SPECIAL CONDITIONS OF CONTRACT – ELECTRICAL & L.V WORK

1. **SCOPE OF WORK** :

The scope of work to be carried out under this contract comprises of the supply, installation, testing and commissioning of Electrical work complete as listed out in Schedule of Quantities. The general character and scope of work to be carried out under this contract is presented in drawings and specifications. The contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with direction of and to the satisfaction of the Owner and Consultant/ Architect. The contractor shall furnish labour, materials, equipment, transportation and incidentals necessary for the completion of work as described in the Tender Documents.

2. **FEES AND PERMITS** :

The Contractor shall obtain all permits/licences and pay for any and all fees required for the installation, inspection and the commissioning of the work.

3. **DRAWINGS** :

The Drawings prepared by the consultants are indicative only of the general arrangement of the installation work. The Contractor shall follow these drawings and specifications in preparing his shop drawings and subsequent installation. He shall check the drawings of other trades to verify space for his installation.

Shop drawings shall be provided of the Main and Sub-Main Switchboards, Distribution Boards, Cable Trays, Reactive Power Compensation Panel, and any other switchboards and panels

, wherever applicable and approval shall be obtained from the Consultant / Developer before commencing fabrication or procurement.

Any equipment or switchboard manufactured without the written consent of the Consultant / Developer prior to the approval drawings shall be liable for rejection.

Drawings show general run of cables, approximate locations of outlets and equipment, utility symbols and schematic diagrams of no dimensional significance. Refer to the Architectural drawings for locations and also obtain approval from the Consultant / Developer wherever dimensions are not shown, or locations cannot be determined from the drawings. Do not scale drawings to obtain locations

4. **MEASUREMENTS OF WORK** :

Payment for Conduiting, cables, earth strips and wires etc. will be made on linear measurements and will be measured upto and including the bends.

5. **TESTING** :

On completion of the installation the testing will be done in conformity with the stipulated performance specifications. Any shortcoming detected in the system/ materials/ workmanship shall be rectified by the contractor to the entire satisfaction of the consultant without any extra cost to the owner. The installation shall be tested again after removal of the defects and shall be commissioned only after approval by the competent inspecting authority and the Consultant/Owner.

The Contractor shall notify the Consultant at least 7 working days before testing of each system. The Consultant reserves the right to be present when such tests are being made.

If the Electrical Inspectorate requires manufacturer's test reports for any equipment used in the project, the Contractor shall obtain such approvals at no extra cost to the client. Such approved reports shall be handed over to the Consultant / client.

Calibration certificates shall be obtained from the Meter and Relay Testing Department of the Electricity Board for all relays and meters used in the project at no extra cost to the client

6. **COMPLETION CERTIFICATE** :

On completion of the installation a certificate in an approved form shall be furnished by the contractor. The contractor shall be responsible for getting the entire installation duly approved by the Electrical Inspector or other concerned authorities, if any, and shall bear all expenses in connection with the same.

7. SCOPE OF WORK

The scope of work to be carried out under this contract briefly comprises of :

a) **INTERNAL & EXTERNAL WORK** : Supply, Installation, connecting, testing and commissioning of the following :

i) Conduiting and wiring for all light points, Ceiling fans, Exhaust fans, Light & power socket outlets, three phase outlets and equipment wiring.

ii) Complete earthing system

iii) All External & Security lighting.

iv) Conduiting and wiring for Telephone system.

v) Conduiting for Computer system.
vi) All Fire Alarm System.
vii) All Public address system
viii) All Cables, Mains & Sub-Mains
ix) All Final Distribution Boards.
ix) Supply & Installation of all electrical panels

b) Receiving at owners stores, storing, handling, fixing in position, connecting testing & commissioning of following owner supplied materials as listed in appendix – II

c) The contractor shall carry out and complete the work under this contract in every respect in confirming with the current rules and regulations of the local Electricity Authority, stipulations of the Indian Standard Institution, and with the directions of and to the satisfaction of the owner. The contractor shall furnish all labour, material, appliances, equipment, transportation and incidentals necessary for providing, installing, testing and commissioning of the whole electrical installation as specified herein and shown as drawings.

This also includes any materials, appliances, equipment and incidential work not specifically mentioned herein or noted on the drawings/documents as being furnished or installed but which are customary to make the installation in working order. The work shall include all incidentals and jobs connected with Electrical installation such as earthing work and cutting chases/holes and making good the same and grouting and equipment.

On completion of the work and before issuing of virtual completion certificate the contractor shall submit to owner "As installed drawings" showing all the details of work done by him.

The contractor shall have a valid contracting licence before starting the work and till the completion of work.

All Civil works in connection with the Electrical Installation including supply, laying and fixing of necessary inserts, hooks, brackets and sleeves etc

8. OWNER SUPPLY MATERIALS

The Owner shall be procuring some equipment and materials for incorporating in this project as listed in the Appendix – II. The contractor shall take the delivery of these materials/equipment from owners store and install them at site and commissioning the same in good condition.

The contractor shall keep the inventory of the materials received and used at site. The surplus or unused materials/equipment shall be returned to Owner's store in good condition. If the contractor fails to give the accounting of materials/equipment, panel

recovery at the rate mentioned in Appendix – II will be done from the contractors bill after allowing wastage allowance.

TECHNICAL SPECIFICATION

1 SPECIFICATIONS FOR INTERNAL WIRING

1.1. SYSTEM OF WIRING:

The system of wiring shall consist of single/multi core FRLS PVC insulated copper conductor wires in non-metallic PVC conduits/ metallic M.S. conduits as called for in the BOQ. All conduits shall be on the surface,(supported from the Ceiling), in the False Ceiling and concealed in other areas where RCC slab is provided unless otherwise called for in the drawings. All Down conduits shall be concealed unless otherwise called for.

1.2. GENERAL

Prior to laying of conduits, the Contractor shall get approved the conduit layout indicating the route of conduit, number and size of conduits, location of junction/ inspection/pull boxes, size and location of switch boxes, point outlet boxes and other details. These conduit layouts shall be got approved by the Consultant and then only conduit layout should be started. Any modification or suggestions shall be approved by the Consultant before the laying of conduits.

1.3. MATERIALS:

M.S. conduits shall conform to Indian Standards IS : 1653 - 1964 -Specification for Rigid Steel conduits for Electrical wiring with the latest amendments.

M.S. CONDUITS:

M.S. conduits shall be solid drawn or lap welded conduits. Stove enameled inside and outside with minimum wall thickness of 1.6 mm for conduits upto 25 mm diameter and 2.0 mm wall thickness for conduits 32 mm diameter and above.

PVC conduits to be used for concealed work for all systems except Fire Alarm & Computer system where M.S. conduits shall be used. PVC conduits shall conform to Indian Standards IS : 9537(Part-3)-1983 -Specification for conduits for Electrical Installation (Part-I) General Requirements.

PVC CONDUITS:

PVC conduits shall be rigid, unplasticised, heavy gauge having 1.6 mm wall thickness upto 25 mm diameter and 2.0 mm wall thickness for all sizes above 25 mm diameter. Minimum size of conduit shall be 20 mm dia. Minimum size of conduit for Power point wiring shall be 25 mm dia. The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer. The number of insulated copper wires that may be drawn into the conduits of various

sizes are given below and the fill shall not exceed 40% the maximum permissible number of 650/1100 volts grade single/multi core PVC insulated copper conductor wires of different sizes, that may be drawn into rigid metallic or non-metallic conduits.

SIZE OF WIRE	**SIZE OF CONDUITS (MM)**				
Nominal cross-Sectional area of wires in sq. mm	20	25	32	40	50 nominal dia in mm
	(Maximum number of wires)				
1.5	5	6	18	-	-
2.5	3	4	10	-	-
4.0	2	3	5	10	-
6.0	-	4	6	8	-
10.0	-	-	3	4	-
16.0	-	-	-	3	5
25.0	-	-	-	2	3

1.4 PVC CONDUIT ACCESSORIES & CONNECTIONS:

The accessories used for PVC conduits shall conform to Indian Standards IS : 3419-1988-(Specification for fittings for non-metallic conduits).PVC conduits shall be joined by means of screwed or plain couplers. Where there are long runs of straight conduits, inspection boxes shall be provided at intervals as approved by the consultant. The threads of the pipe and sockets shall be free from grease and oil. It shall be thoroughly cleaned before making the screwed/plain joints. Proper jointing materials as recommended by manufacturers shall be used for jointing of PVC pipes. Use PVC couplers and connectors for PVC pipe connections and terminations in boxes. All the joints shall be fully water tight. Junction boxes and running joints shall be provided at suitable places to allow for subsequent extensions if any, without undue dismantling of conduit system. As far as possible diagonal run of conduits shall be avoided. Junction between conduit and adapter boxes, back outlet boxes, switch boxes and the like must be provided with entry spouts and smooth PVC bushes. Joints between conduit and iron clad Distribution Boards or control gear shall be effected by means of conduit couplers into each of which will be coupled smooth PVC bush from the inside of box or case. Conduit system shall be erect and straight as far as possible. All jointing methods shall be subject to the approval of the consultant.

