian Electricity Acts and all relevant codes and practices issued by the Indian Standards Institution as amended up-to-date. The work shall also comply with the provisions of the general or local set of legislatures and regulations of any local or other statutory authority which may be applicable.

2.3. The Contractor for electrical works must possess valid Electrical contractor's License endorsed by the Licensing Board. Directorate of Electricity of concerned State Government for the type of work he shall execute.

2.4. The work to be provided for by the Contractor, unless otherwise specified, shall include but not limited to the following :

i. Furnish all labour, supervision, services, materials, supports, scaffolds, construction equipment, tools, plants and transportation etc. required for the proper execution of the job as per drawings, specification and schedule of items and get all necessary tests on materials and work conducted at their cost.

ii. Not withstanding the electrical layout shown in the drawing, the contractor shall obtain further approval of the layout at site from the Consultant / Engineer-in-Charge before commencement of the work.

iii. Furnish samples for approval including arranging necessary tests on samples as directed by the Consultant / Engineer-in-Charge in an approved Laboratory.

iv. To extend facilities to the Consultant / Engineer-in-Charge to inspect work and assist them to obtain samples, if they so desire.

v. Furnish general arrangement drawings of the switchboard and other fabrication items which the Consultant / Engineer-in-Charge may direct for their approval.

vi. To employ a full time experienced supervisor having electrical supervisor's certificate of competency endorsed by the Licensing Board, Directorate of Electricity of concerned State to supervise the work. The Consultant / Engineer-in-Charge have the right to stop the work if the contractor's supervisor is not present when the work is being carried out.

vii. To keep the appropriate Electrical Inspector, supply authority informed as to programme of the work and shall be responsible for ensuring that all work passes their approval.

viii. To provide all incidental items not shown or specified in particular but necessary for proper execution of works in accordance with the drawing, specification and schedule of items.

ix. iptain the work and keep them maintained till handed over to he owner in proper working condition.

x. dinate with all agencies including those engaged by the owner or proper execution of the job.

3.0. MATERIALS

3.1. Materials shall be of the approved quality. A list of materials of approved brand and manufacture is indicated in the annexure. If the list of materials mentioned above stipulates two or more or alternative brands / makes of any product, the decision as to which brand / make shall be used in the work shall be taken by the Architects / Employer and the contractor shall provide the brand / make so selected without any extra cost.

In case, materials are required to be obtained from any manufacturer other than those listed on account of non-availability then prior approval from Architects will be necessary, supported by relevant test certificates qualifying the required standard. Further tests as directed by the architects shall also be carried out by the contractor at their own cost, if required.

3.2. Contractors shall obtain approval of the Architects / Owner of sample of all materials before placing order and the approved sample shall be carefully preserved in an appropriate manner at the site office for verification by the Owner / Architects.

3.3. For standard bought out items, the sizes manufactured by the firms listed shall prevail when there is discrepancy in the sizes mentioned in the schedule without any financial adjustment.

4.0. SPECIFICATIONS

4.1. Unless specifically mentioned otherwise, all applicable codes and standards published by the Bureau of Indian Standard and all other such publication as may be published by them after construction work starts, shall govern in respect of design, workmanship, quality and properties of material and method of testing.

5.0. SAFETY

5.1. All equipment shall be complete with approved safety devices wherever a potential hazard to personnel exists and with provision for safe access of personnel to and around equipment for operation and maintenance functions.

5.2. Special care shall be taken to make enclosed equipment proof against entry of rats, lizards and other creeping reptiles which may create electrical short circuit inside live equipment.

6.0. DRAWINGS

On completion of all works the contractor shall furnish three copies of Ammonia print along with the original tracing of the following as done drawings to the Consultant without any extra cost.

i. Wiring diagram for final power / lighting distribution showing the rating / size of switchgear, cables, conduits, lighting fixtures and all accessories for individual installation.

ii. Detailed arrangement drawings of the switchboard. Complete with dimension in metric units.

iii. Drawings showing the route of conduits and cables with sizes, lengths, sources and destination of all cables with the circuit designation number, etc.

iv. Drawings showing the balancing of phases with connected load in each circuits, etc.

7.0. TEST CERTIFICATES AND INSTRUCTIONS

7.1. Unless specifically mentioned otherwise, the contractor shall furnish in duplicate Manufacturer's Test Certificate with the delivery of the equipment to the Consultant and instruction in English for operations and maintenance of equipment where required.

8.0. TESTING AND COMMISSIONING

8.1. Before each field test, the contractor shall obtain the permission from the site engineer and all tests shall be conducted in the presence of duly authorised representative. Records of each test shall be prepared immediately after the test and this record shall be signed by contractor's representative conducting the test and the site engineer attending the test. Copies of their record in quadruplicate shall be handed over to the Consultant / Engineer-in-Charge.

8.2. A certificate in quadruplicate shall be furnished by the contractor countersigned by the certified supervisor under whose direct supervision the installation was carried out and the owner's site engineer. This certificate shall be in the prescribed forms in addition to the test certificate required by the Local Electric Supply authorities. Recommended format completion certificate is given in Appendix 'A'.

9.0. COMPLETION OF WORK

9.1. Each item of the electrical work shall be considered as complete in all respects only after obtaining permanent service connection from local supply authority, energising, testing and final commissioning of the complete installation as directed by the Consultant / Engineer-in-Charge.

9.2. Payment on each item of electrical work shall be made as per measurement and proportionate to the quantum of works completed. In the event of any dispute with regard to the proportion of work complete, the decision of the Consultant / Engineer-in-Charge shall be final and binding to the contractor.

10.0. PREAMBLE TO THE SCHEDULE OF WORK

10.1. The successful tenderer shall carefully go through the Clauses of Invitation to Tender, Specification, Schedule of Work and drawings and shall include in his rates and sum he may consider necessary to cover the fulfillment of the various clauses contained therein. Unit prices stated in the schedule of work against the item of work shall be inclusive of all installation accessories and consumables necessary to complete the said work within the contemplation of the contract. Beyond the unit prices no extra amount will be paid for incidental contingent work and materials.

10.2. The quantities mentioned in the schedule of work are probable quantities and it must be clearly understood that the contract is not a lump sum contract, that the probable quantities, the value of the entire tender are only indicative and owner does not in any way assure the tenderer or guarantee that the actual quantity of work would correspond to the probable quantities in the tender.

10.3. No change in unit rate will be admissible on any variation of quantity.

APPENDIX

FORM FOR COMPLETION CERTIFICATE

I/We certify that the installation detailed below has been installed by me / us and tested and that to the best of my / our knowledge and belief. It complies with Indian Electricity Rules, 1956 as well as IS:732-1963 Code of Practice for Electrical installation

at _____

Voltage and system of supply _____

a:	Particulars of work	Number	Total Load:	Type of system of wiring
1.	Light points			
2.	Fan points			
3.	Plug points (3 pin)			
4.	Motors			
5.	Other plant			

b: If the work involves installation of overhead lines and/or underground cable

_____

c: Earthing

Description of earthing electrode, size of earth wire and number of earth electrodes provided _____

_____

d: Testing Results

1. i. Between conductors _____

ii. between each conductor and earth _____

1. Resistance of earthing electrodes or earthing system

_____

2. Maximum earthing resistance of installation _____

_____

Signature of Supervisor

Signature of Contractor

Name & Address of Supervisor

Name & Address of Contractor

SECTION : A

TECHNICAL SPECIFICATION FOR ELECTRICAL EQUIPMENT

1.0. SCOPE

This specification covers for supply of materials, fabrication, erection, testing and commissioning of switch boards, Distribution fuse boards. Meter board, lighting equipment, Switches, socket outlets and miscellaneous items. Applicable provisions and conditions of contract shall govern the work under the section.

