

AHMEDABAD MUNICIPAL CORPORATION

(ENGINEERING DEPARTMENT- NORTH ZONE)



**CONSTRUCTION OF INDULAL YAGNIK COMMUNITY HALL AFTER DEMOLITION OF
OLD HALL BUILDING AT F.P.NO. 192, T.P.S.NO. 12 (ASARVA EXTENSION SOUTH) IN
BAPUNAGAR WARD, NORTH ZONE, AHMEDABAD**

TENDER DOCUMENT

Volume -1

Part C - Technical Specification For Electrical Work

Client-

Municipal Commissioner

Ahmedabad Municipal Corporation.

Sardar Patel Bhavan, Danapith,

Ahmedabad.

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General Specifications of Electrical works

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1) GENERAL SPECIFICATIONS

1.1) INTERNAL WIRING:- IS CODES

	PARTICULAR
IS : 732	Code of practice for electrical wiring installation (System voltage not exceeding 650 V)
IS : 1646	Code of practice for fire safety of buildings (General) Electrical installation.
IS : 2509	Rigid non-metallic conduits for electrical wiring.
IS : 6946	Flexible (Pliable) non-metallic conduits for electrical installation.
IS : 1293	3 pin plugs and sockets.
IS : 8130	Specifications of conduits for electrical installation.
IS : 3854	Switches for domestic purpose.
IS : 3415	Fittings for rigid non-metallic conduits.
IS : 4648	Guide for electrical layout in residential building Indian electricity act and rules.

[A] SPECIFICATIONS

RIGID PVC AND FLEXIBLE PVC FRLS LHSFT CONDUITS:

All conduits shall be rigid PVC alloy low in halogens pipe having minimum wall thickness of medium gauge 1.6 to 2.0 approved by F.I.A. & I.S.I. and shall confirm to IS 9537 part 3 and complying with fire safety standards classification V-0. The temperature stability shall be from -20oc - +80oc and also shall be uV stabilised.

Up to 38 mm diameter in slab - minimum 1.8 mm wall thickness.

Up to 38 mm diameter in floor - minimum 2.0 mm Wall thickness.

Above 40 mm. diameter - minimum 2.2 mm. wall thickness.

Flexible conduits shall be formed from a continuous length of spirally wound interlocked steel strip with a fused zinc coating on both sides. The conduit shall be terminated in brass adapters.

ACCESSORIES:

PVC conduit fittings such as bends, elbows, reducers, chase nipples, split couplings, plugs etc. shall be specifically designed and manufactured for their particular application. All conduit fittings shall conform to IS: 2667-1964 and IS: 3857-1966. All fitting associated with galvanized conduit shall also be galvanized.

WIRES:

All wires shall be single core multi-strand/ flexible copper or single strand Copper (if specified in BOQ), PVC insulated **FRLS** grade as per IS: 694 and shall be 660 V\1100 V.

All wires shall be colour coded as follows:

PHASE	COLOUR OF WIRE
R	RED
Y	YELLOW
B	BLUE
N	BLACK
Earth	GREEN (Insulated)

Control (if any)
All Off wires

GREY
Same as phase wires

SWITCHES & SOCKETS:

Switches shall be modular type with silver-coated contacts. Sockets shall be 5 pins with switch and plate type cover. Combination of multiple switch units and sockets should be used to minimize the switch boxes. For heavy duty, metal clad sockets with M.C.B / Isolator mounted in a galvanized steel box shall be provided.

SWITCH PLATE AND BOX:

Plates of the same make, as that of switches shall be used with the modular range. Also M.S. boxes shall be taken as switch boxes.

[B] WORKMANSHIP

The size of conduit shall be selected in accordance with the number of wires permitted under table given below. The minimum size of the conduit shall be 25 mm diameter unless otherwise indicated or approved. Size of wires shall not be less than 1.5 sq.mm. Copper.

Nominal Dia of wires	Nominal Cross sec. Area sqmm	20 mm		25 mm		32 mm		38 mm	
(mm)		S	B	S	B	S	B	S	B
1/2.40	1.50	4	3	8	6	15	9	--	--
1/1.80	2.50	4	2	6	4	10	8	--	--
1/2.24	4.00	2	2	4	3	8	6	--	--
1/2.80	6.00	1	--	4	3	6	6	--	--
1/3.55	10.00	1	--	3	2	5	4	6	5

S - runs of conduits which have distance not exceeding 4.25 m. between draw boxes & which do not deflect from the straight by an angle more than 15 degree

B - runs of conduits, which deflect, from the straight by more than 15°.

Conduits shall be kept at a minimum distance of 100 mm. from the pipes of other non-electrical services. And maintain minimum 200-300 mm distance between telephones, TV & Computer piping. Separate conduits/raceways shall be used for :

Normal lights and 5 A 3 pin sockets on lighting circuit.

Separate conduit shall be laid from D.B. to switch board.

Power outlets - 15 A 3 pin 20 A/30 A, 2 pin scraping earth metal clad sockets.

Emergency lighting.

Telephones.

Fire alarm system.

Public address system & Music system.

For all other voltages higher or lower than 230 V.

T.V. Antenna.

Water level guard.

Computer Wiring

Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc., shall be installed in flexible conduits. Otherwise rigid conduits shall be used. No flexible extension shall exceed 1.25 m. connected or jointed into sockets, bends. Conduits run on surfaces shall be supported on metal 12 mm. thick G.I. pressure saddles which in turn are properly screwed to the wall or ceiling. Saddles shall be at intervals of not more than 500mm. Fixing screws shall be with round or cheese head and of rust-proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building. Unseemly conduit bends and offsets shall be avoided by using fabricated mild steel junction/pull through boxes for better appearances. No cross-over of conduits shall be allowed unless it is necessary and entire conduit installation shall be clean and neat in appearance.

Conduits embedded into the walls shall be fixed by means of staples at not more than 500 mm.intervals. Chases in the walls shall be neatly made and refilled after laying the conduit and brought to the finish of the wall but the building Contractor will do final finish.

Conduits buried in concrete structure shall be put in position and securely fastened to the reinforcement and got approved by the CLIENT AND/OR ITS ARCHITECT, before the concrete is poured. Proper care shall be taken to ensure that the conduits are neither dislocated nor choked at the time of pouring the concrete suitable fish wires shall be drawn in all conduits before they are embedded.

Where conduit passes through expansion joints in the building, adequate expansion fittings shall be used to take care of any relative movement.

Inspection boxes shall be provided for periodical inspection to facilitate withdrawal and removal of wires. Such inspection boxes shall be flush with the wall or ceiling in the case of concealed conduits.

Inspection boxes shall be spaced at not more than 12 meters apart or two 90° solid bends or equal.

All junction and switch boxes shall be covered by 6 mm clear plate. These junction boxes shall form part of point wiring or conduit wiring as the case may be including the cost of removing the cover for painting and re-fixing. No separate charges shall be allowed except where specially mentioned.

Conduits shall be free from sharp edges and burrs and the threading free from grease or oil. The entire system of conduits must be completely installed and rendered electrically continuous before the conductors are pulled in.

Conduits should terminate in junction boxes of not less than 32 mm.deep.

An insulated earth wire of copper rated capacity shall be run in each conduit.

Lighting & Power Wiring:

All final branch circuits for lighting and appliances shall be single conductor/ stranded/ flexible wires run inside conduits. The conduit shall be properly connected or jointed into sockets, bends and junction boxes.

Branch circuit conductor sizes shall be as shown in the schedule of quantities and or drawings.

All circuits shall preferably be kept in a separate conduit up to the Distribution Board. No other wiring shall be bunched in the same conduit except those belonging to the same phase. Each lighting branch circuit shall not have more than ten outlets or 800 watts whichever is lower. Each conduit shall not hold more than three branch circuits.

Flexible cords for connection to appliances, fans and pendants shall be 650/1100 V grade (three or four cores i.e. with insulated neutral wire of same size) with tinned stranded copper wires, insulated,twisted and sheathed with strengthening cord. Colour of sheath shall be subject to the CLIENT AND/OR ITS ARCHITECT'S approval.

Looping system of wiring shall be used. Wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors. No such joints shall be made unless the length of the sub-circuit, sub-main or main is more than the length of the standard coil.

Control switches shall be connected in the phase conductors only and shall be 'ON' when knob is down. Switches shall be fixed in 3 mm. thick painted or galvanized steel boxes with cover plates as specified. Cadmium plated brass screws shall be used.

Power wiring shall be distinctly separate from lighting wiring. Conduits not less than 25 mm. and wires not less than 2.5 sq.mm. copper shall be used.

Every conductor shall be provided with identification ferrules at both ends matching the drawings.

Testing: the entire installation shall be tested for :

Insulation resistance.

Earth continuity.

Polarity of single pole switches.

General: All the wiring switch board, outlet points shall be done in a concealed manner in wall & slab in PVC conduit of minimum 25 mm dia. (medium gauge) & with 650v / 1100v grade PVC insulated flexible copper conductor wire. he switches should be modular with moulded cover plates, blank plates for outlet boxes. The accessories, connectors, sockets, should be fixed with brass chrome / cadmium plated machine screw. For fan points the rates should be with hum -free type 300 W regulators as required to complete the point wiring. The wiring shall be as per IS: 732 and IS: 4648. The wiring shall be done in a looping manner so as to avoid junction boxes at any place. All the looping shall be done only in the switchboard and outlet points. The size of the wire shall be as per the specification. Colour code shall be strictly followed.

The size of wires shall as follow :

25-32 Amp. metal clad points:

Phase / Neutral 6.0 mm²

Earth 4.0 mm²

20 Amp. out let points :

Phase / Neutral 4.0 mm²

Earth 2.5 mm²
 Two nos. of 15 Amps. Socket outlet let connected in parallel
 from DB to first outlet
 Phase / Neutral 4.0 mm²
 Earth 2.5 mm²
 from first outlet to second outlet.
 Phase / Neutral 2.5 mm²
 Earth 2.5 mm²

Light, fans, exhaust fan, 5 Amp. On board plug point, two way light points, bell point etc from switch to outlet.

Phase / Neutral 1.5 mm²

Earth 1.5 mm²

From D.B. to switch board – lighting / 5 A socket etc – i.e. circuit mains part of point wiring

Phase / Neutral 2.5 mm²

Earth 2.5 mm²

15/20 Amps. Socket outlet for AC (Single Phase/Three Phase) / Geyser

Phase / Neutral 4.0 mm²

Earth 2.5 mm²

15/20 Amps. Socket outlet for appliances or looped from sockets with 4 sq mm ckt.