BENDS IN CONDUITS:

Where necessary bends or diversions may be achieved by means of bends and or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly

secured and flush with the finished wall surface, so that the conductors inside the conduits are easily accessible. No bend shall have a radius of less than 2.5 times the outside diameter of the conduit. Conduits shall be cold bend by means of a Bending spring available with the manufacturers. In case it is not available then Heat may be used to soften the PVC conduits, by filling sand in the pipe. Use of PVC conduit in places where ambient temperature is 60 degrees or above is prohibited. PVC Solvent shall be used for joints between conduits, conduits & Junction box etc. PVC checknuts and bushes shall be used for joining conduit with outlet boxes. PVC Closures shall be provided on unused mouths of Junction boxes.

Separate conduits shall be provided for the following system.

i) Lights, Ceiling fans, Exhaust fans & 5A Light sockets.
ii) Power sockets & A/C outlets
iii) Telephone System
iv) Television, Computer & Music system
v) Emergency System.
vi) Public Address System
vii) Fire Alarm System.

Separate switchboards/outlets shall be provided for the following system.

i) Lights, Ceiling fans, Exhaust fans & 5A Light sockets.
ii) Power sockets & A/C outlets
iii) Telephone System
iv) Television, Computer & Music system
v) Emergency System.
vi) Public Address System
vii) Fire Alarm system .

1.5 FIXING CONDUITS:

Conduits and junction boxes shall be kept in position and proper holdfasts shall be provided. Conduits shall be so arranged as to facilitate easy drawing of wires through them. Adequate junction boxes of approved shape and size shall be provided. All conduits shall be installed so as to avoid steam and hot water pipes. After the conduits, junction boxes, outlet boxes & switch boxes are installed in position their outlets shall be properly plugged so that water, mortar, insects or any other foreign matter does not enter into the conduit system. Exposed conduits shall be fixed by means of spacer bar/ saddles at intervals of not more than 600 mm in normal run and 500 mm from both sides of fitting or accessories. The saddles shall be of 3 mm x 19 mm mild steel flat, properly treated with primer and painted, securely fixed to support by means of nuts and bolts/rawl bolts and MS screws as required.

Conduits shall be laid in a neat and organised manner as directed and approved by the Consultant. Conduit runs shall be planned so as not to conflict with any other service pipe lines/ducts.

Where exposed conduits are suspended from the structure they shall be clamped firmly and rigidly to hangers of design to be approved by the Architect. Where hangers are to be anchored to reinforced concrete appropriate inserts and necessary devices for their fixing shall be provided at the time of fixing. Making holes or openings in the concrete will generally not be allowed. In case it is unavoidable prior permission of the Consultant shall be obtained. Conduits shall be fixed in the chase by means of staples not more than 600 mm apart and the chase filled with cement mortar 1 : 4 . Cutting of horizontal chases in walls is prohibited.

1.6. PROTECTION

To minimize condensation or sweating inside the conduit pipes all outlets of conduit system shall be adequately ventilated as directed and approved by the Consultant. All screwed and socketed connections shall be adequately made fully water tight by the use of proper jointing materials i.e. Tropolin for PVC conduits & white lead for metal conduits.

1.7. SWITCH-OUTLET BOXES AND JUNCTION BOXES

All boxes shall conform to Indian Standards IS : 5133(Part-1)-1969 (Specification for boxes for enclosure of Electrical accessories) with the latest amendments. All outlet boxes for switches, sockets & other receptacles shall be fabricated from 1.6mm thick mild steel sheets duly painted with rust proof paint (zinc passivated) as called for, having smooth external & internal surfaces to true finish. Junction boxes and outlet boxes in contact with earth or installed in areas exposed to the weather shall be of 2mm thick mild steel and painted. Where called for, outlet boxes for receiving switches, telephone outlets T.V. outlets, power plugs etc. shall be fabricated to proved shape and size to suit the cover plates of approved make for different utilities. The cover plates shall be of best quality Hylam sheets or ISI grade Urea Formaldehyde Thermosetting insulating material which shall be both mechanically strong and fire retardant, as approved by the Consultant. Proper supports shall be provided in the outlet boxes to fix the cover plates of switches as required. Separate screwed earth terminal shall be provided inside the box for earthing purpose. All boxes shall have adequate number of knockout holes of required diameter for conduit entry. Where called for outlet boxes for receiving switches and fan regulators in one box, shall be fabricated to approved shape and size to accommodate fan regulators and switches to be fixed on grid plates. These boxes shall be covered with Hylam sheets or ISI grade Urea Formaldehyde Thermosetting insulating material which shall be both mechanically strong and fire retardant. All junction boxes, pull boxes and outlet boxes shall be provided with sheet cover Urea Formaldehyde Thermosetting insulating material. The box cover shall be secured to the box with adequate number of round head brass screws of approved

make. Outlets exposed to the weather shall be fully weather tight, complete with rubber gasketed covers, glass where used shall be fully heat resistant for the duty. The outlet boxes shall be painted with two coats of bitumastic paint before they are fixed in position. All Outlet boxes fixed in concrete/recessed in wall shall be of a minimum depth of 55mm.

1.8. INSPECTION BOXES

Rust proof (Zinc passivated) inspection boxes of 1.6mm thick mild steel sheet and of required size, having smooth external and internal finish shall be provided to permit periodical inspection and to facilitate removal and replacement of wires when required. Inspection boxes shall be mounted flush with ceiling/walls finished surface and shall be provided with screwed covers of Urea Formaldehyde Thermosetting insulating material sheet cover secured to the box with brass screws. Adequate holes shall be provided for ventilation in the inspection box covers.

1.9. TELEPHONE SYSTEM

Conduits, junction boxes, draw boxes, outlet boxes and covers to boxes for telephone system shall be as described under relevant clauses elsewhere in these specifications. Conduits for telephone system shall be at least 150 mm away from the electrical conduits. The conduits for telephone wiring shall be of specified size and shall be terminated at outlets as indicated on the drawings. Telephone system conduits shall have 2 mm diameter galvanized steel pull wires installed. Necessary Junction boxes to be provided for easy drawing of the Telephone wires from each unit to the Telephone Tag Box and from the Tag Box to the open ground.

1.10. T.V. & COMPUTER SYSTEM

Conduits junction boxes, draw boxes, outlet boxes and covers to boxes for T.V. & Computer system shall be as described under relevant clauses elsewhere in these specifications. Conduits for T.V. & Computer system shall be at least 150mm away from the electrical conduits. The conduits for T.V. & Computer wiring shall be of specified size and shall be terminated at outlets as indicated on the drawings. T.V. & Computer system conduits shall have 2mm diameter galvanized steel pull wires installed. Necessary Junction boxes to be provided for easy drawing of the Television & Computer wires from each unit to the Junction Box and from the Junction Box to the open ground.
On the completion of the work the Contractor shall submit to the Owner layout Drawings indicating the complete Electrical Installation as installed . These Drawings shall in particular give the following information.

i. Run and size of conduit, location of inspection/outlet boxes etc.
ii. Number and size of wires in each conduit.

iii. Location of switches, outlets, all types of DBs, Telephone, Television ,Computer, Call Bell & Public Address points, Light sockets, Power sockets, Fire Alarm points, etc. .
iv. Layout and particulars of mains and sub-mains and cable route etc.
v. Schematic diagrams for the complete Electrical System.
vi. Layout of Complete Earthing System with size of Earthing conductors.
vii. Layout and particulars of the Telephone, Public Address, Television, Computer.

1.11. CONDUCTORS

PVC insulated multistrand copper conductor wires of 1100 Volts grade shall be used for three phase distribution and PVC insulated multistrand copper conductor wires of 1100 V grade shall also be used for Single phase distribution and shall conform to IS : 694 - 1964 with the latest amendments and shall be ISI marked.

1.12. BUNCHING OF WIRES

Wires carrying current shall be so bunched in the conduit that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

1.13. DRAWING OF CONDUCTORS

The drawing and jointing of copper conductor wires shall be executed with due regard to the following precautions, while drawing insulated wires into the conduits. Care shall be taken to avoid scratches and kinks which cause breakage of conductors. There shall be no sharp bends.
Insulation shall be shaved off for a length of 15mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or ringing.
PVC insulated copper conductor wire ends before connection shall be properly soldered (at least 15mm length) with special Cu solder for copper conductor or shall be properly crimped with copper lugs/sockets as the case may be. Strands of wires shall not be out for connecting to the terminals. All strands of wires shall be soldered at the end before connection. The connecting brass-screws shall have flat ends. All looped joints shall be soldered and connected through terminal block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors having nominal cross sectional area exceeding 6 Sq mm shall always be provided with cable sockets.
At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used. Brass nuts and bolts shall be used for all connections.

Only certified wiremen and cable jointers shall be employed to do jointing work. All wire shall bear the manufacturer's label and the voltage grade at one meter intervals for the full length of coil, and shall be brought to site in new and original packages.