2.0. GENERAL

2.1. The contractor shall submit manufacturer's Test Certificate for switchboards, switch fuse units, meters, rewireable type porcelain fuse fittings, miniature circuit breaker and isolating switches and other items as directed by the Consultant / Engineer-in-Charge.

2.2. After completion of such supply and installation work of the electrical equipment if any defect in the material or workmanship is found by the Consultant / Engineer-in-Charge, the contractor shall remove the same and supply better and approved materials at his own cost.

2.3. All precaution against theft and fire shall also be taken by the contractor.

2.4. The contractor shall provide complete supervisions for proper execution of the work.

3.0. MATERIAL

3.1 All materials used in the work shall be of ISI approved / quality and in its absence conforming to the I.S. Specification.

3.2 For fabricated equipment special care shall be taken to make the enclosed equipment proof against entry of creeping reptile which may create electrical short circuits inside the live equipment.

4.0. L.T. MAIN DISTRIBUTION SWITCH BOARD / DIST. SWITCH BOARD

4.1.0. The 415 Volt main distribution switch board shall have incoming unit fed from L.V. side of transformer or main LT source.

4.2.0. STANDARDS
The equipment shall be designed to confirm to the requirements of I.S. 4237. I.S. 2147 and I.S. 375.

4.3.0. CONSTRUCTION
4.3.1. The main L.T. P.C.C. board shall be of totally enclosed tropicalised, vermin proof, free standing cubical type as front minimum 2.0 mm thick sheet steel construction with angle iron frame work housing incoming switch gear ACB/MCCB, requisite number of outgoint ACB, MCCB, fuse switch or switch fuse units, busbars, switch board shall be readily extensible on both sides. The L.T. terminal of the transformer shall be connected to the incoming terminal of the MCCB/Air Circuit Breaker through adequate number and size of aluminium conductor 1.1 KV grade PVC and A cable.

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4.3.2. The incoming and outgoing functional units shall be arranged in multitier formation, to provide a compact switch board having a pleasant appearance. Each unit shall be accommodated in a separate compartment having gasketed hinged door which shall be interlocked with the operation mechanism so as to prevent opening of the door when the switch is in the 'ON' position and also to prevent closing of the switch with the door not properly secured.

4.3.3. The 'ON' and 'OFF' positions of the switch handle shall be distinctly indicated by proper marking. Modular construction shall be adopted to cater for different units with each cubical having a busbar chamber at top and a rear cable compartment. The maximum height of the devices on the panel shall not exceed 2000mm.

4.3.4. Suitably engraved identification levels shall be provided on each unit.

4.3.5. When switch board of floor or wall mounting type is specified instead of cubicle type with incoming and outgoing Fuse switch unit or switch fuse units, the board shall comprise a suitable length of Busbar chamber. The board shall have provision for future extension. The floor stands or wall bracket shall have sufficient mechanical strength to carry the weight the entire switch board.

4.3.6. The height shall be such that maximum operating height of the top unit shall not exceed 1800 mm.

4.4.0. BUSBAR

4.4.1. The main horizontal busbar shall be air insulated and made of high conductivity, high strength aluminium alloy or electrolyte copper complying with the requirements of grade E 91 E of IS 5082. The current density in each busbar shall not exceed 160 Amp. per sq.cm. for copper and 125 sq.amp. per sq.cm. for aluminium.

4.4.2. The main phase busbar shall have continuous current rating throughout the length of power control centre and the neutral busbar shall have a continuous rating of at least 50% of the phase busbar.

4.4.3. Large clearance and creepage distance shall be provided on the busbar system to minimise the possibility of a fault.

4.4.4. The busbar and vertical risers shall be fully insulated with PVC sleeve or tape to prevent accidental touch.

4.4.5. The busbar including neutral and earth bar shall be short circuit tested for fault withstand of 60 KA RMS for one second as per IS:8623 for factory Built Assemblies.

4.4.6. In no case the rating of busbars shall be less than the Incoming Circuit Breaker or switch.

4.4.7. Busbar should be supplied with insulating material such as Permali, Hylam and support shall be sufficient close and robust and support should permit – sufficient movement for compensation of comparative stress in the event of short circuit.

4.5.0. AIR CIRCUIT BREAKER

The circuit breaker would be constructed in modular construction or would be enclosed in cassettes, designed for easy Switch Board Construction. The formed and welded steel construction should be given corrosive resistance treatment following fabrication work.

The breaker would have three distinct position, service / test /isolated within the cubicle, achieved by a racking cam and slide rails, simplifying inspection and from this position breaker should be able to withdrawn from housing. With door closed, the breaker should be withdrawn to test and isolated position.

The contact system should be designed to ruggedly and to effectively utilize the magnetic force generating in the current path ensuing high short time with- stand current and interrupting capacity and reducing the let through energy. The ACB should be provided with separate set of arcing contacts and main contacts ensuing high mechanical and electrical life. Arc chutes on arcing contacts with de-ionisation plate should be provided. The contact tips should be made of Silver Nickel Alloy and arcing contact tips are of Silver Tungsten Alloy.

ACB should be suitable for manual or Motor wound stored charge spring closing mechanism. ACB should be provided with static trip release, inherent safety inter locks such as safety shutters and door inter lock, "OFF" & "ON" indicator auxiliary switches and contacts. ACB should be complete with overload protection, short circuit protection, under voltage trip, auxiliary contacts and instruments as specified in the schedule.

The ACB should comply with Indian Standard Specification I.S. 2517-1977 and IEC 157 and should be certified by CPRI.

4.6.0. MOULDED CASE CIRCUIT BREAKER

These MCCBs should comprise of a switching mechanism, contact system are extinguishing device and the tripping unit, contained in a compact moulded case and cover.

The insulating case and cover shall be made of high strength heat resistant, flame retardant thermo setting materials, providing interphase insulation of a very high delectric strength and an insulated enclosure with high withstand capability against thermal and mechanical stresses with protection against-secondary fire hazards.

Trip free toggle mechanism should ensure that the trip command overrides all other commands.
MCCB should employ a maintenance free contact system designed to minimise the let through energies while handling abnormal currents. The special sintered contact tip should provide a wiping action, high resistance to erosion during interruption and a stable contact for normal service current.
A series of grid plates should be mounted in parallel between supports of insulating material. The profile of the de-ion steel plates extends directly over the contacts and draws the arc from the moving contact up into the divider chamber, thus confining, dividing and extinguishing the Arc.

The handle position should give positive indication of whether the MCCB is 'ON' (top), 'OFF' (bottom) or 'TRIPPED' (midway).

The tripping element provided on each pole of the MCCB should operate on a common trip bar because of which it does not create single phasing in the event of a fault on any of the phases.

The base design ambient of these MCCBs should 40 degree C.

When specified the MCCB should be fitted with under voltage protection, earth fault protection, alarm & auxiliary switch etc.

4.7.0. FUSE SWITCH UNIT

The fuse switch units shall be of double break type suitable for load break duty, with quick make and break mechanism and front drive mechanism, generally conforming to IS: 4064-1978 having fully shrouded contacts. All switch contacts shall be shelf aligning, spring loaded, silver plated. The isolators shall be connected on the busbar side or incoming side and fuses on the load side. However fully withdrawable carriage to facilitate quick fuse link replacement is preferred.