Phase / Neutral 2.5 mm²

Earth 2.5 mm²

Separate pipes shall be laid for off wires and circuit mains.

Circuit mains of same phase shall be drawn in one pipe with prior permission/discussion with the consultant.

Separate phase, neutral and earthing wire of sizes recommended by consultant shall be drawn for each and every circuit mains.

Mains for lighting and on board plug points shall be of one-size higher wires than those used in off.

The point definition shall be conducting and wiring from D.B. to S.B. and there from to final outlet point including switches and accessories, junction boxes, fan boxes, zarri work with cement –sand etc of Proposed make.

[C] MODE OF MEASUREMENT

The items shall be measured on unit basis or on mtr basis as per BOQ.

1.2 L.T.Panels / MCB Distribution Boards

STANDARD NO.	PARTICULAR
IS : 8623	Factory Built Assemblies of switchgear and control gear.
IS : 4237	General requirements for switchgear and control gear for voltages not exceeding 1000 volts.
IS : 2147	Degree of protection provided by enclosures for low voltage switchgear and controlgear.
IS : 375	Marking and arrangement of busbars.
IS : 2705	Current Transformers
IS : 3156	Voltage Transformers
IS : 1248	Indicating Instruments
IS : 6875	Control switches & Push Buttons

IS:2516 (Part-I&II/Sec-I) -1977 & IS:13947-Part2-1993	Moulded Case Circuit Breaker
IS : 8828-1978	MCB

L.T. PANELS

L.T. Panels shall be indoor type, metal clad, floor mounted, compartmentalised, free standing, totally enclosed, air insulated, cubicle type for use on 415 Volts, 3 phase, 50 cycles system.

Construction

L.T. Panels shall be :-

- I** Of metal enclosed, indoor, floor mounted, free standing construction.
- II** Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.
- III** Provide dust and damp protection, the degree of protection being not less than IP 42 as per IS:2147
- IV** It shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service

Each vertical section shall comprise of:

- i** A front framed structure of rolled/folded sheet steel channel section, of minimum 2 mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker, main horizontal busbars, vertical risers and other front mounted accessories.
- ii** The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2 mm thickness and 100 mm height or 100 x 50 x 50mm MS Channel. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.
- iii** A side cable chamber housing the cable end connections, and power/control cable terminations. 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.
- iv** A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.
- v** Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.
- vi** The height of the panels should not be more than 2000mm. Operating levers/handle etc. of highest unit shall not be at a height more than 1800mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 350mm.
- vii** Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 1.63mm thickness. All sheet panels shall be smoothly finished, levelled and free from flaws. The corners should be rounded. The apparatus and circuits in the power control centres shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.
- viii** Apparatus forming part of the LT panel shall have the following minimum clearances.

a) Between phases	-	32mm
b) Between phases and neutral	-	26mm
c) Between phases and earth	-	26mm
d) Between neutral and earth	-	26mm

- ix Creepage distances shall comply to those specified in relevant standards.
- x All insulating material used in the construction of the equipment shall be of non- hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.
- xi Functional units such as circuit breakers shall be arranged in multi-tier formation. Cable entry for various feeders shall be either from the front through cable alley located in between two circuit sections. All cable entries shall be through glands plates. There shall be separate gland plate for each cable entry so that there will not be dislocation of already wired circuit when new feeders are added. Gland plate shall be 3 mm thick.
- xii Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:
 - a Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.
 - b Cable termination of one functional unit, when working on those of adjacent unit/units.
- xiii All doors/covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorised access.
- xiv Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

Metal Treatment & Finish

All steel work used in the construction of the Sub Distribution Boards should have undergone a rigorous metal treatment process as follows:-

- i Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.
- ii Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.
- iii A recognised phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.
- iv Passivating in de-oxalite solution to retain and augment the effects of phosphating.
- v Drying with compressed air in a dust free atmosphere.
- vi A finishing coat of Powder coating of Siemens gray colour.

BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminium alloy complying with the requirement of grade E-91E of IS : 5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity. The neutral as well as the earth bar should be capable of withstanding fault withstand capacity. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and creepage distances shall be provided on the busbar system to minimize possibilities of fault. High tensile bolts and spring washers shall be provided at all busbar joints/connections.

The Sub Distribution Boards shall be designed that the cables are not directly terminated on the terminals of breaker/switch fuse/fuse switch etc. but on cable termination links. Capacity of aluminium busbars shall be considered as 1.0 Amp per sq.mm of cross section area of the bus bar and also conforming to Table VI of CPWD specification for Internal Electrical Works (Part I) . The main busbars shall have continuous current rating throughout the length of Sub Distribution Boards. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity upto 200Amp; for higher capacity the neutral busbar shall not be less than half (50%)the cross section of that the phase busbars. The busbar system shall consists of main horizontal busbar and auxillary vertical busbars run in busbar alley/ chamber on either side in which the circuit could be arranged/ connected with front access.

Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves.

MOULDED CASE CIRCUIT BREAKERS.

1) GENERAL

Moulded Case Circuit Breaker shall be incorporated in the Sub Distribution Boards wherever specified. MCCB's shall conform to IS : 13947 (Part-II) IEC-947(2) in all respects. MCCB's shall be suitable either for single phase AC 230 volts or three phase 415volts.

2) Frame Sizes

The MCCB's shall have the following frame sizes subject to meeting the fault level as specified elsewhere.

a. Up to 100 Amp Rating	100 Amp frame
b. Above 100Amp to 250 Amp Rating	250 Amp frame
c. Above 250 Amp to 400 Amp Rating	400 Amp frame
d. Above 400 Amp to 630 Amp Rating	630 Amp frame

CONSTRUCTIONS

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable "ON", "OFF" "and" "tripped" indicators. Three phase MCCB's shall have common operating handle for simultaneous operation and tripping of all the three phases. Rotary type operating Handle shall be provided. MCCB shall be load/line reversible type. MCCB shall be site adjustable type with overload setting of 80% to 100%.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermo-magnetic or static release type provided in each pole and connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.

Contacts trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

RUPTURING CAPACITY

The Moulded Case Circuit Breaker shall have a service breaking capacity (Ics) of not less than 35 KA RMS at 415 volts for Sub Distribution Boards or as specified in the BOQ.

TESTING

Routine & Type Test certificate of the MCCB as per relevant Indian Standards (IS) shall be submitted.

MEASURING INSTRUMENTS, METERING & PROTECTION

1) GENERAL

Direct reading electrical instruments shall be in conformity with IS-1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between -10 Degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

2 DIGITAL AMMETERS.

Ammeters shall be digital type display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

3 DIGITAL VOLTMETERS.

Voltmeter shall be digital type display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The voltmeter shall be provided with protection fuse of suitable capacity.

4 CURRENT TRANSFORMERS.

Current transformers shall be in conformity with IS: 2705 (part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1kv. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:

Measuring	: Class 0.5 to 1
Protection	: Class 5 to 1

MISCELLANEOUS

Control switches shall be of the heavy duty rotary type clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type of low watt consumption, provided with series resistor where necessary, and with translucent lamps covers, bulbs & lenses shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Sub distribution boards to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

LABELS

Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of Sub Distribution Boards. Labels shall be properly secured with fasteners.

TEST AT MANUFACTURES WORK

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

- a) Operation checks and lubrication of all moving parts.
- b) Interlocking function check.
- c) Continuity checks of wires, fuses etc. as required.
- d) Insulation test : Testing shall be as per CPWD specification.
- e) Trip tests & protection gear test.

TYPE TEST

The fabricating agency should have CPRI approval for similar panels for short circuit capacity not less than the highest KA fault level rating of switchgear connected. The agency shall have CPRI test certificate for similar panel for the requirement of IP protection.

ACCEPTANCE TEST

Acceptance tests on completed switchboards shall be as follows:

- 1) A general visual check shall be carried out. This shall cover measurement of overall dimension, location, number and type of devices, terminal boxes, location and connection of terminals etc.
- 2) Checking of bill of materials as per approved drawing.
- 3) Checking of operation of various feeders as per approved schematic drawings.
- 4) Operation check shall be carried out for every control function as per schematic drawings by manually simulating fault conditions and operation of control switches/relays etc.
- 5) Checking of interchangeability of identical feeders.
- 6) Insulation resistance test and value measurement on power and control circuits before and after high voltage withstand test.
- 7) High voltage test on power and control circuit as per IS 8623.
- 8) For equipment bought from other suppliers, certified test reports of tests carried out at the manufacturer's works shall be submitted. Normally all routine tests as specified in the relevant standards shall be conducted by the sub supplier at its works and copies of routine test reports shall be furnished.

NAME PLATE

Electrical panels as well as their individual compartments shall be provided with plastic black anodized nameplates with white letter on black background. The nameplate shall be held with self-tapping screws. The size of the plate shall be minimum of 20x75 mm for cubicles and 40x150 mm for panels.

DANGER PLATE

Standard danger notice plate indicating the voltage grade shall be provided on each of the Electrical Panels

TEST/CERTIFICATE

The panels shall be tested after fabrication, assembling and wiring at the Factory.

- 1) Wiring test shall be carried with 1000-volt megger to ensure adequate insulation resistance. (At manufacturer's works)
- 2) H.T. test shall be carried out as per IS at manufacturer's works.
- 3) Functional tests of all components.
- 4) Dimensional checks & Visual examination.
- 5) Primary/secondary current injection test for relays if protection relays are supplied as part of BOQ

INSTALLATION, TESTING AND COMMISSIONING

Electrical panels shall be installed at the locations shown in the drawings. All electrical panels shall be provided with an integral base channel / wall frame for grouting the electrical panels to the floor/ wall as required. The electrical panels shall be grouted with required number of anchor bolts, supplied along with.

The required cables shall be brought and terminated at the electrical panels using cable glands, cable bracket, lugs and sockets as per BOQ. All the cables shall be properly arranged and dressed up in the cable alley. The various power and control cables shall be clamped firmly.

The tightness of all main and auxiliary bus bar connections shall be checked. All wiring terminations and bus bar joints shall be tightened wherever necessary before energizing the electrical panels. The commissioning checks shall include functional checks of all components installed in the panel including interlocks if provided, insulation check with 500 V Megger (not less than 100 mega ohms) etc shall be carried out before the panel board is energized.