The sub-circuit wiring for points shall be carried out in looping system and no joint shall be allowed in the length of the conductors. No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Before the wires are drawn into the conduits the conduits shall be thoroughly cleared of moisture, dust, and dirt or any other obstruction by Drawing dry cloth through the conduits. The minimum size of PVC insulated stranded copper conductor wire for all sub circuit wiring for lights, exhaust fans, ceiling fan and 5A Light sockets points shall be 1.5 Sq mm. In case of power circuit not more than two 15 Amp power outlets shall be grouped in one circuit, wiring for the first power outlet shall be carried out with PVC insulated 6.0 sq mm copper conductor wires. Wiring for the second power outlet shall be carried with PVC insulated 4.0 sq mm copper conductor wires. All power outlets shall be connected with 4.0 sq mm PVC insulated copper conductor wires to the earth terminal of outlet. Separate circuit shall run with PVC insulated 4.0 sq mm copper conductor wires for water heaters, kitchen equipment, window Air conditioners and similar outlets at locations as shown on drawings.

The minimum size of wire from final distribution board to first tapping point in the circuit shall be 2.5 Sq mm. PVC insulated stranded copper conductor wires. Circuit shall not have more than a total of 8 points of fans, 5A Light sockets and Light points and its load shall not exceed 800 watts. Not more than two power circuits shall be drawn through the same conduit. Separate earth wire shall run for each circuit. In case two circuits of the same phase are running in the same conduit then a common earth wire is permissible. The size of earth wire for all the light points, ceiling fans, exhaust fans , light sockets, outlet boxes etc. shall be 1.5 sq mm PVC insulated copper conductor wires.

1.14. JOINTS

All joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joints shall be made inside conduits and junction boxes. Conductors shall be continuous from outlet to outlet. Joints where unavoidable, due to any specified reasons, prior permission in writing shall be obtained from the Consultant before making such connections.

1.15. MAINS AND SUB-MAINS

Mains and sub-mains wires where called for shall be of the rated capacity and approved make. Every main and sub-main shall be drawn into an independent adequate size conduit. Adequate size draw boxes shall be provided at convenient locations to facilitate easy drawing of the mains and sub-mains. An independent earth wire of proper rating shall be provided. The earth wires shall run along the entire length of the mains and sub-mains. The earth wires shall be fixed to conduits by means of suitable copper clips at not more than 1000mm distance. Where mains and sub-main cables are

connected to switch gears, sufficient extra length of sub-main and main cable shall be provided to facilitate easy connections and maintenance.

1.16. LOAD BALANCING

Balancing of circuits in three phase installation shall be planned before the commencement of wiring, shall be got approved by the Consultant and shall be strictly adhered to.

1.17. COLOUR CODE OF CONDUCTORS

Colour code shall be maintained for the entire wiring installation; red, yellow, blue for three phases and "off" circuit black for neutral and green for earth (or bare earth wire)

Telephone Multicore cables shall be of approved make and shall conform to following specifications.

i) Type of conductor ….. Electrolytic Annealed Tinned Cu conductor. (ATC)
ii) Diameter of Conductor ... 0.61 mm dia uniform (minimum size)
iii) Weight of conductor .... 2.52 Kg/Km minimum. iv) Resistance of conductor at 20 degree... 60 Ohms/Km, v) Radial Thickness of PVC insulation...0.3mm $\pm$ 0.05mm uniform
vi) Radious Thickness of PVC sheathing ... 1.2mm uniform $\pm$ 0.2mm
vii) Overall diameter of insulated conductor.. 1.2mm uniform
viii) High voltage Test. Able to withstand upto 500 volts D.C. up to 12 hours immersion in water.

1.18. MOUNTING HEIGHT DETAILS

1.18.1 The bottom of the light/fan switch board shall be at 1.0 meter above the finished floor level unless otherwise specified.

1.18.2 All plugs and socket outlets shall be of 5/6 pin type and the appropriate pin of socket shall be connected to the earthing system.

1.18.3 In case of light and fan circuit only 5 pin 5A socket outlets shall be used. 6 pin 15A socket outlets shall be provided only on power circuits. The switch controlling the socket outlet shall be adjacent to it. 6 pin 15 A socket outlets shall be located at the levels as indicated below unless otherwise specified.

a In Kitchen at 300 mm above kitchen platform or FFL as per the location shown on the drawings.

b In the bathroom at 1800 mm above FFL but Mirror lights shall be above Mirror of wash basin.

c In all other rooms at 150 mm above FFL unless otherwise specified.

1.18.4 All Bracket light fittings ,unless otherwise specified shall be at a height of 2.1 meters above the floor level unless otherwise specified for some locations.

1.18.5 Unless otherwise specified, the ceiling fans shall be hung at 2.75 meters above the finished floor level.

1.18.6 Lamp holders in bath rooms are to be shrouded with insulating materials and fitted with protective shield.

1.18.7 All live conductors are to be insulated and safe guarded to avoid danger.

1.19 **M.S.CONDUIT ACCESSORIES & CONNECTIONS**:

The accessories used for M.S. conduits shall conform to Indian Standards IS : 3837-1966-(Specification for fittings for Rigid steel conduits with the latest amendments. M.S. conduits shall be joined by means of screwed or plain couplers. Where there are long runs of straight conduits, inspection boxes shall be provided at intervals as approved by the Consultant. The threads of the pipe and sockets shall be free from grease and oil. It shall be thoroughly cleaned before making the screwed/plain joints.

Proper jointing and Cleaning materials as recommended by manufacturers shall be used for jointing and cleaning of M.S. pipes. Use M.S. couplers and connectors for M.S.pipe connections and terminations in boxes. All the joints shall be fully water tight. Junction boxes and running joints shall be provided at suitable places to allow for subsequent extensions if any, without undue dismantling of conduit system. As far as possible diagonal run of conduits shall be avoided. Junction between conduit and adapter boxes, back outlet boxes, switch boxes and the like must be provided with entry spouts and smooth M.S. bushes and M.S. Checknuts. Joints between conduit and iron clad Distribution Boards or control gear shall be effected by means of conduit couplers into each of which will be coupled smooth M.S. bush from the inside of box or case. Conduit system shall be erect and straight as far as possible. All jointing methods shall be subject to the approval of the Consultant.

M.S. CONDUIT CONNECTIONS:

Conduit connections for MS conduits shall be screwed metal to metal and be painted with one coat of self etching zinc chromate primer and two coats of enamel paint. The threads and sockets shall be free from grease and oil. Connections between screwed conduit and sheet metal boxes shall be by means of a brass hexagon smooth bore bush, fixed inside the box. Checknuts to be provided on inside and outside of box and connected through a coupler to the conduit or as directed by the Consultant. The joints in the conduits shall be free of burrs to avoid damage to insulation of conductors while

pulling them through the conduits. Connections between PVC and MS conduits shall be through a junction box. Direct connection between PVC and MS conduits is not allowed.

FAN BOX DETAILS

The Fan Box shall be 100 mm x 100 mm x 75 mm deep, M.S. box made of 2mm thick M.S. sheet, having 12 mm dia M.S. rod, bend at centre to support the fan, top screwed cover etc. as per the approval of the Architect/Consultants.

2 CABLES

2.1. GENERAL

MV Cables shall be supplied, laid tested and commissioned in accordance with drawing specifications, relevant Indian Standards specification, Indian Electricity Act and manufacturers instructions. The cable shall be delivered at site in original drums with manufacturers name clearly written on the drums.

2.2. MATERIAL

MV CABLES : MV Cables shall be PVC insulated aluminium conductor armoured and unarmoured cables conforming to IS: 1554 (part I&II)-1976 & IS : 694-1977 (PVC Insulated cables for working voltages upto and including 1100 volts (second revision) with latest amendments. MV cables shall be suitable for under ground use and laid in trenches, ducts, cable trays, under roads and paved areas. MV Cables shall be termite resistant and shall be of approved make.

2.3. JOINTS IN CABLES

The contractor shall take care to see that all the cables are apportioned to various locations in such a manner as to ensure no straight joints in the cable run. If the straight joint in cable is unavoidable due to any specified reasons, prior permission in writing shall be obtained from the Consultant before the use of such straight joints in cable.

2.4. JOINTING BOXES FOR CABLES

Cable jointing boxes shall be of appropriate size, suitable for PVC insulated cables of particular voltage ratings, and shall be manufactured by approved manufacturers.

2.5. JOINTING OF CABLES

All cable joints shall be made in suitable approved cable joint boxes. Jointing of cables in the joint boxes and the filling in of compound shall be done in accordance with the best practice in trade, in accordance with manufacturer's instructions and in an approved manner. All straight Joints shall be done in epoxy mould boxes with TROPOLIC/ M-Seal resin or approved equal. All terminal ends of conductors shall be heavily soldered upto at least 50mm length.

All cables shall be jointed colour to colour and tested for insulation resistance and continuity before jointing commences. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged.

2.6. FILLING OF EPOXY COMPOUND

Equal quantities of resin and hardner shall be taken and mixed thoroughly by hand until the mixture is free from white patches and has uniform colour. No water, oil or any other liquid shall be added to the mixture to make it soft as this will effect the properties of the compound. The mixture shall be used within 30-40 minutes of mixing. The surface on which epoxy compound is to be used shall be free from dust, rust, oil, grease and shall be dry. No disturbance or movement of joint shall be made till the epoxy compound has completely hardened. A smooth surface can be made by rubbing a damp cloth smoothly on the compound before it sets. The joints shall be painted after it has completely hardened.

2.7. CABLES TERMINATION

Cable termination shall be done in terminal cable box using cable glands and the cable ends sealed with sealing compound.