The individual fuse switch units shall be either triple pole and neutral or single pole and neutral as specified with a front operating handle. The fuse links shall be non-deteriorating HRC type complying with IS:2208-1962 and having rupturing capacity of 80 KA at 415 Volts.

The units which are to be installed separately should be totally enclosed fully shrouded sheet steel clad / cast steel casting.

INSTRUMENTS

The measuring instruments shall comply with IS: 1248 in all respects.

Moving iron, square, flush mounting type instruments shall be used for measuring A.C. Voltage and currents.

The instruments shall normally be mounted on the hinged door of an all welded fabricated sheet steel housing of rigid construction to allow easy access to small wirings. Protective circuits shall be protected by HRC type fuse links complying with IS:9224 (Part-II) – 1979. The fuses shall be mounted near the tap-off point from the main connections so that a fault in the instrument wiring does not affect the main supply. Small wiring shall be of 660 Volt grade single core fire resistant P.V.C. cable with copper conductor having minimum size 2.5 sq. mm.

These shall be coloured coded for identification of circuits. The instruments shall be of IMP/Automatic Electric / G.E.C. or equivalent make acceptable to the Consultant / Engineer-in-Charge.

4.8.0. CABLE TERMINATIONS

4.8.1. Separate cable compartment with doors bolted cover plates shall be provided at rear of each vertical section to facilitate cable termination of individual units. The design shall ensure generous availability of space for ease of installation and maintenance of cabling and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section. The compartments shall have detachable cover plate with gaskets at the bottom of the cable compartment unless specified otherwise. Cable glands and slugs of suitable sizes shall be provided for cable termination. Suitable arrangements shall be provided in the compartment for clamping of the cables.

4.9.0. EARTHING

G.I. / copper flats shall run the entire length of the switch board. Two bolted type earthing terminals shall be provided in the board for connecting to the earth grid.

4.9.1. METAL TREATMENT

All steel materials used in the construction of the switch board shall undergo a rigorous rust proofing process comprising alkaline digreousing, descaling in dilute sulphuric acid, cold rinsing, recognised phosphating process. Passivating and drying with compressed air in dust free atmosphere. It shall then receive two coats of highly corrosion resistant enamel paint of approved shade.

5.0. DISTRIBUTION FUSE BOARDS

5.1. The distribution fuse board shall comply with IS:2675-1983 and B.S. 214 in all respects.

5.2. The distribution fuse board shall be housed in a dust and vermin proof metallic enclosure fabricated from 2mm thick all weldad sheet steel suitable for wall / column mounting and complete with a door of rigid construction fitted with dust protecting gasket and robust fasteners. The enclosure shall have suitable provision for fixing fuse fittings and neutral bar on high grade rigid insulating support. The fuse fittings shall be provided with a cable socket for the incoming cable. The socket shall be situated centrally and must be covered by an insulating shroud for safety. Phase separation barriers made out of arc resistant materials shall be provided between the fuse banks. All bare current carrying parts shall be protected with a bakelite sheet of 3.5mm thick to prevent accidental contact.

5.3. The distribution fuse board of single phase and neutral type shall be fitted with an earth bar for termination of each continuity conductor of outgoing circuits.

5.4. In case of concealed system, the boxes are to be flushed with the wall and the cover shall be made from 5mm thick opal acrylic sheet or 3 mm thick decorative white top Bakelite Electrical switch board cover of Hylam make.

5.5. The sheet steel parts shall undergo a rigorous rust proofing process comprising alkaline degreasing, de-scaling in dilute sulfuric acid, cold rising and a recognized phosphating process. The steel work shall then receive two coats of high corrosion resistant primer paint before final painting by application of synthetic enamel paint.

6.0. MINIATURE CIRCUIT BREAKER DISTRIBUTION BOARDS (SP&N)

6.1. The MCB Distribution Board (SP&N) shall be housed in rust protected sheet steel enclosure shall be designed to provide protection against ingress to IP42 of IS-2147. This shall also be provided with the add – on acrylic door / double door (Metallic) when specified. The MCB DB – shall be supplied complete with tinned copper busbars rated 100 Amps and incorporating Isolator; MCB or equivalent RCCB as incomer. MCB's shall be mounted by inserting the MCR onto specially designed mounting channel and tightening just one screw. The special mounting channel shall permit easy removal – even of – MCB in the middle of the bank without disturbing other MCB's.

The incomer shall accept 35 sq.mm. wire with wire while neutral, for branch circuits, accepts 16 sq.mm. wire. The consumer unit shall have provision of 20mm/25mm knockouts at top and bottom and two 32 /23 mm knockout on sides facilitates wiring space making for flexibility and convenience of wiring.

6.2. MCB DISTRIBUTION BOARDS (TP&N)

TPN Distribution Boards shall be fabricated from CRCA sheet. This shall be painted in aesthetically appealing two-tone powder coated finish. The TP & N DB's shall be 4/8/12 for incorporating isolator, MCB or RCCB as incomer. The busbar shall be integral type single piece busbar (Cu) and coupling links. The MCB's shall be arranged in two vertical banks with switch lever operating in horizontal plane for on-off switching. Specially designed mounting channel for quick shop fitting and easy removal shall be fitted.

The sheet steel enclosure fitted with add-on acrylic door / double metallic door shall be provided with protection against ingress IP42 or IS:2147. The incomer shall accept upto 35 sq.mm. cable while the neutral shall accept 16 sq.mm. wires.

Two conduit entry plates at top and bottom shall be provided to facilitate drilling conduit holes at site to suit site requirements. The TPN DB's shall conform to IS: 8623 for factory built assemblies.

7.0. METER BOARD

7.1. Unless otherwise mentioned in the schedule of quantities the Meter Board shall house a kwh meter in a dust and vermin proof metallic

enclosure fabricated from 2 mm thick all welded sheet steel suitable for wall mounting. The door shall be secured by fasteners, enabling dust protecting gasket to be compressed easily. The kwh meter shall be of G.E.C. / Universal or equivalent make and the same shall be mounted on a rigid insulating support. There must be a viewing apprture on the M.S. Door covered with a 2 mm thick clear acrylic sheet for easy meter reading and it shall be possible to seal the enclosure against unauthorised opening.

7.2. The sheet steel enclosure shall undergo rust proofing process and painting as specified in 7.5.

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8.0. FUSE CUT OUTS

8.1. The fuse-cut outs shall be totally enclosed, metal clad suitably for mounting on flat vertical surface and shall be provided with a screwed top cover. It shall be possible to seal the enclosure against unauthorised opening.

9.0. PUSH BUTTONS AND CONTROL SWITCHES

9.1. All push button switches shall be of sturdy design suitable for all types of control circuit. Unit construction shall be adopted so as to have any desired arrangement of contact.

9.2. Control and selector switches shall be of sturdy design with modular construction comprising rotary type switch with pistol grip or twist type operating handle and a number of switching elements operated by a single shaft and shall have suitable position indicator to show that the switch is in selected position.

9.3. The push button and control switch shall be of Larsen & Toubro / Siemens or equivalent make.

10.0. CONTACTOR UNITS

10.1. The contactor units shall comply with IS:2959 in all respects.

10.2. The main contactor units shall be of robust in design having double break bounce free type contacts and pressure type terminal clamps. The contacts shall be made of antiweld silver cadmium oxide. The coil shall be vacuum impregnated, backed with inter-layer paper insulation and finally moulded in hard resin.