TABLE – I
ALUMINIUM/COPPER BUS BAR SECTIONS

Current	Rectangular Cross-Section			
Current	Aluminium		Copper	
Current Rating in amps. upto	No. of Strips / Sizes	Recommended in mm. Strips	No. of Sizes in mm. Phase	Recommended
100	1	20 X 5	1	20 X 3
200	1	30 X 5	1	25 X 5
300	1	50 X 5	1	40 X 5
400	1	50 X 6	1	50 X 5
500	1	75 X 6	1	60 X 6
600	1	80 X 6	-	
800	1	100 X 6	-	

DISTRIBUTION BOARDS

Distribution Board shall be double door, pre wired, per phase isolation type with extended loose wire box at the top and suitable for flush installation. All distribution boards shall be of three phase (415 Volts) type with main incoming MCB and per phase incoming RCCB as in Schedule of Quantities. Distribution boards shall contain plug in or bolted type miniature circuit breaker mounted on busbars. Miniature circuit breakers shall be quick make & quick break type with trip free mechanism. MCB shall have thermal & magnetic short circuit protection. MCB shall conform with IS 8828-1978. Busbars shall be of electrolytic copper. Neutral busbars shall be provided with the same number of terminals as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. Phase barrier shall be fitted and all live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. All distribution board enclosures shall have powder coated painting after metal treatment. A circuit identification card in clear plastic cover shall be provided for each distribution board.

Distribution Board with single phase outgoings requirement shall be Horizontal type.

Distribution Board with three phase outgoings requirement shall be Vertical type.

Distribution Board installed in indoor dry locations shall conform to IP-42. Distribution

Board installed in outdoor & wet locations shall conform to IP- 65.

Miniature Circuit Breakers for lighting circuits, the circuits feeding discharge lamps (HPMV or HPSV) halogen lamps, all power outlet points, equipment/ machinery shall be of "C" series types. All miniature circuit breakers shall be of 10 KA rated rupturing capacity.

Residual current circuit breaker shall be current operated type and of sensitivity not less than 300mA unless otherwise stated. RCCB shall be mounted as the phase incomer inside the distribution board. Distribution board box, MCB's, RCCB's used shall be of one/same manufacturer. Additional cutout/space for outgoing MCB shall be plugged with blank plates.

Only prewired MCB type DB's with per phase isolation type shall be used.

Prewired DBs shall have following feature:

- 1) Recess/ Surface type with integral loose wire box.
- 2) Phase/ neutral / earth terminal blocks for termination of incoming & outgoing wires.
- 3) DIN Channel for mounting MCB's.
- 4) Arrangement for mounting incomer MCB/RCCB/RCBO as required.
- 5) Copper Bus bar & neutral link
- 6) Earthing terminals.
- 7) Wiring from MCB's to phase terminal block.
- 8) Interconnection between terminal block/ incoming switch / bus bar/ neutral terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/ thimbles.
- 9) Terminal blocks should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq mm.
- 10) Terminal block shall be made of flame retardant polyimide material.
- 11) Colored terminal blocks and FRLS wires for easy identification of RYB Phases, Neutral and Earth.
- 12) The prewired DB shall have peelable poly layer on the cover for projection from cement, plaster, paints etc during the construction period.
- 13) Detachable plate with Knock out holes shall provided at the top/ bottom of board.
- 14) Complete board shall be factory fabricated and pre-wired in factory ready for installation at site. The box and cover shall be fabricated from 1.6 mm sheet steel, properly pre-treated with powder coated finish.
- 15) It shall be of double door construction provided with hinged cover in the front where ever specification BOQ.
- 16) Wiring diagram of each DB shall be fixed inside the DB clearly indicating ferrule numbers.
- 17) The DB shall be compartmentalized in such a manner that incomer is having incomer compartment.

1.3 L.T.Cables and Terminations

L.T. CABLES

GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

CONSTRUCTION

L.T. Cables shall be PVC/ XLPE insulated and PVC sheathed aluminium conductor armoured cables conforming to IS : 1554 (Part I) / IS : 7098 (Part I) respectively. Cables shall be of 1100 volt and with ISI certification mark. Conductor of power cables shall be made of electrical purity aluminium conforming to IS : 8130-1 984.

INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, HDPE pipe , masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer-in-Charge. Cable laying shall be carried out as per CPWD specifications/ IS : 1255.

INSPECTION

All HT & LT Cables shall be inspected at site and checked for any damage during transit.

JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

CABLE LAYING

(a) SCOPE:-

The scope of this section comprises specifications for laying of HT & LT UG Cable in Ground, Surface and Cable Trays and Laying in Hume Pipe/Duct

Laying direct in ground

I) GENERAL

This method shall be adopted where the cable route is through open ground and where no frequent excavations are likely to be encountered and where re-excavation is easily possible without affecting other services.

ii) Laying cables in ground

Cables shall be laid by skilled experienced workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metres. Cables shall be laid at depth of 0.75 metres below ground level. A cushion of sand total of 250mm shall be provided including above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water drain. The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall be preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable as far as possible. Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

c) TRENCHING

i) Width of Trench

The width of the trench shall first be determined on the basis indicated herein. The minimum width of the trench for laying a single cable shall be 35 cm.

Where more than one cable is to be laid in the same trench in horizontal formation, the width of the trench shall be increased such that the inter-axial spacing between the cables, except where otherwise specified, shall be at least 20 cm. There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench.

ii) Depth of Trench

The depth of the trench shall be determined on the basis indicated herein. Where the cables are laid in a single tier formation, the total depth of trench shall be 75 cm for LT UG cable and 125 cm for HT UG cable.

iii) Excavation of Trench

The trenches shall be excavated in reasonably straight lines. Wherever there is a change in the direction, a suitable curvature shall be adopted. Where gradients and changes in depth are unavoidable, these shall be gradual. The bottom of the trench shall be level and free from stones, brick bats etc. The excavation should be done by suitable means – manual or mechanical. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench.

iv) Laying of Cable in Trench

The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8 cm in depth before laying the cables therein. After the cable is laid a covering of dry sand of not less than 17 cm of sand shall be provided. Unless otherwise specified, the cables shall be protected by second class brick of nominal size 22cmx11.4cmx7cm or locally available size,

placed on top of the sand (or, soil as the case may be). The bricks shall be placed breadth-wise for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5cm over the sides of the end cables. The trenches shall be then back-filled with excavated earth, free from stones or other sharp edged debris and shall be consolidated by way of rammed and watered, in successive layers not exceeding 15 cm depth.

The contractor shall restore all surface, roadways, sidewalks path, carps or the places cut by excavation to their original condition to the entire satisfaction of the Engineer-in-charge.

v) **Testing before Laying**

At the time of issue of cables for laying, the cable shall be tested for continuity and insulation resistance. Testing before covering
The cables shall be tested for continuity of cores and insulation resistance and the cable length shall be measured, before closing the trench. The cable end shall be sealed /covered.

vi) **Laying on Surface**

This method may be adopted in places like switch rooms, rising distribution) mains in buildings etc. This may also be necessitated in the works of additions and/or alterations to the existing installation, where other methods of laying may not be feasible.

Cables may be laid in surface by any of the following methods as specified:-

- A Directly clamped by saddles or clamps. Supported on cradles.
- B Laid on troughs/trays duly clamped.

The saddles and clamps used for fixing the cables on surface shall be 1 mm thick with fixing interval of 45 cm for cable of over all diameter up to 26 mm and 3mm thick 25mm wide with fixing interval of 60 cm for cable of over all diameter up to 45 mm. For cable of over all diameters above 45 mm the clamps shall be minimum of 3 mm thick 40 mm wide and fixing interval 60 cm. Additional clamping shall be provided at 30 cm from the center of bend on both sides. Saddles shall be secured with screws to suitable approved plugs. Clamps shall be secured with nuts on to the bolts, grouted in the supporting structure in an approved manner. In the case of single core cables, the clamps shall be of non-magnetic material. Suitable non-corrosive packing shall be used for clamping unarmoured cables to prevent damage to the cable sheath. Cables shall be fixed neatly without undue sag or kinks. All MS components used in fixing the cables shall be either galvanized or given a coat of red oxide primer and finished with 2 coats of approved paint.

vii) **Laying on Cable-Tray**

This method may be adopted in places like indoor substations, switch rooms, etc., or where long horizontal runs of cables are required within the building and where it is not convenient to carry the cable in open ducts. The cable trays may be either of perforated sheet type or of ladder type. The width of cable tray shall be chosen, so as to accommodate all the cables in one/two tier plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100 mm. The overall width of one cable tray shall be limited to 800 mm. All cable trays should be galvanized type. The cable tray shall be bonded to the earth terminal of the switchboards. Factory fabricated bends, reducers, tee/cross junctions, etc., shall be provided as per good engineering practice. The radius of bends, junctions etc., shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

The cable tray shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints.

viii) **Laying in covered Duct**

Covered duct shall be provided between substation and switch rooms (where feasible) at Building for taking the cables. Suitable angle iron supports will be provided in this duct by Client. The contractor shall fix the cables by using suitable clamps. The size and material of saddles/clamps shall be as given under laying on surface. AAI may opt for fixing cable trays on angle iron supports and taking / laying cables in trays.

ix) **Cables Hangers or Racks**

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder

clamps or other specialist fixing as required. Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good. The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

x) **Cables Tags**

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

xi) **Testing of Cables**

Prior to installation / burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

- a Before Laying
- b After Laying
- c After Jointing

On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

- a Insulation Resistance Test (Sectional and overall).
- b Continuity Resistance Test.
- c Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, Equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests.

1.4 LIGHT FIXTURES

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Project Manager.

1) **SCOPE :-**

Scope of work under this section shall include inspection at suppliers/manufacturer's premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc as required.