2.8. BONDING OF CABLES

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armoured clamps and gland. The clamps must grip the armouring firmly to the gland or casing, so that in the event of ground movement no undue stress is passed on to the cable conductors. The glands shall be either to the lead sheath by means of 'Plumbing Joint' as on a cone of approved materials, capable of being compressed into lead sheath. The gland or cone shall be capable of effecting a good electrical bond between both the armouring and lead of the cable and the casing.

2.9. LAYING OF CABLES

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cable to avoid forming kinks. The drums shall be unrolled and cables run over wooden rollers in trenches at intervals not exceeding 2 meters. Cables shall be laid at depth of 750mm depth below ground level in the case of MV Cables. A cushion of sand, not less than 75mm shall be provided both above and below the cable, joint boxes and other accessories. HV and MV cables shall not be laid in the same trench and/or along side of water main. The cable shall be laid in excavated trench 80mm layer of sand shall be spread over the cable. The cable then shall be lifted and placed over the sand bed. The second layer of 80mm sand then be spread over the cable. The relative position of the cables laid in the same trench shall be preserved and the cables shall not cross each other as far as possible. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius of bend not less than 12 times the diameter of cable. Minimum 3 M long loop shall be provided at both sides of every straight joint and 5 Meters at each end of the cable. Distinguishing marks shall be made on the cable ends for identification.

Insulation tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identification. Aluminium Labels etched with the size of cable shall be provided around the two ends of each cable.

2.10. PROTECTION OF CABLES

The cable shall be protected by placing burnt bricks over the cables 600mm wide on the top layer of sand for the full length of underground cable. Where more than one cable is running in the same trench, the bricks shall cover all the cables and shall project a minimum of 80mm on either side of the cable.
Cable under road crossings and any surfaces subjected to heavy traffic, shall be protected by running them through Hume pipes of suitable size and Heavy grade quality.

Cables under paved areas (which form part of the building) shall be protected by running them through Stoneware/Hume pipes of 150 mm dia(minimum size) one meter below road level.

2.11. CABLES INSIDE BUILDINGS

Cables inside buildings shall be laid either in masonry trenches or carried on through trays or brackets. Where cables run in ducts inside the buildings the cables shall be adequately clamped to angle iron brackets, secured to the wall, as directed and approved by the Consultant. Where cables are suspended from ceilings they shall be carried over troughs or trays as directed and approved by the Architect. The supports shall be placed not more than 1.0 meter apart. All cables passing through walls below paved area, and concrete shall run through stone ware pipes or Hume pipes of adequate diameter recessed or exposed as directed. Cables running along walls shall be supported and clamped to saddles, or hanger rigidly anchored at close intervals. Clear space between parallel cables shall be equal to the diameter of the cable but not less than 50mm. Where called for cable trenches shall be filled with fine sand. The contractor shall ensure that hangers, brackets and other supporting arrangements for cables are placed in proper position at the time of building the walls, concreting slabs, etc. cutting holes or opening in concrete may be carried out only with prior permission of the Architect.

All excavations and back fill including timbering, shoring and pumping required for the installation of the cables shall be carried out as per the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layers not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer. The Contractor shall restore all surfaces roadways, side walks, curbs, walls or other works cut by excavation of their original condition, to the satisfaction of Consultant.

2.12. MARKERS AND WARNING PLATES

Approved CI cables markers shall be provided along the route of the cables at every 30 meter distance and at both ends of road crossing, indicating HV cables and MV cables as applicable. Special CI markers shall be provided at all buried cable joints indicating "Electrical Cable Joints. GI plates engraving the size of cable and the place it serves shall be tied to the cable at regular intervals of 2 meters for easily identification of the cables.

2.13. TESTING OF CABLES

Prior to burying of the cables, following tests shall be carried out:

a. Insulation test between phases and phase to earth for each length of cable before and after jointing.

On completion of cable laying work and jointing the following tests shall be conducted in the presence of the Consultants.

a. Insulation Resistance test (Sectional and Overall)
b. Continuity Resistance Test.
c. Sheath continuity Test.
d. Earth Test.
e. Physical Dimensions Test.

All tests shall be carried out in accordance with relevant Indian Standard Codes of practice and Indian Electricity Rules. The contractor shall provide necessary instruments, equipment and labour for conducting the above test and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Architect / Consultant.

3.0 EARTHING

3.1 EARTHING

All the non-current metal parts of electrical installation shall be earthed properly. All metal conduits, trunking, cable sheaths, switchgear, outlet boxes, distribution boards, light fittings, fans and all other parts made of metal or conductive material shall be bonded together and connected by means of specified earthing system.

All earthing will be in conformity with the relevant provision of Rules 33 and 61 of the Indian Electricity Rules 1956 and Indian Standard Specifications IS:3043-1987 with latest amendments.

3.2. EARTHING CONDUCTORS

All earthing conductors shall be of high conductivity electrolytic copper of 99 % purity and shall be protected against mechanical injury or corrosion.

3.3. SIZING OF EARTHING CONDUCTORS

The cross sectional area of copper earthing conductor shall be same as the active conductor for sizes of active copper conductor upto 4.0 sqmm and shall be half the size for 16 sq mm active copper conductor and above. All fixtures, fans, outlet boxes and junction boxes shall be earthed with 1.5 sqmm PVC Insulated copper conductor wires. All power sockets and single phase A/C units shall be earthed with 4.0 PVC Insulated copper conductor wires. All Three phase Final Distribution Boards shall be earthed with 2 nos 4 mm dia bare copper conductor wires. The sizes of the earth continuity conductors should not be less than half of the largest current carrying conductors.

The Sub-Distribution Board shall be earthed to 2 nos 600mm x 600mm x 3mm copper plate earthing stations through 25m x 3 mm copper strips.

3.4. CONNECTION OF EARTHING CONDUCTORS

Main earthing conductors shall be taken from the earth connections at the main switchboards to an earth electrode with which the connection is to be made. Submain earthing conductors shall run from the main switchboard to the sub-distribution boards. Final distribution boards earthing conductors shall run from sub-distribution boards.

3.5. PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures or cables and conductors, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system. The electrical resistance of metallic enclosures for cables and conductors measured between earth connections at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuse or circuit breakers and shall not exceed 1 ohm.

3.6. PROTECTION FROM CORROSION

Connections between copper and galvanised equipment shall be made on vertical face and protected with paint and grease. Galvanised fixing clamps shall not be used for fixing earth conductors. Only copper fixing clamps shall be used for fixing earth conductors. When there is evidence that the soil is aggressive to copper, buried earthing conductors shall be protected by suitable serving and sheathing.

3.7. EARTHING STATION

Plate Electrode Earthing : Earthing electrode shall consist of a tinned copper plate not less than 300mm x 300mm x 3mm thick as called for in the Schedule. The plate electrode shall be buried as far as practicable below permanent moisture level but in any case not less than 4.2 meters below ground level. Wherever possible earth electrodes shall be located as near the water tap, water drain or a down take pipe as possible. Earth electrodes shall not be installed in proximity to a metal fence. It shall be kept clear of the buildings foundations and in no case shall it be nearer than 2 meters from the outer face of the wall. The earth plate shall be set vertically and surrounded with 150mm thick layer of charcoal, dust and salt mixture. 20mm GI pipe shall run from the top edge of the plate to the ground level. The top of the pipe shall be provided with a funnel and a mesh for watering the earth through a pipe. The funnel over the GI Pipe shall be housed in a masonry chamber, approximately 300mm x 300mm x 300mm deep. The masonry chamber shall be provided with a cast iron cover resting over a GI frame embedded in masonry. Refer Sketch for additional details.

Pipe Electrode Earthing: Earthing electrode shall consist of a GI Pipe (class 'A') Indian Tube Company make or approved equal not less than 40mm dia and 4.5 meters long. GI Pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia drilled at 75mm interval upto 2.5 meters length from bottom. The electrode shall be buried vertically in the ground as far as practicable below permanent moisture level with its top not less than 1.25 M below ground level. The electrode shall be in one piece and no joints shall be allowed in the electrode. Wherever possible earth electrodes shall be located as near water tap, water drain or a down take pipe. Earth electrodes shall not be located in proximity to a metal fence. It shall be kept clear of the building foundations and in no case shall be nearer than 2 meters from the outer face of the wall. Refer Sketch for additional details.

The pipe earth electrode shall be kept vertically and surrounded with 150mm thick layer of charcoal dust and salt mixture upto a height of 2.5 meters from the bottom. At the top of the electrode a funnel with a mesh shall be provided for watering the earth. The main earth conductors shall be connected to the electrode just below the funnel, with proper terminal lugs and check nuts. The funnel over the GI pipe and earth connection housed in a masonry chamber, approximately 350mm deep. The masonry chamber shall be provided with a cast iron cover resting over a CI frame embedded in masonry.

3.8. EARTH CONNECTION

All metal clad switches and other equipment carrying single phase current, shall be connected to earth by a single connection. All metal clad switches carrying medium voltage and high voltage shall be connected with earth by two separate and distinct connections. The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI Pipe of adequate size.

Earthing conductors outside the building shall be laid 600mm below the finished ground level. The over lapping in copper strips at joints where required, shall be minimum 75mm. The joints shall be riveted and brazed with copper rivets and greased in approved manner. Sweated lugs of adequate capacity and size shall be used for all termination of wires above 1 Sqmm size and bare copper wire above 2.0mm dia. Lugs shall be bolted to the equipment body after the metal body is cleaned of paint and other oily substance and properly tinned. The earth wires entering the Final Distribution Boards shall be terminated with copper sockets crimped to its ends and tightened to the terminal with the help of flat end brass screws.