10.3. The contactor units shall be of Larsen & Toubro / Siemens / Crompton Greaves make.

11.0. LIGHTING EQUIPMENT (Bank Supply Item)

11.1 The luminaires for fluorescent lamps shall be shop assembled fully wired and suitable for 1 No. 4 ft. tube or 2 Nos. 4 ft. tubes as the case may be. The salient features of these luminaires are basic channels / rails, 240 volt ballasts with copper winding wire, spring loaded bipin type lamp holders, glow type starters and condensers. Reflectors and / or decorative covers shall be supplied as specified in the Schedule of Quantities.

11.2 The luminaires for incandescent lamps shall be as specified in the schedule of quantities and approved by the Consultant / Engineer-in-Charge before the same is used.

11.3 The incandescent Bulkhead type fittings shall be of cast aluminium alloy body, finished by application of synthetic enamelled silver grey paint outside, white insides, with front glass, wire guard, tropicalised gasket, B.C. Lamp holder and suitable for use with 100 Watt G.L.S. Lamp. The fittings shall have tapped 19mm E.T. for conduit entry.

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11.4 The Highbay luminaires for sodium /mercury vapour lamps shall be integral type unit having a spun aluminium canister at the top for housing control gear, terminal block for the incoming supply, earthing terminal and suspension arrangement. The luminair shall have reflectors of spun anodized aluminium with a secular finish and suitable for use with 250 / 400 watt HPSV / HPMV lamp as the case may be.

11.5 The Post-top lantern type luminaires shall have a die-cast aluminium electrical unit / housing with provision for pipe entry from below, a canopy made of spun aluminium and an opal, white acrylic diffuser resistant to ultraviolet radiation and heat. The luminaire shall be rain proof, insect tight and fully wired upto the terminal block and suitable for use with 80/125 watt HPMV or 100 watt G.L.S. Lamp as specified in the schedule of quantities.

11.6 The flood lighting luninaires shall have a rugged construction housing made of cast aluminium alloy of low copper content for corrosion resistant, highly polished and anodised aluminium reflector for beam control, a heat resistant front glass with gasket and terminal block. To facilitate aiming and fixing bracket shall be provided on the housing. The luminaire shall be rain proof, and suitable for use with 1000W tungsten halogen lamp or 250 / 400 Watt HPSV lamp as specified in the schedule of quantities.

11.7 The ballasts for fluorescent tube shall conform to IS: 1534 & IS:1534 (Part-I) 1977 and the same for high intensity discharge lamps shall conform to IS:6616-1982 and these shall have high grade synthetic enamelled copper winding wires, quality grade insulation materials, good quality low hysteresis loses electrical stampings and complete unit shall have polyester filling. The ballasts shall be suitable for use on single phase 240 Volts 50 Hz. A.C. system and of G.E.C. / Phillips make.

11.8 The capacitors shall comply with IS:1569-1976 and be of hermetically sealed type.

12.0. CEILING FANS AND REGULATORS

The ceiling fans and regulators shall conform to IS:374-1979. The fans shall have totally enclosed capacitor start and run motors suitable for operation on 230/240 Volt, Single phase, 50 Hz. A.C. system. The regulator shall have an 'ON' 'OFF' position next to the lowest speed contact and shall be provided with at least five running positions.

13.0. EXHAUST FANS

13.1. The Exhaust fans shall conform to IS:2312-1967 and suitable for operation on 230/240 Volt single phase, 50 Hz. A.C. system. The fans shall be ring mounted type designed to give maximum air volume changes under free air flow conditions.

14.0. SWITCHES

14.1. Light and fan switches shall be rated for 5 amp. 250 volts and of Piano-key type and suitable for flush mounting on sheet steel board or seasoned teak wood board of double panel construction. The switches shall be of Anchor or equivalent make acceptable to the Consultant / Engineer-in-Charge. For surface mounting these shall be of robust design, tumbler type and of Ellora or equivalent make. The switches shall comply with relevant I.S.

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15.0. SOCKET OUTLET AND PLUG

15.1. These shall be of 3 pin type and of rating 6 amps (For light) and 16 amps. (for power). Each socket outlet shall be complete with controlling switch and plug top. Protective fuse links shall be provided with 16 amps. power socket outlet. The socket outlets shall have piano-key type switches and of Anchor or equivalent make acceptable to the Consultant / Engineer-in-Charge. The socket outlet and plug shall comply with the relevant I.S. specifications.

16.0. SWITCH BOXES

Sheet metal (16 SWG) switch boxes / connection boxes with 3 mm thick bakelite top cover flushed in wall by housing the box after cutting brick wall. Sheet metal boxes shall be treated against corrosive by passivation or other approved method.

17.0. FEEDER PILLAR

17.1. The feeder pillar shall be of the floor mounting type, totally enclosed and weather proof. The cubicle shall be fabricated out of heavy gauge sheet steel of thickness not less than 10 gauge with suitable side frames and 12 gauge stiffeners.

17.2. Hinged doors of not less than 3 mm thick shall be provided at the front and rear of the cubicle to provide access for installations, operations, tests and inspection. All doors shall be fitted with dust excluding gaskets. The door shall also be fitted with suitable locking arrangement to prevent unauthorised opening. The cubicle shall be designed for mounting over cement concrete plinth by the roadside and shall be of substantial construction capable of withstanding the vibration normally experienced due to vehicular traffic.

17.3. The sheet steel materials used in the construction of the cubicle shall undergo a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid, cold rinsing and a recognised phosphating process. After matel treatment, the interior of
the cubicle shall be painted with two coats of air drying red lead primer followed by two coats of air drying anti-condensation paint. The exterior of the cubicle shall be painted with two coats of stoving red oxide primer and finished by application of two coats aluminium paint or any other colour shade acceptable to Consultant / Engineer-in-Charge.

17.4. Ventilation louvers in the form of finely divided wire mesh shall be provided on the two sides to ensure natural ventilation.

18.0. TUBULAR POLE / G.I. PIPE POLES

Where tubular steel pole are specified (either swagged or stepped), the same should be manufactured and supplied as per I.S. 2713 part I to III – 1980. Where G.I. pipe pole are specified the same should be approved to I.S.

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19.0. LOOP-IN JUNCTION BOX

19.1. These junction boxes shall be drip proof type dust and vermin proof construction fabricated from 2 mm thick sheet steel having internal dimensions of 200 x 150 x 130 mm depth for single phase distribution system and 250 x 200 x 130 mm depth for three phase distribution system. These shall have moulded bakelite base connector block with anti-vibration nickel plated brass terminals of suitable size and rating and porcelain fuse fittings.

20.0. MANUFACTURER'S DRAWING

20.1. The successful tenderer shall submit for approval General arrangement and dimensioned drawings for Power and Lighting distribution switch board, Motor Control centre, Bus-duct arrangement, Miniature circuit breaker distribution board, Fuse Distribution board, Interlocked Switch socket outlets, Clock switch control panel, T P Power Cable junction box and cable rack etc. as required in three sets before commencing manufacture.

21.0. WORKMANSHIP AND INSTALLATION WORK

21.1. The workmanship shall be of good commercial quality and all supply materials and installation work shall be completed to the full satisfaction of the Consultant / Engineer-in-Charge.

22.0. CONTRACTORS RATE TO INCLUDE

22.1. Apart from other factors mentioned elsewhere in this contract, the rates for the above shall include for the following :

i. All labour, materials, tools and construction equipment required for fabricating and fixing of above stated items.
ii. Scaffolding including erection and removal.
iii. Making good of all damaged civil work, if any.
iv. Necessary modification of pre-laid conduit including supply & fixing of Metal / PVC conduits and accessories, chase cutting etc. as required to complete the work.