2) The lighting and their associated accessories such as lamps, reflectors, housings, ballasts etc., shall comply with the latest applicable standards, more specifically the following:

General and safety requirements for Luminaires

Part-1 Tubular fluorescent lamps

IS – 1913 (Part-1)

Industrial lighting fittings with metal reflectors

IS - 1777

Decorative lighting outfits

IS - 5077

Bayonet lamp holders

IS - 1258

Bi-pin lamp holders for tubular fluorescent lamps

IS - 3323

Electronic Ballasts for fluorescent lamps – General & Safety requirement	IS – 13021 (Part-1)
Electronic Ballasts for fluorescent lamps – Performance requirement	IS – 13021 (Part-2)
Ballast for HP MV lamps	IS - 6616
Tubular Fluorescent lamps	IS - 2418 (Part-1 to 4)
Luminaries – General requirement	IS – 10322 (Part-1)
Luminaries – Constructional requirement	IS – 10322 (Part-2)
Luminaries – Screw and Screwless termination	IS – 10322 (Part-3)
Luminaries – Methods of Tests	IS – 10322 (Part-4)
Particular requirement – General purpose Luminaries	IS – 10322 (Part-5/Sec-
Particular requirement – Recessed Luminaries	IS – 10322 (Part-5/Sec-
Particular requirement – Luminaries for Road and Street lighting	IS – 10322
Particular requirement – Flood Lighting	IS – 10322 (Part-5/Sec-
High pressure mercury vapour lamps	IS – 9900 (Part-1)
Tungsten filament general electric lamps	IS - 418

3) **LIGHT FITTINGS-GENERAL REQUIREMENTS :**

- a) Fittings shall be designed for continuous trouble free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Degree of protection of enclosure shall be IP-65 for outdoor fittings except bulkhead fitting. Bulkhead fitting shall be provided with IP-54 protection.
- b) Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/ ballasts.
- c) All fittings shall be supplied complete with lamps. All mercury vapour and sodium vapour lamp fittings shall be complete with accessories like ballasts, power factor improvement capacitors, starters, etc. Out door type fittings shall be provided with weather proof junction boxes (IP-55) and IP-54 Control gear boxes.
- d) Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires upto 4 sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.
- e)
- f) All hardwares used in the fitting shall be suitably plated or anodized and passivated.
- g) Earthing : Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing

continuity throughout the fixture.

- h) Painting/Finish : All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burns.
- i) The housing shall be powder coated/stove-enamelled or anodised as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia mandrel.
- j) Metal used in BODY of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

4) **LIGHT FITTINGS – SPECIAL REQUIREMENTS**

Box Channel Type Industrial Fittings

Box type slim line channel must be in screw less construction manufactured from M.S. CRCA sheet steel powder coated with MS CRCA cover, powder coated white. Light reflection surface in Box/Channel type fittings shall be in a POLYESTER PRECOATED STEEL having a reflection factor of not less than 80%. SCREWLESS DESIGN & CONSTRUCTION Light fixtures shall be preferred due to their ease of maintenance, especially for box/channel for box/channel type fixtures.

Moisture Proof Industrial Fittings

Surface mounted totally enclosed moisture proof fixtures must be in polycarbonate body and diffuser with transparent prismatic interior and smooth exterior and frosted end. Fixture must be completely sealed with polyurethane double gasket to achieve IP 65 protection. Fixture is complete with CRCA steel white powder coated / enameled finish reflector.

18 W / 36 W Fluorescent and 36 W CFL Low Glare Light Fittings

Recessed mounted, modular fluorescent lighting fixture made of CRCA Sheet steel powder coated (white) housing, electro chemically brightened and anodised reflector, three dimensional cross louvers with concave contours, fresnel top at louver saddle to increase efficiency. The luminance of <200 cd/M² at 63 degree viewing angle in all directions so as to confirm Cat-2 classification of CIBSELG3

Highbay Industrial Fittings

Industrial Highbay luminaries shall be provided with pressure die cast housing along with all accessories, orthocyclically wound open construction ballast, capacitor & semi parallel ignitor connected to terminal block and mounted on the gear plate. The gear shall have side entry for ease in maintenance. The spun aluminium reflector is suitable for narrow as well as wide beam distribution. The luminaire will be suitable for metal halide lamp HPI BU + 250 W which has 25500 lumens and 2.5 min restrike time (when operate with son gear).

ACCESSORIES FOR LIGHT FITTINGS REFLECTORS

The reflectors shall be made of CRCA sheet steel/aluminium /Silvered glass/Chromium plated sheet copper as required. The thickness of reflectors shall be as per relevant standards. Reflectors made of steel shall have stove enameled/ vitreous enameled/epoxy coating finish. Aluminium used for reflectors shall be anodized/epoxy stove enameled /mirror polished. The finish for the reflector shall be as specified. The reflectors shall be free from scratches /blisters and shall have a smooth and glossy surface having optimum light reflecting coefficient. Reflectors shall be readily removable from the housing for cleaning and maintenance without use of tools.

LAMPS

1) TLD

Lamp shall be environment friendly low pressure mercury discharge lamp with mercury content less than or equal to 5 mg. The lamp shall have minimum lumen maintenance of 85 and CRI of 85. The lamp must comply to ROHS (Restriction of Hazardous substances) and covered by WEEE. Lamp should be fully re-cyclable. The lamp should be low on maintenance with life of 40 K hours in case of electromagnetic ballast and 65 K hours in case of HF ballast upto 10% failure. The discharge glass shall be lead free.

TLD Lamps shall be minimum tri-phosphor type and have bi-pin bases. Colour spectrum of light shall be equivalent to "PHILIPS color 84 or color 86 color 82 or "OSRAM color 21 or color 11 or color 41 (as required at site)".

The fluorescent Tubes (TLD) should have cool daylight colour designation. But Architects reserve the right to prescribe either Cool Daylight or Bright White or Incandescent Colour Designations for TLD. NO extra payment will be made over the quoted rate of bidder for this. The 36 W fluorescent tubes will have Nominal Luminous Flux of not less than 3350 lumens whether so mentioned in the Schedule of Quantities or not.

T 5 – HIGH EFFICIENCY ECO-FRIENDLY LAMPS

T-5 lamp shall be environment friendly low pressure mercury discharge lamp with mercury content less than or equal to 3 mg. lamp should have lowest CO2 emission compared to any other comparable light source (40% less than a TL-D standard lamp, 26% less than TL-D / 80). T-5 lamp shall be 100% lead free. T-5 lamp shall be designed for operation with electronic gear and well suited for dimming. Maximum lumen output to be reached at approx 35oC in free burning position. T-5 lamp can be ignited from -15oC to + 50oC. Lamp should be fully recyclable and must comply to ROHS (Restriction of Hazardous substances) and shall be covered by WEEE. T-5 shall have 16 mm in diameter service life of TL-5 lamp should be 10% more than TL-D lamps. T-5 lamp shall have lumen efficacy of upto 104 Lux / W and shall have excellent colour rendering to En 12464 (Ra 80 to 89).

2) CFL

Compact fluorescent lamp shall have same luminous flux and power consumption as fluorescent tubes but less than half the length and more compact than U-shaped and circulator lamps. CFL shall be suitable for use with conventional control gear & standers and for HF electronic control gear. CFL lamp shall be non integral type of OSRAM / GE / PHILIPS/Havells Sylvania only.

HIGH FREQUENCY ELECTRONIC BALLAST

High frequency electronic ballast shall be used with fluorescent / Compact Fluorescent Lamps wherever specified in the schedule of quantities. High frequency electronic ballast shall comply to the following:

IEC 927, IEC 928 for $\leq 10\%$ total harmonic distortion.
EMI / RFI – Confirming to FCC / VDE Class A/B.
Line Transient as per IEEE C62.41.
Ballast Crest Factor C1.7%.
No Stroboscopic Effect
Constant Wattage / Light output between 240 V \pm 10%.
Circuit protection for surge current and inrush current.
Short circuits, open lamp protection
PF > 0.99 for fluorescent / T5 lamp and 70.95 for CFL.
Deactivated lamp protection
for use with single and twin lamps
RFI < 30 MHz EN 55015
Total Harmonic Distortion (THD) $\leq 10\%$
Immunity to interference EN 61547
Safety EN 60928 / IEC 928 / IS 13021 (Part I)
Performance EN 60929 / IEC 929 / IS 13021 (Part II)
Vibrations & Bump tests IEC 68-2-6 FC
IEC 9001

Quality Standard	ISO 9001
Environmental Standard	ISO 14001
DC Operation	EN 60924
Emergency Lighting Operation	VDE 0108

Total System consumption (lamps + ballast) for

- 1 x 36 W TLD, shall not exceed 40 W
- 1 x 28 W T-5, shall not exceed 32 W
- 1 x 35 W T-5, shall not exceed 40 W
- 1 x 14 W T-5, shall not exceed 16 W
- 1 x 18 W CFL, shall not exceed 20 W
- 1 x 36 W CFL, shall not exceed 40 W

LED LIGHT FIXTURES

Construction :- The LED based lighting should meet the Ingress Protection as specified in the technical specification. The fixture enclosure should be of aluminum or steel or alloy with heat sinks. However, if the vendor is unable to meet the specification as per technical specifications, due to design limitations or any other reasons, the contractor shall approach to Engineer Incharge or consultant for clarifications.

The LED light fitting will be modular in design with sufficient spatial isolation between the driver circuit and LED module. LEDs in the LED module should be in such a manner that failure of single LED does not affect performance of balance LEDs in the module. The LEDs and the diffuser should be mounted in such a manner so as to ensure that the LEDs are not visible to the naked eye in both 'ON' and 'OFF' condition. Proposed diagram of light fittings along with polar chart and lux levels should be forwarded along with the supply of light fixtures.

Design Specifications. The light fittings should be suitable for 140V-270V AC supply. The components used in the light fittings should be standardized to permit interchangeability. The design requirements of the various components of the light fittings are as follows: -

Driver	220-240V A.C. 50/60Hz integrated (non dimmable)
Degree of protection	IP65 for Flood lights and post top or any outdoor type
Surge	➤ 4kV
Gaskets	All gaskets will be industrial grade with life not less than 50,000 hrs
Standards /Certification	IESNA LM 79 , IESNA LM 80 , IESNA LM 21, JSS 5555, IEC 61347-2-13, IEC 62384, IEC 60529 and IEC 60598
Efficacy	➤ 80Lm/w for general , >110-120Lm/w for flood lights

Heat Sink :- The LED lights should have heat sink which permits self cooling of the LED components. The heat sink should have integral radial fins with a central ring for effective heat dissipation.

Driver Circuit:- The driver circuit should be able to withstand adverse environmental conditions, the LED light fittings would be subjected to. The PCBs of the driver circuit would be subjected to ESS test and other tests mentioned in these specifications. The driver circuit should be simple in construction and easily replaceable. Sufficient isolation to be provided to avoid heating of PCBs during functioning of the LEDs. The driver circuit should consist of inbuilt protection circuit to protect from heating, short circuits surges etc.