3.9. EARTH RESISTANCE

The earth resistivity of the soil where the earthing stations are located shall be submitted to the Consultant before the earthing work starts and get the approval of the Consultant/Owner. If the earth resistance is too high and multiple electrode earthing does/not give adequate low resistance to earth, than the soil resistivity immediately surrounding the earth electrodes shall be reduced by adding sodium chloride, calcium chloride, sodium carbonate, copper sulphate, salt and soft coke or charcoal in suitable proportions as directed by the consultants.

3.10. RESISTANCE TO EARTH

The resistance of each earth system shall not exceed 1.0 ohm in the case of Medium Voltage system and 0.5 ohm in the case of High Voltage system.

4 TESTING

4.1. GENERAL

On completion of the work the entire installation shall be subject to following tests:

a) Wiring Continuity Test
b) Insulation Resistance Test
c) Earth Continuity Test
d) Earth Resistively Test

Besides the above any other test specified by the local Authority shall also be carried out.

All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the Contractor at his own cost.

4.2. TESTING OF WIRING

All wiring systems shall be tested for continuity of circuits, short circuits and earthing after wiring is complete and before energising. The Test Certificates for the complete wiring shall be submitted in the Format and the Total Electrical Installation shall be got approved by the Electrical Inspector.

4.3. INSULATION RESISTANCE TEST

The insulation resistance shall be measured by applying between earth and the whole system of conductors, or any section thereof with all fuses in place and all switches closed (except in concentric wiring) all lamps in position of both poles of the installation , otherwise electrically connected together, a direct current pressure of not less than twice the working pressure(provided that it does not exceed 660 volts for medium voltage circuits) be applied. Where the supply is derived from A.C. three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 divided by the number of points on the circuit provided that the whole installation shall not be required to have an insulation resistance greater than one mega ohm. The insulation resistance shall not be measured between all conductors connected to one phase conductor of the supply and all the conductors connected to the middle wire or to the neutral or to the other phase conductors of the supply. Such a test shall be carried out after removing all metallic connections between the two poles of the installation and in these circumstances the insulation resistance between conductors of installation shall not be less than that specified above.

The insulation resistance between the case of frame work of housing and power appliances, and all live parts of each appliance shall not be less than that specified in the relevant Indian Standard Specifications or where there is no such specification shall not be less than half a mega ohm.

4.4. TESTING OF POLARITY OF NON-LINKED SINGLE POLE SWITCHES

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been fitted in the same conductor through out, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three or four wire installation a test shall be made to verify that every non-linked single Pole switch is fitted in a conductor to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Consultant as well as the local authorities.

4.5. EARTH RESISTIVITY TEST

Earth resistivity test shall be carried out in accordance with Indian Standard code of practice for earthing IS:3043:1987. All tests shall be carried out in the presence of the Consultant/Owner.

4.6 TEST CERTIFICATES

The Electrical Installation shall be tested as per relevant Indian Standards and Test Certificate to this effect shall be submitted to the Owner. The Contractor has to get the Total Electrical Installation approved by the Electrical Inspector and the permission to energise the same shall be submitted to the Owner.

5.0 M V PANELS, SDB's ,CAPACITOR PANELS & FINAL DISTRIBUTION BOARDS

All the Panels and Capacitor Banks shall be suitable for operation on 3 phase, 4 wire, 415 Volts, 50 cycles, neutral grounded at transformer and short circuit level not less than 33 MVA at 415 volts.

The MV Panel shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. All Panels and Distribution Boards shall be fabricated by the contractor by using specified components as per the specifications given below:

5.1. CONSTRUCTION FEATURES

The Panels shall be metal enclosed sheet steel cubical, indoor, dead front, floor mounting type. The distribution boards shall be totally enclosed, completely dust and vermin proof. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. Panels shall be preferably arranged in multitier formation. All doors and covers shall be fully gasketed with foam rubber and/or rubber strips and shall be lockable. All MS sheet steel used in the construction of Panels shall be 2mm thick and shall be cut to different sizes and bolted as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be bolted type and not welded type.

All covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of Panels. A base channel of 75mm x 40mm x 5mm thick shall be provided at the bottom. A minimum of 200 mm between the floor of MV Panel & Distribution board and lower most unit shall be provided. The Panel shall be of adequate size with a provision of 20% spare space to accommodate possible future additional switchgear in addition to spare feeders.

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Knockout holes of appropriate size and number shall be provided in the Panels in conformity with the location of incoming and outgoing cables.

Panels shall be provided with removable sheet steel plates at top and bottom to drill holes for cable entry at site. MV Panel shall be of Extendible type.

The Panels shall be suitable for IP 42 protection.

5.2. CIRCUIT COMPARTMENTS

Each circuit breaker, MCCB and switch fuse units shall be housed in separate compartments and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the ACB/MCCB/switch fuse unit in 'on' and 'off' position. Safety interlocks shall be provided for air circuit breakers to prevent the breaker from being drawn out when the breaker is in 'on' position. The door shall not form an integral part of the draw out position of the ACB. All instruments and indicating lamps shall not be mounted on the ACB compartment door. Sheet steel barriers shall be provided between

the tiers in a vertical section. The Knobs for holding the cubicle door in closed position shall be spring operating rotating type and not screwed type.

5.3. INSTRUMENT ACCOMMODATION

Separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contractors and control devices etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, bus bar and connections.

5.4. BUS BARS & BUS BAR CONNECTION

The bus bar and interconnections shall be of electrolytic Copper of 99.9 % purity of rectangular cross sections suitable for full load current for phase bus bars and full rated current for neutral bus bar and shall be extendible on either side. Minimum 200 Amps capacity bus bars shall be provided in the distribution boards. The bus bars and interconnections shall be insulated with PVC heat shrinking sleeves and colour coded. The bus bars shall be supported on unbreakable, non hygroscopic insulated SMC supports at regular intervals to withstand the forces arising from short circuit in the system. All bus bars shall be provided in a separate chamber and properly ventilated. The current density of copper shall not be more than 1.6 Amps per sq.mm cross sectional area of Bus bar. If Aluminium bus bars are provided the current density of Aluminium shall not be more than 0.8 Amps per sq. mm cross section of Aluminium bus bar.

The bus bar size shall be designed in such a way that the maxim Temperature of bus bar shall not exceed 75 c degree C.

All bus bar connections in Panel and Sub-distribution boards shall be done by drilling holes in bus bars and connecting by cadmium plated M.S. bolts and nuts . 20% Additional cross section of bus bars shall be provided in all distribution boards to cover up the holes drilled in the bus bars. Spring and flat washers shall be used for tightening the bolts.

Automatically operated safety shutters to screen the live cluster when the breaker is withdrawn from cubicle is to be provided.

All connections between bus bars and switches and between switches and cable alley terminals shall be through solid copper strips of proper size to carry full rated current and insulated with PVC heat shrinking sleeves . All the M V Panels and SDBs shall be completely factory wired, ready for connection. All the terminals shall have adequate current rating and size to suit individual feeder requirements. Each feeder shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and feeders shall be distinctly marked with a small description of the service installed. Minimum width of busbar Alley shall be 300 mm and that of cable alley shall be 450 mm.

5.5. TERMINALS

The outgoing terminals and neutral link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformer for instruments

metering shall be mounted on the terminal blocks. Cable compartments shall be provided for incoming and outgoing cables with suitable bus bar extension and supports.

5.6. WIREWAYS

A horizontal wire way with screwed covers shall be provided at the top to take inter-connecting control wiring between different vertical sections.

5.7. CABLE COMPARTMENTS

Cable compartment of adequate size shall be provided in the Sub Distribution Boards for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate proper supports shall be provided in cable compartments to support cables. All incoming and outgoing switch/MCCB's terminals shall be brought out to terminal blocks in the cable compartment.

5.8. METERS

All meters shall be housed in a separate compartment and accessible from front only. Lockable doors shall be provided for the metering compartment. The details of other meters and indicating lamps are as described in each switch board and neutral selector switch of appropriate range and scale. Wiring for meters shall be colour coded and labeled with approved plastic ferrules for easy identification. All meters shall be digital.

5.9. CURRENT TRANSFORMERS

Where ammeters are called for CT's shall be provided for current measuring more than 60 Amps. Each phase shall be provided with separate current transformer of accuracy class I and suitable V.A. Burden for operation of associated metering and Relays. Current transformers shall be in accordance with IS:2705-1964 as amended upto date and Cast Resin Type. Tape wound CTS are not acceptable. The name plate of CT's. Shall be fixed in such a way it can be easily readable without dismantling.

5.10. INDICATING PANEL AND METERING EQUIPMENT

All meters and indicating instruments shall be accordance with relevant Indian Standards. The meters shall be flush mounted and drawout type. Indicating lamps shall be neon type and of low burden. Indicating lamps shall be backed up with fuses of 5 Amps and toggle switch.

5.11.EARTHING

Copper earth bars of 25mm x 3mm shall be provided for all panels for the full length and connected to the frame work of the Panel.