23.0. METHOD OF MEASUREMENT

23.1. Unless otherwise mentioned in the Schedule of Quantities, measurement will be on net quantities of work produced. In the event of any dispute with regard to the measurement of work executed, the decision of the Consultant / Engineer-in-Charge shall be final, and binding to the Contractor.

SECTION : B

TECHNICAL SPECIFICATION FOR WIRING SYSTEM

1.0. SCOPE

1.1. This specification covers for supply of materials, erection and commissioning of distribution wiring, connection to distribution boards, cable laying, earthing and miscellaneous items. Applicable provisions and conditions of contract shall govern the work under the section.

2.0. GENERAL

2.1. Works to be provided for by the Contractor, unless otherwise specified shall include but not be limited to the following :

i. Furnishing of labour, materials, supports, scaffolds, transportation etc. required for the work.

ii. To provide all incidental items not shown or specified in particular but reasonably be implied or necessary for successful completion of the work in connection with the drawings specification and schedule of items.

iii. To provide all supervision for proper execution of the work

iv. To conduct and bear all costs in respect of any test advised.

2.2. After completion of supply and installation of wiring system and earthing, if any defect in the material or workmanship is found by the Consultant / Engineer-in-Charge, the contractor shall remove the same and supply better and approved materials at his own cost.

2.3. All precaution against theft and fire shall also be taken by the contractor.

3.0. MATERIALS

3.1. All materials used in the work shall be ISI approved quality and in its absence conforming to the IS Specification.

4.0. WIRING SYSTEM

4.1. The electric load of all lights, power outlets, etc. shall be balanced across the three phases.

4.2. Generally the final loading of any sub-circuit for lights and fans shall not exceed 800 watts and shall not be connected to more than total 10 fans, lights, socket outlets, etc. Bell push if operated at low voltage shall be fed from a separate circuit of distribution fuse board.

4.3. The final 16 amps sub-circuit for power shall be connected to a maximum one 16 amp. socket outlet or two 6 amp. socket outlets.

4.4. A power circuit shall always be originating from a distribution fuse board or MCB DB and the same shall run in a separate conduit.

4.5. The point wiring shall mean wiring from one way of distribution board to point of utilisation of electricity i.e. where the load is applied and this shall include complete wiring from distribution board, supply and fixing of switch board, controlling switches, ceiling rose, batten holder and socket outlet etc.

4.6. Insulated or covered earthing conductors where used, shall have green insulation braiding or covering as appropriate. Under no circumstances shall the colour green be used for other than earthing conductor. In addition where it is required, cables of different colours be used. For identification purposes the following system shall be employed :

Red or any colour (other than: Black or green)		For outer phases or switch wire.
Black	:	For middle wire or Neutral.

4.7. Unless otherwise mentioned in the schedule of quantities, single way porcelain / bakelite terminal connectors with nickel plated brass inserts and screws to suif the conductor size shall be used for intermediate wiring / joints in junction boxes and in switch boards or by any other method approved by the Consultant / Engineer-in-Charge.

4.8. Distribution wiring in conduit to light, fan, plug points etc. shall be done in looping in system. In this system, no joints or connections shall be made anywhere of the system except at terminating points such as at terminals of switches, ceiling roses, etc. and in case of socket outlets at the socket terminals. Intermediate wiring joints of neutral wire in junction boxes will not be permitted.

4.9. In the looping back system of wiring on hard wood batten, the wiring shall be done without any junction or connector boxes on the line. All intermediate joints or connections shall be made in the switch board only. Intermediate wiring joints of neutral wire in the junction box will not be permitted.

5.0. CONDUIT WIRING

5.1. All conduit shall be conforming to I.S. 9537 (Part – II) – 1981 and finished with galvanised or stove enamelled surface. All conduit accessories shall be conforming to IS:2667-1988 and be threaded type. Conduit less than 20mm in diameter shall not be used. All conduits shall be of 1.4 to 1.8 mm thickness below 32 mm dia. and 1.6 to 2.2 mm thickness for 32 mm dia. and above.

5.2. The conduit for each circuit shall be erected complete with necessary bushes before drawing in of any wire. Galvanised M.S. Spacer of 3mm thick minimum shall be used between the conduit saddle and fixing surface. The saddle shall be fixed at an interval of not more than 750 mm apart for vertical run and 600mm apart for horizontal run.

5.3. The joint in conduits shall be made by means of threaded couplers and threaded accessories only to ensure electrical continuity throughtout. All pipes after cutting, the threading shall be carefully reemed cut with special reamer to remove any burr and then painted immediately with an anti-corrosive preservative after removing all traces of oil or grease. Junction boxes shall be provided with gasketed covers to render them dust and damp proof. The conduit accessories having pull outlet for conductors shall only be used in all conduit installation.

5.4. Where specified, P.V.C. conduit conforming to IS:2509-1973 or IS:9537 (Part – III) shall be used. The thickness of P.V.C. conduit shall be adequate to withstand mechanical injuries. Where necessary PVC conduit, accessories conforming to IS:3419-1976 shall be used along with PVC conduit.

5.5. The entire conduit system shall be effectively earthed by means of suitable earthing conductors and the resistance from any point to earth shall not be more than one OHM.

5.6. After installation of conduit pipes and fittings are completed in all respects, the exposed outer surfaces of the conduit and accessories shall be painted with two coats of approved enamel paints or aluminium paint over a coat of red oxide as required to match the surrounding wall finishing. To protect against rust the bare thread portion shall be painted with anti-corrosive preservative.

6.0. CONCEALED WIRING

6.1. Recessed conduit wiring system : This system of wiring shall comply with all the requirements of surface conduit wiring system specified in Causes 5.1 to 5.6 in addition to the following Clauses.

6.2. Making of chase : The chase in the wall shall be filled up neatly made and be of ample dimensions to permit the conduit to be fixed in the manner desired. In case of buildings under construction, chases shall be provided in the wall, ceiling etc. at the time of their construction and shall be filled up neatly after erection of conduit and brought to the original finish of the wall. Specially for ceiling, conduit shall be laid before casting.

6.3. Fixing of conduit in chase : The conduit in chase in the wall shall be fixed by means of staples or by means of saddles not more than 60 cm apart. Fixing of standard bends or elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with a long radius which will permit easy drawing in conductors. All threaded joints of conduits shall be treated with some approved preservative compound to secure protection against rust.

6.4. Inspection boxes : Suitable inspection boxes shall be provided to permit periodical inspection and to facilitate removal of wires, if necessary. These shall be provided in the inspection box covers.

6.5. Types of accessories to be used : All outlets such as switches, wall sockets etc. may be either flush mounting type or of surface mounting type.

The outlet box shall be the same as in Clauses 15 of Section I and shall be mounted flush with the wall. The metal box shall be efficiently earthed with conduit by an approved means of earth attachment.

6.6. Fish wire : 1 x 18 SWG G.I. wire inside the conduit and accessories to be provided with an extension of 230 mm at both the conduit ends.

6.7. Conduit laying in floor /roof slabs before casting : M.S. / G.I. /rigid PVC/polythene conduit shall be laid straight as far as practicable and properly placed including binding with the steel reinforcement rods with 22 SWG G.I. binding wire so that proper positions of conduits are maintained.

While laying the conduits for concealed wiring in the ceiling / beams / columns / walls before casting the contractor shall ensure that both ends of the conduit are plugged by means of dead – end sockets or otherwise to prevent the entry of any foreign material against conduit chocking.