Diffuser :- The diffuser is to be made of injection moulded polycarbonate material. The design of the diffuser is to be such that there should be no bright/dark spot. Further, diffuser should suitably protect the light fitting from causing blinding effect without unduly reducing the lux level of the light fittings.

Housing Frame. The external frame should be designed to meet the type testing requirements of the specifications. Mounting dimensions and fitting arrangement is to be finalised in consultation with Engineer Incharge or consultant. The complete light fitting should be non-corrosive and should be able to withstand the environment the light fitting would be subjected to. The internal surface of the housing should be reflective and should have highly reflective white glossy colour. The fixture should have powder coating painting as per IS 5 code 632.

LED Module . The LED module will either be a high power LED or multiple LEDs of low wattage. LED efficiency shall be 100 to 130 lumen/watts. The LED modules should be standardized and similar in construction. The modules should be interchangeable between the light fittings. The lux levels of the light fittings should be as mentioned in the specification. LEDs in the LED module should be arranged in such a manner that failure of single LED does not affect performance of balance LEDs in the module. LED light fittings should consist of inbuilt protection circuit to protect the driver circuit and LED module from heating, short circuit surges etc. The illumination level shall not have infra-red and ultra-violet emission exceeding acceptable safe limits. The contractor shall enclose the proof of procurement of LEDs from OEMs approved for supply at the time of inspection of the unit against each purchase order.

Cables . The Power & Control wiring inside the LED light fittings is to be done up to the terminal strip of reputed make using 0.75 sq mm Teflon coated wire and properly ferruled at both ends.

Tally Plate & Circuit Diagram Plate. Anodized Aluminum tally plates conforming to NES 723 as stated below will be supplied along with the equipment:-

- (a) Equipment Tally
- (b) Manufacturer Tally
- (c) Ckt Diagram Tally plate.

TESTING AND ACCEPTANCE OF LED LIGHT FIXTURES

Eligibility Criteria. The contractor should have test certificates of LED fittings conforming to type tests requirement indicated in this chapter. In case the fixtures have not been type approved or the design/ material/technical specifications of the LED based fixtures offered by the contractor have been changed/upgraded from the already type approved fixtures, the fixtures would be subjected to type testing as per the requirement specified in this chapter. The firm should be in the field of manufacturing the LED based lighting systems and shall submit documentary evidence to this effect along with their offer.

Routine Test. LED light fittings will undergo routine test as per approved QAP. The routine tests comprises following tests:-

(a) **Performance Test.** The luminaire should be tested for its functioning at upper voltage limit, lower voltage limit and transient voltages of supply system. The unit should work satisfactorily for 720 hrs. at 65°C ambient. The illumination level shall also be measured during the performance test and the level shall not be less than as stipulated in this specification. The performance tests would include following:-

- (i) Lux Values
 - (ii) Wattage
 - (iii) Lumen Efficiency of LED Module
 - (iv) Operation of inbuilt protection circuits for heating and short ckt surges.
- (b) Insulation Test (with 500V DC megger)

- (c) High Voltage test
- (d) Physical inspection, Dimensions and Weight
- (e) Failure of single LED must does not affect the overall performance of Light
- (g) ESS and Burn-in Test
- (h) IP/Dust Test
- (I) Plating/Painting
- (j) Reverse Polarity Test
- (k) Surge Test
- (l) Transient Test and Die electric Test

Certification.

In addition, to the Routine Tests mentioned above, the contractor has to submit the specified tests certificates for acceptance of the LED based lighting fixtures. The contractor should adhere to the Standards created by the Illuminating Engineering Society of North America (IESNA) applicable for LED lighting. The under mentioned IESNA certification as described below should be provided by the OEMs:-

(a) **IESNA LM-79 (Assembled LED Light Fixture)** . IESNA approved method for the Electrical and Photometric measurements of Solid-State Lighting (SSL) products provides performance data (i.e. light output and efficacy, light distribution, and color characteristics) for the entire, integrated product—versus separate results for the light source (“LED”) and luminaire provided by traditional relative photometry. It also applies to LED-based products incorporating control electronics and heat sinks requiring only line voltage or DC power supply. The approved methods describing procedures and precautions in performing reproducible measurements of LEDs should ensure that the following properties are determined:-

- (I) Total Luminous Flux
- (ii) Luminous Intensity Distribution
- (iii) Electrical Power
- (iv) Luminous Efficacy (calculation)
- (v) Colour Characteristics should include following data:-
Chromaticity
CCT
CRI

IESNA LM-80 (LED Source). It defines the approved methods for measuring lumen depreciation of solid-state (LED) light sources, arrays and modules. LM-80 is a testing standard for the manufacturers of LED emitters not for the manufacturers of lighting fixtures. The OEMs of LED luminaires should procure LEDs which are LM 80 certified and should produce necessary certificate along with test results.

IESNA TM-21 (Determines Life of the LED light fitting)

TM-21 recommends a method for forecasting the lumen maintenance of LED light sources beyond the 6000 hours of data obtained by LM-80 testing. This is the method to be used to derive the number of hours before the L70 (70% of initial lumens) standard of lumen maintenance is reached. The OEMs of LED luminaires should procure LEDs which are LM 21 certified for 50,000 hrs of operation up to 70% output maintenance and submit necessary certificates.

CEILING FANS:-

SCOPE:-

1.1.1 This schedule specifies requirements for inclusion under standards and labeling programme for ceiling fans. Following sweep sizes of ceiling fans would be eligible for grant of star rating.

90mm, 1050mm, 1200mm, 1400mm, 1500mm

1.1.2 The referred Indian Standard is **IS374:2019** (Specifications for Electric Ceiling Type Fans) with all amendments , as applicable.

Schedule of Tests:-**a. Method of Tests:-**

The testing method and procedure shall be as per IS 374:2019 with all amendments, as applicable.

b. Parameters to be tested:

Parameters for initial verification and challenge testing are the mandatory type tests listed under clause 18 f IS 374:2019 with all amendments, as applicable for determination of service value.

Conditions of compliance:

The performance requirements would be in accordance to clause 15 of IS 374:2019 including all amendments , as applicable. For compliance with the requirements of this standard, the rated quantities of air delivery and service value shall not be inferior to the minimum values specified in Table 1 of IS 374:2019

Table 1 Performance Value for Fans (Clauses 15.1 & 15.2)

S.no	Fan Size mm	Minimum Air Delivery M3/min	Minimum Service Value m3/min/W
(1)	(2)	(3)	(4)
i)	900	130	3.1
ii)	1050	150	3.1
iii)	1200	210	4.0
iv)	1400	245	4.1
v)	1500	270	4.3

Note:- Air delivery values are on the air velocity measurement upto 15m/min.

Star Rating Plan:

Based on the threshold values laid down under IS 374:2019 including all amendments as applicable , there shall be two separate star rating plans based on sweep sizes of ceiling fan.

For sweep size < 1200mm (i.e. 900mm and 1050mm) , the star rating plan would be as per below:

Table 4.1 Valid from 1st September ,2019 to 30th June,2022

Star Rating	Service Value
1 Star	≥ 3.1 to < 3.6
2 Star	≥ 3.6 to < 4.1
3 Star	≥ 4.1 to < 4.6
4 Star	≥ 4.6 to < 5.1
5 Star	≥ 5.1

For sweep size ≥ 1200mm (i.e. 1200mm, 1400mm and 1500mm) , the star rating as per below:-

Table 4.2: Valid from 1st September ,2019 to June,2022

Star Rating	Service Value
1 Star	≥ 4.0 to < 4.5
2 Star	≥ 4.5 to < 5.0
3 Star	≥ 5.0 to < 5.5

4 Star	≥ 5.5 to < 6.0
5 Star	≥ 6.0

Note: In accordance with Table 1 (Performance values for fans) of IS 374:2019 including all amendments, as applicable

For 1400mm , minimum service value for fans be 4.1 (for 1 Star)

For 1500mm , minimum service value for fans be 4.3 (for 1 Star)

Tolerance Limits:-

The performance values claimed are minimum values & shall be subject to tolerance, if any as per clause 15.2 of IS 374:2019 including all amendments, as applicable.

Sampling for Check and Challenge testing:-

The samples of ceiling fans would be picked up by BEE or its designated agency. The testing would be conducted at the NABL accredited laboratory. Two samples of the specific model would be picked up at random from the retail outlet for the purpose of check testing.

Qualifications:-

For participation under BEE's star labeling program, every ceiling fan, being manufactured or sold or imported in the country shall.

Conform to all the performance requirements laid down in IS 374:2019 including all amendments, as applicable.

Carry BIS licensing (i.e. ISI marking) or Quality Certification such as ISO-9001 or above.

Particulars of the label and manner of display:-

The label design, manner of display & contents would be as per Annexure-1 of the Schedule 8.

Annexure-1

(Refer Clause 8 of the Schedule)

LABEL DESIGN AND MANNER OF DISPLAY

1.1 PLACEMENT

All ceiling fans must display the label at the point of sale. **The label shall be affixed on motor of ceiling fan.**

For units not on display , the label may be attached to the exterior of the packaging having the same directions of display. The label must be attached to the unit when the unit is removed from its packing.

1.2 MATERIALS AND SHAPE

The label shall be an adhesive label of non-perishable material when used on the switch housing / switch cup, if it is to be attached as a display on the exterior of the packaging then the label may be displayed by printing on the casing or a self-adhesive label, as applicable.

1.5 EARTHING

SCOPE

This section covers the essential requirements of earthing system components and their installation. For details not covered in these specifications, IS Code of Practice on Earthing (IS : 3043-1987) shall be referred to.

APPLICATION :

The electrical distribution system is with earthed neutral (i.e. neutral earthed at the transformer/ generator end). In addition to the neutral earthing, provision is made for earthing the metallic body of equipments and non-current carrying metallic components in the substation, as well as in the internal/ external electrical installations.

Earthing system is also required for lightning protection, computer installations etc. for function reasons.

Earthing requirements are laid down in Indian Electricity Rules, 1956 as amended from time to time, and in the Regulations of the Electricity Supply Authority concerned. These shall be complied with.