Provision shall be made for connection from this earth bar to the main earthing bar on both side of the Panel.

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5.12. PAINTING

All sheet steel work shall under go a process of degreasing pickling in acid, cold rinsing, phosphating, passivating and then sprayed with a high corrosion resistant primer. The

primer shall be baked in an oven. The finishing treatment shall be by application. Two coats of synthetic enamel paint of approved colour and powder coated. The nine Tank process shall be adopted.

5.13. LABELS

Engraved anodized aluminium labels shall be provided on all incoming and outgoing feeder switches. Circuit diagram showing the control wiring shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet. The Label shall indicate the name of the feeder, the specific area it is feeding, ampere rating and the cable size it is receiving. The Labels shall be provided on the backside of the Panel in case of back access. All the SDBs and Panels shall be subject to tests specified in relevant Indian Standards and test certificate shall be furnished.

5.14. SHOP DRAWING

Before fabricating the Panels the contractor has to submit shop drawing showing the general arrangements, bill of materials and the wiring diagram for all the Panels to the Consultant and get approval from the Consultant.

INSPECTION

At all reasonable times during production and prior to shipment of equipment the contractor shall provide and secure for Consultant/ Owners representative every reasonable access and facility at their plant for inspection.

5.16.TEST CERTIFICATES

Testing of Panels and SDBs shall be carried out at factory and at site as specified in Indian Standards. The test certificates for the tests carried out at factory shall be submitted in duplicate.

5.17 MINIATURE CIRCUIT BREAKER (MCB)

Miniature circuit breaker shall be quick make and break type and confirm with Indian Standards IS : 8828 – 1978 (Specifications for Miniature Air Break Circuit breakers for voltage not exceeding 1000V) The housing of MCB's shall be heat resistant and having a high impact strength. The fault current of MCB's shall not be less than 9000 Amps at 230 volts. The MCB's shall be flush mounted and shall be provided with trip free manual operating mechanism "ON" and "OFF" indications.

The MCB contacts shall be silver nickel and silver graphite alloy coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with magnetic fluid plunger release for over current and short circuit protection. The over load or short circuit devices shall have a common trip bar in the case of DP and TPN Miniature circuit breakers. The MCB shall be tested and certified as per Indian Standards prior to installation.

5.18. MOULDED CASE CIRCUIT BREAKERS(MCCB) : MCCB's shall be in accordance with IS: 2516-1985 & IEC 157-1 with the latest amendments. It shall be enclosed type made of Heat resistant high strength, flame retarding, thermosetting material rated for 500 V, 50 Hz. It shall have three position indicator 'ON', 'OFF' & 'TRIP' at top, bottom & middle position. The minimum breaking capacity of MCCB's shall be 25 KA upto 100 AMPS rating and 35 KA for MCCB's above 100 AMPS rating. All MCCB.s shall have door operating handle (Rotary Operating Handle). The short circuit rating of all MCCB's shall be ICS and not ICU. The short Circuit Current rating has been mentioned in each item in the BOQ.

5.19 LV MCCB(Moulded Case Circuit Breakers)

5.19.1General

Moulded case circuit breakers shall be incorporated in the switch board wherever specified. MCCB shall conform to the latest IEC 60947-Part 1&2 & IS 13947:1993 in all respects.

They shall be of Category A with a rated service breaking capacity (Ics) rating.
MCCBs shall be available in fixed or plug-in/withdrawable versions as well as in 3-pole and 4-pole versions. For plug-in/withdrawable versions, a safety trip shall provide advanced opening to prevent connection and disconnection of a closed circuit breaker.
MCCBs shall be designed for both vertical and horizontal mounting, without any adverse effect on electrical performance. It shall be possible to supply power either from the upstream or downstream side
MCCBs shall provide class II insulation (according to IEC 60664-1 standard) between the front and internal power circuits.
Rated insulation voltage shall be 750V AC (50/60 Hz).
The circuit breaker shall comply with the isolation function requirement of IEC 60947-2 section 7.1.2 to marked as suitable for isolation/disconnection to facilitate safety of operating personnel while the breaker is in use.

All MCCBs required as per BOQ shall have Ics – rating not Icu rating.

Construction
For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries.
The operating mechanism of MCCBs shall be of the quick-make, quick-break type with fault tripping overriding manual operation. All poles shall operate simultaneously for circuit breaker opening, closing and tripping
MCCBs shall be actuated by a toggle or handle that clearly indicates the three positions: ON, OFF and TRIPPED in order to ensure suitability for isolation complying with IEC 60947-2
The operating mechanism shall be designed such that the toggle or handle can only be in OFF position if the power contacts are all actually separated, in OFF position, the toggle or

handle shall indicate the isolation position. Isolation shall be provided by a double break on the main circuit

MCCB shall be equipped with a "push to trip" button in front to test operation and the opening of poles.

Current Limiting, Discrimination & Endurance

MCCBs shall comprise a device, designed to trip the circuit-breaker in the event of high-value short-circuit currents. This device shall be independent of trip unit.

The electrical endurance of MCCBs, as defined by IEC 60947-2 standard, shall be at least equal to 3 times the minimum required by the standard

The MCCB shall employ maintenance free double break contact system to minimize the let-through energies and capable of achieving discrimination up to the full short circuit capacity of the downstream MCCB.The manufacturer shall provide both the discrimination tables (with test certificates) and let-through energy curves.

5.19.3 Accessories

MCCB shall be provided with the following accessories, as specified in schedule of quantities.

i) Under voltage trip
ii) Shunt trip
iii) Alarm switch
iv) Auxiliary switches

All the accessories shall be rated for continuous operation. These Auxiliaries shall be common for the similar type and range of MCCBs.

It should be possible to fit MCCBs with a motor mechanism for electrically controlled operation.

5.19.4 Interlocking

Moulded, case circuit breakers shall be provided with the following interlocking devices.

a) Extended door handle.
b) Handle interlock to prevent unnecessary manipulations of the breaker.
c) Door interlock to prevent the door being opened when the breaker is in ON position.
d) Defeat-interlocking device to open the door even if the breaker is in ON position.

The MCCB shall be current limiting type and comprise of quick make – Break switching mechanism. MCCBs shall be capable of defined variable overload adjustment. All MCCBs shall have adjustable short circuit pick-up.

The trip command shall override all other commands.

Protection Functions Wherever Specified

All the MCCBs shall be with microprocessor based trip units with adjustable Overload & Short circuit protection . Earth fault/Earth leakage protection shall be provided in the MCCB.

Trip units shall be fully interchangeable type and it should be possible to upgrade the trip unit anytime without any modifications in the installation.

In case of overload, Pre alarm indication shall be provided on the MCCB.

Trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorised access to the settings.

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

Protection settings shall apply to all circuit breaker poles.

Trip units shall be equipped with Thermal memory feature to reduce the stress on the installation in case of repetitive overloads.

All electronic components shall withstand temperatures up to 125 °C.

5.19.5 Testing

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

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

5.20 AIR CIRCUIT BREAKER

General

The ACBs shall comply to IEC 60947 Part I & II and IS 13947 Part I & II and shall be suitable for operation on 415 Volts, 50 Hz 3 Phase system.

The breaker shall comply with Isolation function requirements of IEC 60947, Part-II, section 7.12 and shall be clearly marked as “Suitable for Isolation / Disconnection” to ensure safety of operating personnel.

The ACB shall provide Class –II insulation between front panel and internal power circuit as per IEC 60947 Part II Section-7.12 to avoid accidental contact with live parts during inspection & maintenance.

The ACB shall be 3/4 pole with modular construction, draw out, manually/electrical operated and shall be capable of providing short circuit, overload and earth fault protection with time delay through micro processor based control unit sensing the true RMS value to ensure accurate measurement meeting the EMI/EMC requirement as per standard.

Neutral should be equal to In (Nominal Current) rating of circuit breaker .

The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity shall be as specified on the single line diagram and shall be equal to the short circuit withstand values for 1 (one) sec.

ALL ACBs shall be designed for Ics rating for 1 second

Circuit breakers shall be designed to 'close' and 'trip' without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel and integral with the breaker. The ACB shall be provided with a door interlock.

5.20.1 Constructional Features

All Air Circuit Breakers (ACB) shall be 3 / 4 pole with modular construction and moulded housing, flush front, and draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" "TRIP" indications. ACB shall have inbuilt Anti pumping feature.

The contacts shall be of silver-plated copper with moving and fixed contacts totally enclosed for enhanced safety and inaccessibility to live parts.

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate.

The current carrying capacity of neutral pole shall be equal to main poles. Four pole ACBs shall have 4th pole / neutral protection adjustable at site at 100%, 50% through neutral C.T's.

There shall be 4 distinct and separate position of the circuit breaker on the cradle.

Service Position Main Isolating contacts and Control contacts of the breaker are engaged.

Test Position Main Isolating contacts are isolated but control contacts are still engaged.

Isolated Position Both main isolating and control contacts are isolated.

Maintenance Circuit breaker fully outside the panels ready for maintenance after the cubicle door is opened.

There shall be provision for locking the breaker in any or all of the first three positions.

There shall be mechanical indicator on the front panel for "**READY TO CLOSE"** situation for the breaker by checking all inter-locking

5.20.2 Protection Functions

Microprocessor based trip Unit

The ACB control unit shall be interchangeable on site for adaptation to changes in the installation.