All precaution must be taken while laying the conduits on the slabs, R.C. walls, columns, etc. and the contractor shall rectify at his own cost, if any defects are found during process of drawing cables through the concealed prelaid conduits.

Each M.S. / G.I. conduit shall be provided with protruding length of 150 mm on free end of the conduits under the bottom level of slab / beam.

Each rigid PVC/polythene conduit shall be provided with protruding length of 150mm on free end of the conduits under the bottom level of slab / beam.

There shall be no intermediate joints in one straight run of conduit.

All ceiling outlets shall be terminated in a round M.S./G.I. circular box (80 mm depth minimum) / deep box to suit standard size ceiling rose or/and rectangular M.S. junction box or Fan Hook Box as the case may be.

It will be mandatory for the contractor to get the layouts approved by the Engineer-in-Charge / Consultant, measurements are checked when the conduits are laid and bound to steel reinforcement rods, before he can release the work for casting of slabs / floor / beams etc.

6.8. Connector Boxes, Draw-in-Box, Junction Boxes :

These shall be constructed from 14 SWG M.S. sheet and have M.S. cover. Minimum size for connector box is 150mm x 100mm and for Draw-in-Box is 100mm x 100mm with required depth upto 80mm.

6.9. Fan Hook Box :

These shall be 100mm dia x 80mm depth, constructed from 14 SWG M.S. sheet and provided with one 16mm dia. M.S. rod of 300mm long having 'U' bend inside the box.

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6.10. Painting :

Outside of wall switch board, connection box, draw-in-box and other M.S. accessories shall be painted with two coats of anti-corrosive paint in addition to other painting instructions given elsewhere.

7.0. WIRES

7.1. Unless otherwise mentioned in the schedule of quantities, only single core PVC insulated / PVC insulated & sheathed cable consisting of single / multistrand / flexible copper / aluminium conductor and of approved manufacturers conforming to relevant I.S. shall be used for wiring in conduit system.

7.2. The maximum number of wires drawn in one conduit shall not be greater that the recommended number given in the Table 1 given at the end this section.

8.0. PVC SHEATHED WIRING LAID ON HARD WOOD BATTEN

8.1. Unless otherwise mentioned in the schedule of quantities only single core flat PVC/Polyethylene insulated and sheathed wire of 650 volts grade consisting of single / multistrand, copper / aluminium conductor conforming to relevant ISG shall be used for exposed batten wiring.

8.2. All PVC wires shall run on well seasoned perfectly straight hard wood batten varnished on four sides but not less than 10mm finished thick and the width of which is such as to suit total width of cables laid on batten. Prior to the erection, these shall be painted with one coat of varnish. The battens shall be screwed to the walls and ceiling by flat head wood screws to wood plugs or other approved plugs at an interval not exceeding 750mm. The flat head wood screws shall be counter sunk within wood batten and smoothened down with a file.

8.3. Link clips shall be conforming to IS:2412-1975 and these shall be so arranged that one single clip shall not hold more than two twin core PVC wire upto 2.65 sq.mm. above which a single clip shall hold a single twin core wire. The clips shall be fixed on varnished wood batten with brass pins spaced at intervals of 100mm in the case of horizontal runs and 150mm in the case of vertical runs. The link clips shall be made of heavy tinned brass sheet or Aluminium sheet the thickness being not less than 27 gauge.

8.4. Where wires pass through walls / floors these shall be protected from mechanical injury by means of rigid steel conduit. The end of the conduit shall be neatly bushed with bakelite. The conduit shall extent 1.5mm above the floor and flush with the ceilings or walls.

8.5. After erection, the P.V.C. wiring along the batten shall be painted with one coat of synthetic enamel paint of an approved colour.

9.0. INSTALLATION AND WIRING OF DISTRIBUTION FUSE-BOARDS */ MCB DISTRIBUTION BOARD.

9.1. Where fixing of distribution fuse board / MCB DB on doubel teak wood board is specified only hinged type wooden board with brass hinge shall be provided and the size of the board shall be such as to match the size of the Distribution fuse board / MCB DB. A minimum margin of 25mm shall be provided on all sides of the distribution fuse board / MCB DB. The outgoing circuit shall be taken out through a horizontal slot at the rear side of the distribution fuse board / MCB DB enclosure.

9.2. Where fixing of Distribution fuse board / MCB DB on M.S. frame is specified, the frame shall have sufficient mechanical strength to carry the weight of the D.F.B. /MCB DB.

9.3. Where fixing of Distribution fuse board / MCB DB will be of concealed type, the chase in the wall shall be neatly made and be of ample dimensions to permit the DB to be recessed in wall and flushed with finished wall surface.

9.4. The cable / wires shall be connected to the terminal only by soldered or crimped lugs, unless the terminal is of such a form that it is possible to securely clamp them without cutting away of cable strands.

9.5. All bare conductors shall be rigidly fixed in such a manner that a clearance of at least 25mm is maintained between conductors and material other than insulating material.

10.0. CABLES

10.1. TYPE AND QUALITY OF CABLES

Unless otherwise specified in the Schedule of Quantities all wiring cables shall be PVC insulated and PVC sheathed conforming to relevant IS Standard. The conductor of cable shall be of stranded wires of aluminium or copper as specified. All power cables shall be 1100 volts grade, PVC insulated, PVC sheathed and armoured with stranded aluminium conductor. Materials should be obtained from the approved list of manufacturers / brands as indicated in the document.

10.2. HANDLING OF CABLES

It shall be ensured that both ends of the cables are properly sealed to prevent ingress / absorption of moisture by the insulation.

When the cable drums have to be moved over short distances, they should be rolled in the direction of the arrow marked on the drum. While removing cables, the drum shall be properly mounted on jacks or on a cable wheel or any other suitable device, making sure that the spindle, jack, etc. are strong enough to take the weight of the drum.

10.3. DEFECTIVE CABLES

Cables with kinks and straightened kinks or with similar apparent defects like defective armoring etc. shall not be installed.

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10.4. BENDING RADIUS

Cable runs shall be uniformly spaced, properly supported and protected in an approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and kinking of the cable. The minimum safe bending radius for all types of PVC cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable larger radius shall be adopted.

10.5. LENGTH OF CABLES

All cables shall be laid in one length. No joint shall normally be made at any intermediate point in through runs of cables unless the length of the run is more than the length of the standard drum supplied by the cable manufacturer. In such cases where jointing is unavoidable, the same shall be made by means of standard cable joint boxes / kits. Before cutting the cables, the requisite length between terminals (including extra length required at loops) shall be carefully measured.

10.6. STRIPPING OF OUTER COVERING

While cutting and stripping the outer covering (i.e. sheathing of the cable, care shall be taken that the sharp edge of the cutting instrument does not cut or damage the inner insulation of the conductor. The protective outer covering of the cable shall be stripped off near the connecting terminal the protective covering being maintained upto a point as close as possible to the connecting terminal.

11.0. CABLE LAID IN TRENCHES

11.1 Cables shall be laid generally in accordance with Indian Standard Code of Practice IS: 1255.

11.2. SIZE OF TRENCH

Unless otherwise mentioned in the Schedule of Quantities the minimum width and average depth of trench for laying a single cable in ground shall be 460mm and 760mm for L.T. and 1000 mm for H.T. cable respectively. For laying of multiple 11 KV and 6.6 KV grade power cables horizontal axial spacing shall be 250mm. For 1100 volt grade power cables the horizontal axial spacing shall be 150mm. However, communication cable shall not be taken in a common trench. Where more than one cable are to be laid in the same trench in horizontal formation, the width of trench shall be increased according to the above stated inter-axial spacing between the cable except where otherwise specified). There shall be a clearance of at least 150mm between the trench edge and axis of the end cable.