MATERIALS

The material of earth and earth conductor shall be as specified in BOQ

EARTH ELECTRODES

The type of earth electrode shall be any of the following :-

- a) Plate/ Pipe earth electrode as specified in BOQ.

Electrode materials and dimensions

The materials and minimum sizes of earth electrodes shall be as specified. The cross sectional area of earthing conductor shall not be smaller than half of the largest current carrying conductor subject to an upper limit of 80 Sq.mm. If the area of the largest current carrying conductor or bus bar exceeds 160 sq.mm then two or more earthing conductors shall be used in parallel, to provide at least half the cross sectional area of the current carrying conductor or bus bars. All fixtures, outlet boxes, junction boxes and power circuits upto 15 amps shall be earthed with PVC insulated copper wire.

All 3 phase switches and distribution panels upto 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper / GI wires. All 3 phase switches and distribution panels upto 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper / GI wires. All switches, bus bar, ducts and distribution panels of rating 200 amps and above shall be earthed with minimum of 2 nos separate and independent 25 mm x 3 mm copper / GI tape.

EARTHING CONDUCTOR

The earthing conductor (protective conductor from earth electrode upto the main earthing terminal/ earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper and in the form of wire or strip as specified. The size of earthing conductors shall be as specified.

HARDWARE ITEMS

All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrode and forged tinned brass in case of copper plate electrodes.

PROTECTIVE (EARTH CONTINUITY/ LOOP EARTHING) CONDUCTOR

i) The material and size of protective conductors shall be as specified.

ii) Unless otherwise specified, GI conductor should not be ordinarily used as protective conductor within any circuit beyond a Distribution Board downstream.

LOCATION FOR EARTH ELECTRODES

Normally an earth electrodes shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases electrodes may be located further away from the building, with the prior approval of the Engineering-In-Charge.

INSTALLATION

1) ELECTRODES

VARIOUS TYPES OF ELECTRODES

- a) Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in drawing.
- b) In locations where the full length of pipe electrode is not possible to be installed due to meeting a water table, hard soil or rock, the electrode may be reduced length, provided the required earth resistance result is achieved with or without additional electrodes, or any alternative method of earthing may be adopted, with the prior approval of the Engineer-In-Charge. Pipe electrodes may also be installed in horizontal formation in such exceptional cases.
- c) Plate electrode shall be buried in ground with its faces vertical, and its top not less than 3 m below the ground level. The installation shall be carried out as per the CPWD specifications.
- d) When more than one electrode (plate/ pipe) is to be installed, a separate of not less than 2m shall be maintained between adjacent electrodes.

1) ARTIFICIAL TREATMENT OF SOIL

When artificial treatment of soil is to be resorted to, the electrode shall be surrounded by charcoal/ coke and as indicated in enclosed drawings. In such cases, excavation for earth electrode shall be increased as per the dimensions indicated in the CPWD specifications

2) WATERING ARRANGEMENT

- a) In the case of plate earth electrodes, a watering pipe of 20mm dia. medium class GI pipe shall be provided and attached to the electrodes as shown in the drawing and a funnel with mesh shall be provided on the top of this pipe for watering the earth.
- b) In the case of pipe electrodes, a 40mm x 20mm reducer shall be used for fixing the funnel with mesh
- c) The watering funnel attachment shall be housed in a masonry enclosure of size not less than 30 cm x 30 cm x 30 cm.
- d) A cast iron/MS frame with MS cover of 6mm thick, and having locking arrangement shall be suitably embedded in the masonry enclosure.

EARTH CONDUCTOR

In the case of plate earth electrodes, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers. In the case of pipe earth electrodes, wire type earthing conductor shall be secured as indicated in drawing using a through bolts, nuts and washers and terminating socket. The earthing conductor from the electrode upto the building shall be protected from mechanical injury by a medium class, 15mm dia GI pipe in the case of wire, and by a minimum of 40mm dia, medium class GI pipe in the case of strip. The protection pipe in ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be fixed on walls. The earthing conductor shall be securely connected at the other end to the earth stud/ earth bar provided on the switch board by; Soldered or preferably crimped lug, bolt, nut and washer in the case of wire, and, Bolt nut and washer in case of strip conductor.

EARTH BUS AND MAIN EARTHING TERMINAL

In all installations, main earthing terminal shall be provided at the main switchboard. This may be in the form of earth stud or single earth bar depending on the type of the switchboard.

Following conductors shall be terminated on to the main earthing terminal.

- a) Earth connection from electric supply company (where provided)
- b) Earthing conductor from electrode.
- c) Protective conductors
- d) Equi-potential bonding conductors.

PROTECTIVE (LOOP EARTHING/ EARTH CONTINUITY) CONDUCTOR

Earth terminal of every switchboard in the distribution system shall be bonded to the earth bar/ terminal of the upstream switchboard by protective conductors. Two protective conductors shall be provided for a switchboard carrying a 3 phase switchgear thereon.

EARTH RESISTANCE

The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be up to 8 ohms.

Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode (s), different type of electrode, or artificial chemical treatment of soil etc., as may be directed by the Engineer-In-Charge, at additional cost as per the provisions of the contract.

MARKING

- i) Earth bars/ terminals at all switch board shall be marked permanently, as 'E'.
- ii) Main earthing terminal shall be marked 'SAFETY EARTH- DO NOT DISCONNECT'.

MEASUREMENT OF EARTH ELECTRODE RESISTANCE

- 1) Two auxiliary earth electrodes, besides the test electrode, are placed at suitable distance from the test electrode. A measured current is passed between the electrode 'A' to be tested and an auxiliary current electrode 'C' and the potential difference between the electrode 'A' and auxiliary potential 'B' is measured. The resistance of the test electrode 'a' is then given by

$$R = V/I$$

Where,

R- Resistance of the test electrode in ohms

V- Reading of the voltmeter in volts

I- Reading of the ammeter in amps

- 2) Stray currents flowing in the soil may produce serious errors in the measurement of earth resistance. To eliminate this, hand driven generator is used.

If the frequency of the supply of hand driven generator coincides with the frequency of stray current, there will be wandering of instrument pointer. An increase or decrease of generator speed will cause this to disappear.

- 3) At the time of test, the test electrode shall be separated from the earthing system.
- 4) The auxiliary electrodes shall be of 13mm diameter mild steel rod driven up to 1 m into the ground.
- 5) All the three electrodes shall be so placed that they are independent of the resistance area of each other. If the test electrode is in the form of a rod, pipe or plate, the auxiliary current electrode C shall be placed at least 30m away from it and the auxiliary potential electrode 'B' shall be placed mid-way between them.
- 6) On These principles, "Megger Earth Tester" containing a direct reading ohm-meter, a hand driven generator and auxiliary electrodes are manufactured for direct reading of earth resistance of electrodes.
- 7) On These principles, "Megger Earth Tester" containing a direct reading ohm-meter, a hand driven generator and auxiliary electrodes are manufactured for direct reading of earth resistance of electrodes.

SPECIFICATION FOR HOT DIP GALVANIZING PROCESS FOR MILD STEEL USED FOR EARTHING FOR ELECTRICAL INSTALLATION

GENERAL REQUIREMENTS

- I) Quality of Zinc
Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS:209-1992.

ii) Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm. The weight of coating expressed in grams per square metre shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface. The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing. Jointing of earthing tape shall be by welding. All joints and cut ends shall be properly painted with aluminium paint.

1.6 DATA AND VOICE

1) TELEPHONE WIRING

1 GENERAL

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall be approved either by ITD / DOT of Govt. of India.

Work shall be carried out as per the Method of Construction specified by BIS and as specified by DOT (Department of Telephone), Govt. of India. Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of Engineer in Charge.

2 Scope

To provide wiring for telephone on surface of wall or ceiling concealed in slab, wall, under flooring, etc., through existing metallic conduits, rigid PVC conduits, PVC trunking with all necessary hardware, material, etc. as specified.

To provide, install, test & commission the instruments / equipment and accessories used in telephone system, such as; Main Distribution Frames (MDF), Krone Modules, Over Voltage Magazine, PBX / EPABX, CO-axial cable, Rosette box, Jumper wire, etc.

3 Material

PVC Telephone cable: PVC insulated Tinned copper solid conductor with minimum 0.5 mm dia. (Single & Multi pair) properly paired and colour coded, shall be terminated on KRONE module with suitable tool.

Jelly filled Armoured Telephone cable: PVC insulated, PVC sheathed with steel armouring, Tinned copper solid conductor with minimum 0.5 mm dia multi pair, with Jelly, properly paired and colour coded.

Saddles: Saddles fabricated from G I sheet of required gauge (16/18 gauge) either galvanized finish or painted with superior quality enamel black paint, with necessary shearing for mechanical strength, semi circular shaped with extended piece having suitable holes for fixing on spacer. **Hardware:** Sheet Metal (SM) screws of required sizes, plugs, wooden gutties, etc.

MDF: Manufactured by reputed manufacturer of specified capacity, facility for wall mounting, with door & lock, aluminium frame for fixing of KRONE, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour.

Junction box: Manufactured by reputed manufacturer of specified capacity, facility for + wall mounting, with door & lock, aluminium frame for fixing of Krone, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour. The depth of the box should consider the height of KRONE module plus protection magazine.

Over Voltage protection Magazine: Manufactured by reputed manufacturer of 10 pair capacity, with 3 pole gas discharge tube should be properly fitted on KRONE module in MDF / Junction box.

Rosette box: PVC / Bakelite box with LED indicator, RJ 11 jack, facility for fixing on wall.

Jumper wire: Twin twisted PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia.

KRONE Module: Disconnection type KRONE module having capacity to connect 10 pairs with silver-plated terminal

contacts.

RG-11 Co-axial low voltage grade cable: PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia, with connector at both ends suitable for termination in RJ type socket.

PBX (Analogue type): Manufactured by reputed manufacturer and approved by Telephone Engineering Certificate (TEC) of specified extensions, having following features:

- Direct Inward dialling (DID) with voice guidance facility.
- Caller line Identification (CLI) on Analog as well as digital extension.
- Call Billing software (CB)
- Dynamic STD locking
- Conferencing facility for specified extensions.

EPABX (Digital type): Manufactured by reputed manufacturer and approved by Telephone Engineering Certificate (TEC) of specified extensions, having following features:

- Direct Inward dialling (DID) with voice guidance facility.
- Caller line Identification (CLI) on Analog as well as digital extension.
- Call Billing software (CB)
- Dynamic STD locking
- Conferencing facility for specified extensions.
- Provision of battery back-up and power failure line transfer.