Sensors shall be non-magnetic or static type for accurate current measurements up to Ics value and CTs should not saturate up to the max. short circuit current of the LV network.

The ACB control unit shall measure the true rms value of the current

The ACB control unit shall offer the following protection functions as standard:

Long-time (LT) protection with an adjustable current setting and time delay;

Setting range Ir	40% to 100% of In
Time Delay settings tr	0.5 to 24 Sec

Short-time (ST) protection with an adjustable pick-up and time delay;

Setting range Isd	1.5 to 10 times Ir
Time Delay settings tsd	0 to 0.4 sec

instantaneous (INST) protection with an adjustable pick-up and an OFF position.

Current and time delay setting shall be indicated in amperes and seconds respectively On a digital display.

Earth-fault protection with an adjustable pick-up and time delay shall be provided if indicated on the appended single-line diagram. ACB trip unit should have capability to show Earth fault current value.

Setting range Ig	50% to 200%
Time Delay settings tg	0 to 0.4 sec.

Trip unit shall continuously display the most heavily loaded phase current on a LCD display.

It should be possible to change the settings of ACB in ON condition. User should not have to shut down the system for changing the current/time parameters of an ACB, thus allowing to have maximum continuity of supply.

Communication option

The trip unit shall be communication capable for integration into
BMS system.
Communication function should be independent of the control unit.

b. Thermal Memory

When the breaker shall re close after tripping on overload, then the thermal stresses caused by the overload if not dissipated completely, shall get stored in the memory of the release and this thermal memory shall ensure reduced tripping time in case of subsequent overloads. Realistic Hot/Cold curves shall take into account the integrated heating effects to offer closer protection to the system.

d. Trip Indication:
LED Fault status indicators along with remote fault signaling shall be provided to display the type of fault that caused a trip, without any external auxiliary supply or battery, resulting in faster fault diagnosis and reduced system down time.

e. Test Facility
Test facility to test the operation of the release in different protection zones by simulating CT inputs externally through a testing kit.

f. Self Powered
The release shall draw its power from the main breaker CTs and shall require no external power supply for its operation.

g. Tripping of the Breaker
The release shall trip the breaker directly the breaker trip rod.

h. Zone Selective Interlocking
The release shall be suitable for communication between breakers to enable zone selective interlocking. This feature shall be provided for both short circuit and ground fault protection zones to offer intelligent discrimination between breakers. This feature enables faster clearance of fault conditions; thereby reducing the thermal and dynamic stresses produced during fault conditions and thus minimizes the damage to the system.

i. Rated insulation voltage shall be 1000 volts AC.

j. Accessories
All the control wiring of ACB shall be accessible from front along with accessories like Aux contacts U/V, Shunt and Closing coil. All the accessories shall be rated for continuous operation.

5.20.3 Minimum 4 No and 4 NC auxiliary contacts shall be provided on each breaker. The contacts shall be rated 4 amps. The auxiliary contact blocks shall be so located as to be accessible from the front. The auxiliary contacts in the trip circuits shall close before the main contacts have closed. All other contacts shall close simultaneously with the main contacts. The auxiliary contacts in the trip circuits shall open after the main contacts open.

5.20.4 Safety Features

The **safety shutter** shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.

There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Earthing bolts shall be provided on the cradle or body of fixed ACB.

Arc Chute Filters (stainless steel filters) wherever necessary shall be provided to absorb the energy released during breaking. Thus limiting the stress exerted on the installation.

ACB should have **Arc Chute Filter Cover.**

It shall be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

5.21 Automatic Transfer Switch (ATS)

The ATS shall transfer the load from one source to another source without any disruption for running the equipment and lighting. The ATS shall conform to IEC. 60947-6-1. The ATS shall have overlapping switched neutral for eliminating voltage transients and ground fault protection due to unbalanced load during change over. The ATS shall transfer the load from one source to another source with high speed through solenoid operating mechanism. ATS shall have provision for transferring load manually by operating handle in emergency conditions or malfunctioning of ATS. The complete operation of ATS shall be controlled by Inbuilt PLC.

TECHNICAL SPECIFICATIONS FOR CAPACITOR BANKS

6.1 **SCOPE**

This section covers the specification for supplying of 480 volts 3 phase 50 HZ capacitor banks and power factor correction control panel .

6.2 **REQUIREMENTS**

Capacity of the capacitor banks and control panels shall be indicated in the enclosed Schedule.

6.2.1 Each 100/50/25 KVAR capacitor banks shall be provided the following components.

i) Incomer capacitor duty MCCB's
ii) 3 pole contactor capacitor duty.
iii) Set of push buttons for manual start & stop.
iv) Selector switch for manual & automatic.
v) Indicating lamps for "ON" and "OFF" indications

6.3 **CONSTRUCTION**

6.3.1 The capacitor banks shall generally conform to IS : 2834 and **heavy duty** MPXL and 480 Volts.

6.3.2 The capacitor units shall be indoor type, air-cooled with double metalised paper extra law losses 480 volts hermetically sealed. The impregnant used shall be non-inflammable, non-oxidising, lower freezing point type synthetic compound gas filled capacitors can also be used.

6.3.3 Main connections from the active element shall be brought out through porcelain bushing. Care shall be taken to solder the bushing to the cover to ensure perfect hermetic sealing.

6.3.4 Capacitor units shall be provided with externally mounted discharge resistors to reduce the residual voltage to less than 50 volts in one minute of switching off.

6.3.5 Individual capacitor unit shall be provided with T.P. MCCB's capacitor duty, bus bars and terminal chambers to each bank of required KVAR. Terminal chamber shall be suitable for bottom/top cable entry. Two earth terminals shall be provided to each capacitor bank.

6.3.6 Painting of panels shall be Epoxy powder coated with minimum paint thickness of 50 micron with colour RAL-7032 as per DIN.

6.3.7 The Sheet Metal work for Capacitor Control Panel shall be similar to M.V. Panel construction features specifications.

6.4 The Bus bar material and arrangements in capacitor control panels shall be similar to M.V. Panel Bus bar and Bus bar connections specifications.

6.5 Cable compartments in Capacitor control panel shall be similar to cable compartment described in M.V. Panel Specifications

6.6 The APFCR shall be sensitive to pick up load even 1% of rated current of C.T.S and correct the P.F accordingly. The C.T for sensing current shall be provided in the main L.T Panel and wiring to be done from that C.T to APFCR. Provide harmonic level indication in this meter with communication port.

6.7 **TEST AT MANUFACTURERS WORK**

All routine and type tests as per IS : 2834 shall be carried out at manufacturer's work and test certificates shall be furnished to the owner.

LIST OF APPROVED MANUFACTURERS FOR DIFFERENT MATERIALS TO BE USED IN THIS PROJECT (All materials shall be ISI mark)

Sl.No.	Details of Materials	Manufacturers Name
1.	M.S. Conduits and accessories Conduit accessories	BEC Sharma/Steel Craft/ Rama/Disco
2.	FRLS P.V.C. conduits and accessories	BEC(Black) / Polypack/ESC
3.	FRLS P.V.C. insulated copper conduc tor wires 1100 volts grade	Bonton/ Havells /ESC/Rallison
4.	MCCB,s and Accessories	Schneider/Legrand/ABB
5.	Miniature circuit breakers/ DB	Legrand / Schneider/ABB
6	Auto Transfer Switch	Emerson/Socomec/Schneider
7.	Switches, sockets Citric/Legrand Myris	SchneiderOPAL/Honeywell
8.	Gang Box sockets	Make same as make of switch &
9.	G.I. Pipe	Tata/Jindal
10.	PVC insulated Aluminium/copper conduc- Tor armoured cables of 1100 V / volt grade.	Havells /Rallison/ Bonton
11.	PVC insulated flexible copper conduc- tor cables of 1100 V grade	Bonton/ Havells /ESC/Rallison
12.	FRLS PVC insulated Twisted / shielded Copper L.V. Cable	Bonton/Fusion
13	Cable Glands	Chromium plated Brass heavy duty glands, double compression, weatherproof with rubber washer and gaskets of Comet make
14	Cable Lugs	Dowells crimping type
15	LED Light fixtures	Regent/Philips/Divinity/Trilux
16	GLS Lamps/CFL Lamps/ Tube Lights	Osram / Philips
17	Special light fixtures	As per BOQ
18.	Day light/Occupancy Sensor	Schneider/ Philips/Crabtree/Lutron
19	Indicating Lamps	Schneider / ABB
20	Terminal Blocks	Elmex
21	Energy meter	Schneider / Socomec/Neptune
22	Industrial socket outlet socket and top	Cape/Legrand/Clipsal/Hensel/Neptune
23	Earth Leakage Circuit Breaker	Legrand /Schneider/ Hager/ABB
24	Maintenance Free Earthing/LA	Cape/Alltec/ERICO/Ideal Power
25.	Telephone Tag Block	Krone
26.	Cable Tray System	BEC/Indiatech/KM/AAA/Era control
27.	Raceway – with sheet steel System	BEC/Indiatech/KM/AAA/Eracontrol

28.	Floor Access Box	Davis / MK
29.	SDB's and Panels	EVA/Neptune/Indiatech/Era control System
30	Fire Alarm system	Notifire /Edwards/Tyco/Siemens
31.	Auto dialer	Jabletron/Sontay
32	Water Leak Detection System and Rest of the Components	Tracetek/DCI/AGNI Sontay or equivalent
33.	Rodent Repellent System	Maser Electronic
34.	Public Address System	Bosch /Honeywell/tyco
35.	Wire Mesh Tray	Legrand – Cablofil /OBO
36.	Speakers	Bosch / Honeywell
37.	PA system	Bosch / Honeywell
38.	Poles	Poles are used in the work of approved binder of HPSEBL Kaushal industries & Electro steel India.
39	Transformer	Transformer & Panel used in the work of approved binder of HPSEBL Power solution GTP Power Projects PVT. LTD.
39.	Panel	As per specification
40.	GO Switch, Pin insulator, Disc insulator Sets Completed, DO Fuse, Lighting Arrester, Surge Arrester (Porcelain Type)	
41.	All I steel items should be of Sail and Tata.	
38.	Any other items apart from above list shall be prior approved from Consultant/PMC/Architect/Client.	