11.3. EXCAVATION OF TRENCH AND PREPARATION OF BED

The trench shall be excavated in reasonably straight line where there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable these shall be gradual.

Adequate precautions shall be taken during excavation not to damage any existing cables, pipes or similar installations in the proposed route. Where bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried out without the approval of the Consultant / Engineer-in-Charge.

The bottom of the trench shall be level across the width and free from stone, brick bats etc. The trench shall be then provided with a cushion of fine sand, the thickness of the cushion being not less than 75mm.

11.4. LAYING OF CABLES

All cables shall be tested for proper insulation prior to laying. The cable drums shall be transported on wheels to the place of work. The cables shall be laid out in proper direction as indicated on the drum using cable drum lifting jacks. In case of higher size cables, the laid out cables shall run over rollers placed at close intervals and finally transferred carefully on to the trenches and racks, care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used. The entire length of cable shall as far as possible, be paid in one operation. However, if this is not possible, the remainder of the cable may be shifted from position by 'falking' i.e. by making one long loop in the reverse direction. For crossing water, gas or sewerage pipes, etc. cables shall be taken above the pipes where minimum 500mm clearance is not available. The cable shall cross these pipes through RC/GI pipes at a minimum depth of 750 mm from finished ground level keeping the distance between the utility pipes and pipe carrying cables 300mm minimum.

While laying cables parallel to building, railway track, utility pipe lines, drainage, sewerage, etc. the minimum clearance shall not be less than 1000 mm.

Adequate length of cables shall be pulled inside the switch boards, control panel terminal boxes, feeder pillar etc. so as to permit neat termination of each core.

11.5. SURPLUS CABLE

At the time of original inspection, approximately 1 meter of surplus cable (in the form of a loop or otherwise) shall be left at each entry or exit of the cable at a pole or at the pillar box, or near any terminal as may be directed by the Consultant / Engineer-in-Charge.

11.6. PROTECTIVE COVER FOR CABLES DIRECTLY BURIED IN GROUND

Except where otherwise directed by the Consultant / Engineer-in-Charge, the cable (for the entire length in trench) shall be protected by a layer of bricks laid flat on top and shall be provided at least by 75mm sand cushioning both at top and bottom. This brick protection shall cover all the cables in the trench (single cable or multiple cables, in horizontal formation). In case of a single cable, the brick protection shall consist of one brick flat (with the length along the width of the trench) and supported on two lines of brick 'OFF' edge, one on each side of the cable (with the length of the bricks along the length of the trench).

For multiple cables in horizontal formation, in addition to the two outer lines of brick-on-edge, there shall be additional lines in between adjacent cables. The top cover of brick flat shall extend to cover all the cables each brick being supported on the lines of brick-on-edge.

11.7. BACK FILLING OF TRENCH

After laying of cables the remaining portion of the trench shall be back filled with good excavated soil and well rammed in successive layers not exceeding 300mm depth each and duly compacted to the satisfaction of the Consultant / Engineer-in-Charge. Surplus soild of excavation shall be removed or disposed of as per direction of the Consultant / Engineer-in-Charge.

11.8. All material like sand, brick and clamp, etc. shall be supplied by the contractor. The cable laying rate shall be inclusive of all these items.

12.0. CABLES LAID THROUGH PIPE SLEEVES

12.1. Entry of cable from underground trenches to the building or tunnel shall be through pipe sleeves. Necessary precaution shall be taken to make entry point fully water tight by properly sealing the pipe sleeves in a manner approved by the Consultant / Engineer-in-Charge.

12.2. Where cables are required to cross roads, railway tracks and surface drains, they shall be taken through pipe sleeves at a minimum depth of 1000 mm.

13.0. LAYING OF CABLES ON RACK / TRAY / BRACKET / HOOKS / MASONRY TRENCH

13.1. Where cables are required to be laid directly along structure walkway, walls, ceiling, they shall generally be taken exposed on brackets, cable racks, trays, hooks laid along building structure. Spacing of saddles / hooks shall be such that the cables are straight and shall not exceed 750 mm.

13.2. The cable rack / trays shall be ladder type / pre-fabricated perforated type and bends / curvature shall be smooth and suitable for bending the largest cable running in the rack / tray. The cable rack / trays shall be suitably installed on the building structure with proper support at regular intervals.

13.3. Cable rack / trays shall be so arranged that they do not obstruct or impair clearance of passage way.

13.4. Where there is possibility of mechanical damage cable racks / trays shall be adequately protected by sheet steel cover.

13.5. Unless otherwise specified in the schedule of quantities the rack / trays shall be painted with corrosion resistant paint and finished with enamel paint of shade battleship grey or any other colour shade acceptable to Consultant / Engineer-in-Charge.

14.0. CABLE ROUTE MARKER

14.1. Cable route markers shall be provided at each joint, entry to buildings, each turn, either side of the road crossings and at 30 meter intervals for straight cable runs and at location directed by the Consultant / Engineer-in-Charge.

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14.2. The cable marker shall be of cement concrete slab of R.C.C. type (1:2:4) and of size 600mm x 300mm at the bottom and 500mm x 200mm at the top with a thickness of 100mm with marking CABLE and shall be laid flat at finished ground level centered over the cables for easy identification.

14.3. Unless otherwise specified in the schedule of quantities galvanised iron type cable route marker of size 100mm dia 50mm thick G.I. Plate with marking 'CABLE' thereon welded to 35mm x 35mm x 6mm angle iron 600mm long fixed in a rigid manner may also be used as approved by the Consultant / Engineer-in-Charge.

14.4. All materials like cable route marker, sand and cement etc. for fixing the same be supplied by the contractor. The cable laying rate shall be inclusive of all these items.

15.0. CABLES TERMINATION

15.1. Power cable termination shall be carried out in such a manner as to avoid strain on the terminals by providing suitable clamp near the terminals. All power cables shall be terminated to the switch fuse terminals, busbars, etc. by means of suitable sizes crimping type or soldering type cable socket / lugs / ferrules and empire tape upto palm of the cable lug. PVC tape shall not be used directly, because of its poor thermal stability. It may however, be used over the empire tape. Control cables shall be terminated by crimping or directly clamped in the terminal blocks by screws.

15.2. When pinching the smaller size conductor directly in the terminal bore of the switches, the individual strands shall be fanned out and cleaned by wire wool or emery paper and the cleaned surface shall be coated with a thin layer of oxide inhibiting grease. The conductor shall be tightened fully to the terminal bore buf over tightening shall be avoided.

15.3. For connection to busbars and other terminals brass or cadmium plated / nuts / bolts and washers shall be used. Copper cables shall never be terminated directly on aluminium busbar. Suitable measure shall be taken to avoid heating due to bimetallic contacts.

15.4. A selection chart of crimping type cable lugs for various combination of cables / busbar / fuse switch terminals is shown below :

	Material of busbar / switch terminals	Material of Cables	Material of crimping lug
a:	Aluminium	Aluminium	Aluminium over tin plated copper
b:	Copper	Aluminium	Aluminium lug with copper plated palm
c:	Silver / tin plated copper	Aluminium	Aluminium or tin plated copper
d:	Aluminium	Copper	Tin plated copper
e:	Copper	Copper	Copper or tin plated copper

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16.0. EARTHING

All non current carrying metallic part of varioud electrical equipment as well as cable armouring, metallic conduit, cable racks / trays, brackets, supporting structures, etc. shall be effectively earthed by not less than two separate and distinct earth connection in accordance with Indian Electricity Rules, and the relevant Indian Code of Practice for earthing 3043 1987.