4 Method of Construction:

Drawing of telephone wire through Steel conduit / PVC conduit / PVC Trunking:

As specified in Chapter for Point Wiring.

Erection of Jelly filled armoured Telephone cable:

Erection shall be done as per the layout finalized, in perfect level and plum. Before fixing the cable shall be straightened as far as possible for good aesthetics look. Cable shall be fixed with saddles firmly clipped on cable. Saddles shall be fixed to wall with minimum 50x8 mm SM screws with plugs/wooden gutties (Distance between two saddles shall be minimum 600 mm). Wooden gutties shall be used wherever required (Especially for stone wall). The entries made in wall, floor slab, etc for laying the cable shall be made good by filling and finishing with plastering the same.

Erection of MDF Junction box / Rosette box / PBX / EPABX, etc:

Specified equipment shall be fixed to wall with minimum 50x8 mm SM screws, with necessary plugs, wooden gutties, etc. or may be fixed on Table Top if required.

Mode of Measurement :

Work done for telephone in Steel / PVC conduit / PVC Trunking will be measured on running meter basis, (i.e. per running meter) for each single run. For the other accessories / equipments shall be done as per unit specified. (I.e. Job / each)

2) Computer Cabling

A UTP Networking Cable

General

All material shall conform to relevant standard as per ISO/IEC11801, CENELEC EN50173 & TIA/EIA 568-B2-1; CUL listed & ETL verified.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of Engineer in Charge.

SCOPE

To lay the cables for Computers on surface of wall or ceiling concealed in slab, wall, under flooring etc, through existing metallic conduits, rigid PVC conduits, PVC trunking, with all necessary hardware, material, etc. as specified. The cable shall be used only for connections between Information Outlet & Patch/ Multimax Panel. (Exception: For making MDIX patch cord)

MATERIAL

UTP cable:

4 pairs, 100 ohms, unshielded twisted pair (UTP), each pair separated by a PE former (Star shaped) solid 23AWG tinned copper conductor rated for temperature of 750 C, PVC insulated grey colour with following types as in the table 1.12/1

Table 1.12/1

Sr. No.	Type	Class	Tested frequency
1	Cat 6	E	350MHz
2	Cat 6+	E	500MHz

- 1) The Category 6 cable and Category 6 channel components shall be manufactured by a single manufacturer. The manufacturer shall warrant the Category 6 channel cable, components, and applications for a period of 20 years.
- 2) The Delay Skew on the 100 meter channel shall not exceed 30 ns
- 3) The 20 year warranty shall be a transferable warranty and has component replacement policy in case of manufacturing defect
- 4) Category 6, 100mtr channel, **4-connection** model should guarantee 400% margin over standard NEXT specification across swept frequency
- 5) Category 6, 100mtr channel, **6-connection** model should guarantee +4dB margin over standard NEXT Specification across swept frequency (1~250MHZ)
- 6) The high performance Category 6 UTP cable 23AWG shall be of the traditional round design with Mylar bisector tape Non-Plenum rated.
- 7) The cable shall support Voice, Analog Baseband Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS422, RS-485, 10BASE – T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, IEEE 1394B S100 and S400, as well as all 77 channels (550 MHz) of analog broadband video.
- 8) The cable jacket shall comply with Article 800 NEC for use as a non-plenum cable. The 4 pair UTP cable shall be UL□ and c (UL□) Listed Type CM.
- 9) Performance shall be characterized to 550 MHz to support high-bandwidth video applications

Non Plenum CAT6 UTP Cable

- 1) Weight=25.3 lb (1000 ft)
- 2) Jacket Thickness=.022 in
- 3) Outside Diameter=0.232 in
- 4) Conductor Diameter=.022 in
- 5) Insulation Type=High density Polyethylene
- 6) Jacket Material=PVC
- 7) Maximum Pulling Tension=25 lbs
- 8) Nom. Velocity of Propagation=0.69
- 9) Max DC Resistance=9.83 Ohms/100m
- 10) Mutual Capacitance @ 1 kHz = 4.95 nF/100m
- 11) Operating Temperature= -20 to 60° C
- 12) The high performance Category 6 UTP cable shall be of the **traditional round design with Mylar bisector tape.**
- 13) The 4 pair UTP cable shall be UL Type CM (non-plenum)

- 14) Performance shall be characterized to 550 MHz to support high-bandwidth video applications

Method of Construction:

The cable shall be laid in provided separate casing n capping/ PVC conduit/ trunking 400mm away from electrical cables wherever required without sharp bends. The cable shall be spliced at both the ends for punching/ crimping at keystone jacks/ UTP connectors.

Mode of measurement: Executed quantity shall be measured on running metre basis

B UTP Patch cord

Structured cabling, to make connections from switch to patch panel or information outlet to computer

Material:

UTP Patch Cord:

Assembly (conforming to EIA/TIA 568B-2-1) of Cat 6 type 4 unshielded twisted pair 24-26AWG (0.51mm-0.40mm), each pair separated by a PE former (Star shaped) 100 ohms stranded wire PVC insulated cables with modular RJ-45 polycarbonate UL94V housing 15milliohms gold over nickel contacts (superior three piece connector) crimped on both ends with T568A & T568B wiring schemes with 8P8C connection. The cord shall be branded. The cords shall be used in structured cabling in accordance with following table 1.12/2.

Table 1.12/2

Sr. No.	Length	Use in
1	1m	from switch to patch panel
2	3m	from computer to information outlet

- 1 All patch cords shall exceed TIA/EIA and ISO/IEC Category 6/Class E specifications.
- 2 All patch cords shall be backward compatible with Category 5 and Category 5E systems
- 3 The patch cords shall incorporate an anti-snap feature that provides maximum protection from snagging during moves and re-arrangements.
- 4 Patch cords shall be UL listed, UL-C certified and AUSTEL approved.
- 5 Patch cords shall support network line speeds in excess of 1 gigabit per second.

Physical Specifications:

Contact Material:	Phosphor Bronze
Contact Plating:	Gold 50 micro-inch (1.27 microns) Nickel 100 micro –inch (2.54 microns)
Insertion Life:	750 minimum
Plug Material:	Polycarbonate UL-rated 94 V-O
Operating Temperature:	14°F to 140°F (-10°C to 60°C)

Method of construction:

The patch cord shall be erected for making connections from switch to patch panel or from computer to information outlet.

Mode of measurement: Executed quantity shall be counted on number basis

2 NETWORKING COMPONENTS:-

i) 24 Port Gigabit Switch

Scope:

To be used in wired LAN connections.

Material:

Gigabit Ethernet Switch:

24 nos. of 10/100/1000 Base-T Gigabit ports, 2 or 4 combo SFP slots for flexible fibre backbone, VLAN, manageable, 19" standard rack mountable, auto detection of MDI/MDIX, Layer 2, Safeguard Engine to protect against traffic flooding caused by virus/worm outbreaks with rack mountable clips, screws, console utility software.

1. Feature-rich solution with functionality enabling by Secure Always On access to mission critical Applications
2. High performance switch architecture and stacking performance delivering 320Gbps
3. High-density 10/100/1000 ports for edge connectivity
4. Shared SFP uplinks ports per switch for gigabit fibre connectivity

Technical Specifications:

- ☐ 10/100/1000 Ethernet ports: 24 per switch
- ☐ SFP Gigabit ports: 4 per switch
- ☐ SFP support: SX, LX, XD, ZX, CWDM, 100FX & T1
- ☐ Resilient Stacking: up to 8 units
- ☐ Stacking ports: 2 built-in ports per switch
- ☐ Total stacking capacity: 320 Gbps
- ☐ Individual switch packet throughput: 36 Mpps
- ☐ Individual switch capacity: 88 Gbps
- ☐ Concurrent VLANs: 256
- ☐ Jumbo Frame Support on Gigabit ports
- ☐ Maximum MAC addresses: 8,000

Additional features:

- ☐ Customizable Auto-negotiation Advertisements (CANAs)
- ☐ Distributed Link Aggregation Groups
- ☐ Virtual Link Aggregation Control Protocol (VLACP)
- ☐ Nortel Multiple Spanning Tree groups
- ☐ Single IP address for stack management
- ☐ Resilient fail-safe stacking
- ☐ Automatic Unit Replacement (Configuration and Software)
- ☐ Automatic Detection Automatic Configuration (ADAC)
- ☐ 802.1X Single Host Single Authentication
- ☐ 802.1X Single Host Multiple Authentication
- ☐ 802.1X Multiple Host Multiple Authentication
- ☐ 802.1X Guest VLAN
- ☐ 802.1X Non-EAP (NEAP) access
- ☐ DSCP-based Recognition, Marking and Recolouring
- ☐ Ingress and Egress Port Mirroring
- ☐ Broadcast and Multicast Rate limiting per port
- ☐ ASCII Configuration File
- ☐ Web, NNCLI, JDM
- ☐ SSHv2 and SNMPv3 secure management support
- ☐ Nortel Secure Network Access (NSNA) support
- ☐ BPDU Filter
- ☐ Stack Monitor
- ☐ USB software and ASCII configure upload

- ☐ New unit quick to configure

Resiliency Features:

- ☐ Should support a technology which will allow multiple physical network links between two network Switches logical link and load balance the traffic across all available links
- ☐☐ Generally all the physical ports in the link aggregation group must reside on the same switch. It should also support protocols remove this limitation by allowing the physical ports to be split between two switches.
- ☐☐ Load balancing mechanism should not be round robin or dynamic which may not work with applications like Voice & Video, where session persistence is must.
- ☐☐ Main Objective of above features is to achieve Active-Active Cluster Switching .And achieve sub second failover in case of Link failure & Device Failure which will result in 99.999% uptime.

Electrical specifications:

- ☐ Power supply: AC 100-240V, 50-60Hz
- ☐ Input current at 110v: 1.3A
- ☐ Input current at 220v: 0.7A
- ☐ Max power consumption: 150W

Dimensions:

- ☐ Width: 438.2mm (17.25 in)
- ☐ Height: 1RU 43.7mm (1.72 in)
- ☐ Depth: 368.3mm (14.5 in)

Environmental specifications:

- ☐ Operating temperature: 0 to 50 degrees C
- ☐ Storage temperature: -25 to 55 degrees C
- ☐ Relative humidity: 10% - 90% non-condensing
- ☐ Peak noise level: 42.4 dB
- ☐ Thermal rating: 290 BTU/hr
- ☐ Calculated MTBF: 312,001 hrs

Hardware:

Chromium plated brass nuts & bolts with special type of U shaped square washers of required sizes.