POINT WIRING

The rates for all point wiring items shall include :

1. Conduits, Conduit specials, bushes and other fittings concealed or exposed as called for.

2. Embedding conduit and allied fittings including the outlet boxes in walls, floors etc., during construction and/or in chases including cutting chases and making good with cement mortar as necessary in the case of concealed conduit work.

3. Providing and fixing approved fixing devices, saddles and grouting the same as required for exposed conduits.

4. Fabrication and Supply of G.I .boxes for switches, ceiling fan hooks, Exhaust fans outlet and lighting fixtures with 1.6 mm thick sheet steel.
5. Providing and fixing junction boxes with 3mm Hylam or 3mm/5mm thick Perspex sheet cover duly painted from inside to match the colour of the walls. All Junction boxes shall be MS only.
6. All fixing accessories such as clips, brass screws/brass washers rawl plugs etc.

7. All work & material necessary (including circuit wiring from DB to first tapping point of each circuit with 2.5 sq. mm wires) in complete wiring of a switch circuit of any length from the distribution board to the following via the switch:
   a) Ceiling rose b) Connector c) Back plate d) Socket outlet e) Lamps Holder f) Any other terminal outlet boxes g) Ceiling fan and Exhaust fan

8. Switch, socket outlet as called for.
9. Cable/wire as required upto lamp holder.
10. All metal boxes and boards concealed or surface mounted including those required for housing fan regulators.
11. All accessories necessary to complete wiring as specified.
12. FRLS PVC Insulated stranded Copper conductor earth wire for fixtures, switch outlet boxes and third pin of 5/15 Amps. socket to common earth.

13. Painting all exposed M.S. conduits, outlet boxes and junction boxes.

14. M.S. conduit for concealed and exposed wiring.

15. 2 mm dia G.I. pull wires in conduit work, wherever necessary.

16. The switch plate shall be made of I.S.I. grade Urea Formaldehyde Moulding powder. The base of the switches shall be made from high heat resistant phenol formaldehyde powder. The cost of switches shall include the cost of cover plates, cadmium fixing screws etc.
    The switches/sockets shall be rocker operated.
17. Separate Earth wire shall run along with each circuit both for power and light circuits.
18. Cutting of floor and making good for carrying conduits also.
19. Numbering of Circuits with ferrules for all circuits at both ends.
20. Providing 15 Amps capacity Bakelite terminal Blocks for terminating the phase, neutral and earth wire at each fixture location.
21. PVC insulated copper conductor wire ends before connection shall be properly soldered (at least 15 mm length) with special Cu solder for copper conductor or shall be properly crimped with copper lugs/sockets as the case may be. Strands of wires shall not be out for connecting to the terminals. All stands of wires shall be soldered at the end before connection. The connecting brass-screws shall have flat ends. All looped joints shall be soldered and connected through terminal block/connectors.
22. Provide embossing on the sockets engraving "UPS" and "RAW"

CONDUITING & WIRING FOR TELEPHONE & COMPUTER SYSTEM

The rates for conduit work shall include :

1. All necessary specials and fittings.

2. M. S. inspection, junction and outlet boxes as required.

3. 3/5 mm thick Perspex sheet covers for inspection & junction boxes.

4. All fixing accessories such as clips, nails, brass screws/brass washers, etc.

5. 2 mm dia G.I. pull wires in conduit work, wherever necessary.

6. Providing and fixing approved saddle, hooks and grouting the same as required in the case of all exposed conduit work.

7. Embedding conduit and allied fittings including the outlet boxes in walls, floors etc., during construction and/or in chases including cutting chases and making good with cement mortar as necessary in the case of concealed conduit work.

8. Painting all inspection, junction and outlet boxes.

9. PVC conduit for concealed conduit wiring .

10. Painting of Hylam/perspex sheet cover from inside to suit the colour of the surrounding wall with two coats of paint.

11. Supply and fabrication of G.I. outlet boxes .

12. The outlet cover plate for Telephone outlets shall be made of I.S.I. grade Urea Formaldehyde Moulding powder. The cost of outlets shall include the cost of cover plates, cadmium fixing screws etc. also.

13. Numbering of wires on both ends of the wires for easy identification with PVC ferrules.

EARTHING

The rates for earthing items include :

1. All fixing accessories such as brass saddles, brass screws, raw plugs etc.

2. Jointing by riveting in case of copper earth strips (2 per joint) and by welding in case of GI strips.

3. Cutting chase, making holes and making good the same wherever required.

4. All masonry work including earth work for earthing stations, earthing tapes and wires.

5. Effecting adequate and proper interconnections.

6. Use of copper thimbles for all wire terminations in the Distribution Boards , switches and sockets.

CABLES, MAINS AND SUB-MAINS

The rates for all items of work shall include:

1. Embedding conduits and allied fittings in walls, floors, etc., during construction and/or in chases including cutting chases and making good as necessary in the case of concealed conduit work.

2. Providing and fixing approved saddles, hangers, trays etc., and grouting the same as required for exposed conduits where called for. Providing dash fasteners for the threaded MS down rods(primer coated) used for hanging the cable \trays.

3. Providing and fixing junction boxes with 5 mm thick 'Hylam' sheet covers.

4. Effecting adequate and proper connections at terminations.

5. Ensuring that provision is left in various buildings components and trenches as the work proceeds, for incorporation of cable supports at a later date.

6. Providing all fixing accessories such as clamping devices, nuts and bolts, screws etc.

7. Clamping to supports where laid in trenches.

8. Excavation of trenches and bringing the trenches to exact level as required.

9. Providing sealing compound, thimble, solder etc., at joints and terminations as called for.

10. Providing proper supports for cable terminal boxes as called for.

11. Wherever cables pass through walls, ceiling, paved area or below roads provide sleeves/ hume pipes and making good as necessary.

DISTRIBUTION BOARDS

The rates for the following items of work generally include :

1. The supporting rigid steel frame work.

2. 1.6 mm thick MS boxes complete with dust proof and vermin proof covers and locking arrangements, mounted flush with surfaces.

3. All fixing accessories such as dash fasteners , bolts, nuts, screws, etc. as required.

4. Building into masonry/concrete work including all necessary cutting and grouting with cement mortar 1:2.

5. Effecting adequate and proper connections.

6. Effecting proper bonding to earth.

7. Painting/lettering on switches and distribution boards the location they serve and providing on each board its circuit diagram.

8. Touching up all damaged paint over exposed work with one coat of red oxide primer and two finishing coats of approved synthetic enamel paint.

9. Main Distribution Board and Final Distribution Boards shall be fabricated by Contractor with the specified equipment.

10. Provide 6 Amps. SP MCB for Light Points Circuits, 20 Amps. SP MCB for Power Circuits and 32 Amps. SP MCB for 1.5 Ton AC Unit .

SUPPLY & FIXING OF LIGHTING FIXTURES AND FANS

The rate for fixing of lighting fixtures and fans shall include:

1. Receiving the fixtures from the Owner's stores and assemble the same at site and testing the fixture before fixing.

2. All components that may be required to make the installation complete in all respects such as:

   a. Suitable length of down rod, hanger and connecting wires, where called for.

   b. Wires for connecting the fixtures to the point through connector blocks.

   c. All wood and metal blocks to serve as base of fixtures.

   d. Bonding with common earth wires.

3. Drilling holes in supports where required.

4. Fixing clamps, GI bolts and nuts, clips, brass screws, dash fasteners and other fixing accessories as required, including leaving necessary provision for fixing at time of concreting.

5. Approved enamel painting for hanger rods, clamps and other components and fixing accessories as called for.

6. Testing and commissioning of all fixtures and fans after installation.

7. The lighting fixtures shall be suitable for 230 Volts, single phase 50 cycles A.C. supply system.

8. Incandescent lamps shall be 100 Watts (maximum) and fluorescent lamps shall be 18 watts and 36 watts.

9. Use G.I. suspenders and clamping to the slab with dash fasteners(4 per fitting) , including turn buckle arrangements for adjustable heights for hanging. They should be the same suspenders as used for hanging the False Ceiling grid ceiling.

10. The contractor to mark the size of light fittings, speaker and fire alarm components on the false ceiling for the interior contractor to cut holes.