16.1. EARTH ELECTRODE

16.1.1. PIPE ELECTRODE

The earth electrode for earthing station shall comprise G.I. pipe 'B' Class of 50mm internal diameter and 3 mtr. long in one single piece with holes 12mm dia on all sides at 150mm centre, upto a minimum height of 2.5 metre from bottom. Removable caps / wire mesh funnel shall be provided at the top of pipe to facilitate pouring of water. Suitable clamps made of 40mm x 6mm galvanised M.S. flats complete with bolt and nut shall be provided with the electrodes at 100mm from the top end for connecting earth conductor. No joints will be allowed in the earth electrode. The electrode shall be driven at least 2 metre clear from masonry structure and the distance between two electrode shall be not less than 2 metre when installed in parallel and preferably placed twice the length of the electrode i.e. 6 metre. A masonry inspection pit of size 600mm x 600mm x 450mm deep (unless otherwise stated) shall be built with 125 mm thick cement mortar (6:1) brick work both inside and outside plastered 20mm thick and neatly cemented 1.5 mm thick, inside top and outside around the top of the earth pit, so that the top of the G.I. pipe is 250mm below the finished ground level and the opening
on top shall be provided with C.I. manhole ring having lockable C.I. cover fixed & flush with the outside finished ground level.

16.1.2. PLATE ELECTRODE

Where plate electrode for earthing is to be employed, the size of the plate shall not be less than 600 mm x 600mm x 6.3mm for G.I. plate in thickness and 600mm x 600mm x 3.15mm thickness in case of copper plate.

The plate shall have a drilled hole 14mm dia. at the centre. The G.I. flat of not less than 30mm x 6mm (1 No. 25mm x 6mm G.I. flat for lighting conductor installation) should be connected to the plate by means of a 63 mm long 12mm dia galv. Bolt, double nuts using double galv. Washers. In case of copper plate, copper flat of not less than 32mm x 6.0 mm shall be used as the earth lead. The flat shall first be fastened on one side of the plate, leaving adequate length of flat, which shall be taken over to the other side i.e. to the earth busbar, switch board, pole, continuous earth wire for G.H. line, service bracket, lighting arrestor or the object to be earthed and be fastened as per the details of IS:3043-1987. No joint on the earth lead conductor is permitted. Every care be taken to ensure that the ends of the wire/flats have been securely clamped by the bolt on cleaned surface of the plate and established a good electrical contact.

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The plate shall be buried vertically at a minimum of 6.0 M below the ground level for sandy soil and 2.0 m below the ground level for normal soil. In order to place the same at the prescribed depth, the dimension of pit to be excavated shall be 900mm x 900mm 3000mm deep. The G.I. plate shall be placed in position by the contractor only after the inspection of excavated pit and approval is obtained from the Consultant /Engineer-in-Charge.

After placing the plate the earth lead conductor shall be protected by means of a continuous length of G.I. pipe (Class B) having 50mm dia (minimum) bore or route depending upon the size of the lead, right from plate upto a height of 600mm metre (2 ft.) above ground level. The whole length of pipe shall be fill with bituminous compound of approved make and brand. The molten compound shall be poured from the top end of the pipe and topped upto over flowing.

A masonry inspection pit for the earth station of size approximately 600mm x 600mm x 450mm depth (unless otherwise stated) shall be built with 125 mm thick cement morter (6:1) brick work with 1st class bricks, both inside and outside plastered 20mm thick and neatly cemented 1.5mm thick, inside, top and outside around the top of the earth pit. The opening on top shall be provided with C.I. manhole ring having lockable C.I. cover fixed and flush with the outside finished ground level.

Electrodes shall be buried at least 2 metre away from masonry structure / building / pole or object to be earthed. However,

earthing electrodes for L.T. installations should be as close to the down conductors as possible. Electrodes when installed in parallel, shall not be placed less than 2 metre apart and preferably placed at distance greater than 6 metres.

All the excavations shall be duly back filled dressed and rammed.

16.2. EARTH BUSBAR

16.2.1. GALVANISED M.S. FLAT

Unless otherwise specified in the schedule of quantities the earth busbars shall be of heavily galvanised M.S. Flat of cross section 40mm x 6mm having adequate number of drilled holes with 10mm galvanised steel bolts, nuts, plain and spring washers for securely connected the earth leads and the continuity conductor. The busbar shall be fixed on wall, having clearance of 6mm from wall with spacing insulators with at least the numbers 13mm G.I. rag bolts spaced about 500mm apart.

16.2.2. COPPER FLATS

To be used, as specified in the schedule of items, where earthing requirements are more stringent Brass bolts, nuts, washers shall be used for connections.

17.0. EARTH LEAD CONDUCTORS

17.1. The earth lead for each electrode shall be 7/14 SWG standed G.I. wire connected securely to the earth electrode and earth busbar. The earth lead shall be mechanically protected with a continuous length 20mm dia G.I. Pipe (Class 'B') right from the electrode to the earth busbar and the pipe shall be filled with bituminous compound.

17.2. Galvanised M.S. Flat earth conductor directly buried in ground shall generally be taken at a depth of 600mm and shall be provided with one coat of bituminized paint, one layer of half lapped bituminised tape and a final coat of bituminised paint to prevent corrosion.

17.3. The earth conductor when laid inside building / sub-station shall be taken either exposed on cable racks / trays, walls, ceiling, etc. or embedded in concrete depending on installation. Galvanised M.S. saddles clamped to M.S. flat spacers with tapped holes shall be used for clamping earth conductor. Flats shall be supported at intervals not exceeding 1000 mm and stranded wires at intervals of 300mm.

17.4. Connection of earthing leads to earth electrodes and termination of flat earth continuity conductor to equipment shall be made by means of bolting. Connection of stranded earth wire to earth bus as well as to equipment shall be made through crimping type lugs and bolting. Jointing and tapping of flat earth conductor shall be done by means of welding.

17.5. The earth resistance from any point of the earthing system shall not be more than one ohm.

18.0. WORKMANSHIP AND INSTALLATION WORK

18.1. The workmanship shall be of good commercial quality and all supply material and installation work shall be completed to the full satisfaction of the Consultant / Engineer-in-Charge.

19.0. CONTRACTORS RATE TO INCLUDE

19.1. Apart from other factors mentioned elsewhere in this contract, the rates for the above shall include the following :

i. All labour materials, tools and construction equipment required for proper execution of job.

ii. Scaffolding including erection and removal.

iii. Making good of all damaged civil work if any.

iv. Necessary modifications in prelaid conduits for drawing cables through it and making good all damages.

20.0. METHOD OF MEASUREMENT

20.1. All stove enamelled black M.S. conduit, G.I. conduit / pipe and rigid PVC Conduit shall be measured for neat length as laid or fixed over all fittings. Bends, elbows, tees, etc. shall not be paid separately.

20.2. Installed cable measurement will be based on length from gland to gland with an allowance of 300mm for cable entering switch boards.

20.3. Unless otherwise mentioned in the Schedule of Quantities, measurement will be on neat quantities of work produced. In the event of any dispute with regard to the measurement of work executed, the decision of the Consultant / Engineer-in-Charge shall be final and binding to the Contractor.