Method of construction:

The Ethernet switch fitted with rack mountable clips shall be fixed in U Rack (Networking Cabinet) with 4 nos. of chromium plated brass nuts & bolts. The switch shall be configured for TCP/IP addresses for switch IP & Gateway

Mode of measurement: Executed quantity shall be counted on number basis

3 NETWORKING ACCESSORIES

A UTP connector (RJ-45)

General:

All material shall conform to relevant standard.

Scope:

To make MDIX (Cross) patch cord required for cascade connections of switches & routers.

Material:**UTP connector:**

Assembly of Gold over nickel contacts with 1.5A current carrying capacity, 30V with 15milli ohms contact resistance, 8P8C connection easy to crimp with crimping tool in polycarbonate UL94V housing.

Method of construction:

The UTP cable shall be spliced, untwisted not more than 12mm, inserted into the connector with sequence as shown in the **diagram** _____ as per EIA/TIA 568 B.2-1 & crimped firmly with crimping tool.

Mode of Measurement: Executed quantity shall be counted on number basis.

B Information Outlet (Ethernet) (IO)

General:

All material shall conform to relevant standard.

Scope:

For connecting computers to wired LAN or external wireless Ethernet interface in Wireless LAN.

Material:***Information Outlet Flush/ Surface type:***

Spring shuttered front access, high impact plastic body FR grade with high performance unshielded RJ-45 keystone jack (conforming to EIA/TIA 568-B.2-1 Cat 6), 15 milliohms contact resistance, gold over nickel spring contact, 1.5A current carrying capacity, with T568A/T568B wiring option, insulation displacement connector for cable crimping to accept 22-26AWG solid wire for connections up to Gigabit Ethernet.

- 1 All Category 6 outlets shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in TIA/EIA 568-B.2-1 Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801:2002 Second Edition.
- 2 The Category 6 outlets shall be backward compatible with Category 5E, 5 and 3 cords and cables.
- 3 The Category 6 outlets shall be of a universal design supporting T568 A & B wiring.
- 4 The Category 6 outlets shall be capable of being in a modular patching situation or as a modular telecommunication outlet (TO) supporting current 10BASE-T, Token Ring, 100 Mbps TP-PMD, 155 Mbps ATM, 622 Mbps ATM using parallel transmission schemes and evolving high-speed, high-bandwidth applications, including Ethernet, 1000BASE-T and 1.2 Gbps ATM.
- 5 The Category 6 outlets shall be capable of being installed at either a 45 or a 90 angle in any M-series modular faceplate, frame, or surface-mounted box avoiding the need for special faceplates.
- 6 The Category 6 outlets shall have improved pair splitters and wider channel for enhanced conductor placement. The outlet shall also have a low-profile wire cap, which protects against contamination and secures the connection. Multicolored identification labels shall be available to assure accurate installation.

Hardware:

Sheet Metal (SM) screws of required sizes, plugs, wooden gitties, etc.

Method of construction:

The Information outlet shall be fixed on the wall with sheet metal (SM) screws, rawl plugs/wooden gitties and making due connections as per EIA/TIA 568 B.2-1 by splicing the UTP cable, untwisted up to 12mm & punching the 4 pairs in the keystone jack with the help of punching tool. Not a single wire shall be left without connections.

Mode of Measurement: Executed quantity shall be counted on number basis.

C Patch Panel

Scope :-

Structured cabling for the installation of keystone jacks

Material:

Patch Panel:

Three piece structure including front panel, cable management plate with pre-fitted B-clip to help in routing cables & metal case of 1.6mm thick Mild Steel powder coated panel of size 442.6mm X 44.5mm with the provision for 1 to 24 high density keystone jacks

- 1 24 and 48 port patch panels with 110 IDC connector terminations on rear
- 2 The patch shall have electrical performance guaranteed to meet or exceed TIA/EIA 568-B.2-1 Category 6 and ISO/IEC Category 6/Class E specifications
- 3 The panel shall have vertical and horizontal cord organizers available as to improve patch cord management.
- 4 The panel shall be available in 24-port and 48-port configurations with universal A/B labeling and 110 connector terminations on rear of panel allowing for quick and easy installation of 22 to 24 AWG cable.
- 5 The patch panel shall have a black powder finish over high-strength steel.
- 6 The panel shall be equipped with a removable rear mounted cable management bar and front and rear labels.
- 7 The panel shall be UL listed, UL-C certified and ACA approved.
- 8 The panel shall support network line speeds in excess of 1 gigabit per second and be backward compatible with Category 5e, 5 and 3 cords and cables.
- 9 The Category 6 modular jack panels shall meet or exceed the Category 6/Class E standards requirements in ISO/IEC 11801, CENLEC EN 50173 and TIA/EIA and shall be UL Listed.
- 10 The panels shall be either wall or 19-inch rack mountable.
- 11 The panels shall meet the following specifications:

Performance Specifications:

		High performance Solution	Premium performance Solution
Category 6 Channel (4 connectors)			
	Typical worst pair margin	Guaranteed Margin	Guaranteed Margin
Insertion Loss	64.3%	5%	7.5%
NEXT	6.6 dB	6 dB	7 dB
PS NEXT	7.3 dB	7.5 dB	8.5 dB
ELFEXT	6.4 dB	6 dB	8 dB
PSELFEXT	6.1 dB	8 dB	10 dB
Return Loss	6.6 dB	4 dB	4 dB
Frequency Range	1 -250MHz	1 -250MHz	1 -250MHz

Operational Specifications:

Operating Temperature Range:	14°F to 140°F (-10°C to 60°C)
Storage Temperature Range:	-40°F to 158°F (-40°C to 70°C)
Humidity:	95% (non-condensing)
Nominal Solid Conductor Diameter:	0.025 to 0.020 in (0.64 to 0.51 mm) (22 to 24 AWG)

Nominal Stranded Conductor	
Diameter: Insulation Size:	0.025 to 0.020 in (0.64 to 0.51 mm (22 to 24 AWG)
Insulation Size:	0.042 in (1.08 mm) (22 to 24 AWG) Maximum DOD
Insulation Types:	All plastic insulates (including PVC, irradiated PVC, Polyethylene, Polypropylene, PTF Polyurethane, Nylon, and FEP)
Insertion Life:	750 minimum insertions of an FCC 8-Position Telecommunications Plug
Front Panel:	Black powder painted steel
Plastic:	High-impact, flame retardant, UL-rated 94V-0 thermoplastic

1.7 CABLE TRAYS AND RACEWAYS

1 CABLE TRAYS

The cable tray shall be fabricated out of slotted/perforated GI sheets as channel, sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanised or painted to the desired lengths.

Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 1994.

The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.

The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.

The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 800mm.

Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part-II -1994. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25mm x 5mm flats at specified spacing as per of CPWD General Specification of Electrical Work Part II -1994. Flat type suspenders may be used for channels upto 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the Engineer-In-Charge, to take the weight of the cable tray with the cables.

The entire tray (except in the case of galvanised type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint. The cable tray shall be bonded to the earth terminal of the switch boards at both ends.

The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly. Cable laid on cable tray shall be clamped on the tray at suitable intervals as

per CPWD specifications.

2) UNDER FLOOR TRUNKING

Under Floor Trunking for convenience outlet points, telephone outlets and computer outlet points shall be provided as per details given in drawings. Ducts will be manufactured from GI as mentioned in BOQ with a reinforcing web as per relevant BS or relevant standards of the country of manufacture.

Triple compartment system for convenience outlets, telephone outlets and computer data outlets will be provided as specified in the BOQ. Two types of trunking shall be provided, flush floor system with removable modular covers and removable compartment partitions and underfloor tracks as shown in the drawings or as specified in the BOQ. Junction boxes shall be constructed from same finish as the ducting, with top frames adjustable for height at each corner. Segregation of compartments of the ducting shall be maintained through the boxes. The complete assembly shall comply with requirements of Indian Telecom.

Lids of Junction boxes and floor ducting shall be of same make unless otherwise indicated. Lids shall be arranged to accommodate the floor finish as indicated.

Under floor ducting shall be straight and level and adjusted in height to relate to the finished floor level, as indicated.

Where ducting cross expansion and settlement joints occur in the building structure, suitable provision shall be made to allow for movement of the structure. The Contractor shall submit his proposals for the approval of Engineer-in-Charge.

Open ends of ducts shall be temporarily plugged immediately after installation to prevent ingress of water and solid materials. The boxes of under floor ducting shall be fitted with temporary lids immediately after they are installed and they shall be maintained as effective protection against ingress of water and solid material until the permanent lids are fitted after screeding is complete.

Method to be used for forming fire barriers at fire resistant structural elements such as floors and walls shall be submitted for the Engineer-in-Charge's approval.

Installed ducts shall be cleaned internally with a swab before cables are drawn-in.

If the protective finish of ducting is damaged after fixing, the damage shall be made good in a manner approved by Engineer-in-charge.

1.8 EXTERNAL LIGHTING AND POLES

SPECIFICATIONS

Street light poles, M.S. poles / Octagonal poles shall be as per the drawing given. The sections for the pipe shall be as shown in the drawing. The poles shall be welded properly and grinding shall be perfect to show smooth surface and stability shall be maintained. The light fixtures to be mounted above the poles shall be as specified in the BOQ. All the poles shall be treated with 2 coats of red oxide and after the putty and other works shall be spray painted with automotive category paints only. In case of powder coating 7 tank process shall be adopted. The painting or the powder coating option shall be as per the BOQ.

MATERIALS :

Support shall be any of the following types as specified :

- (i) Steel tubular poles, Casting Material
- (ii) Octagonal pole with base plate foundation type.

Support shall be adequate strength and conform to rule 76 of the Indian Electricity rules. The size of pole sections shall be selected in accordance with relevant IS specifications to suit the requirements of Loading.

Length of supports shall be specified, so as to satisfy the relevant functional requirements like the ground clearance of lines when installed, street lighting etc.

Steel tubular poles :

- (i) Steel tubular poles shall conform to IS: 2713 (part 1 to 3) These shall be of seamless / swage and welded type in three stepped sections as specified.
- (ii) The pole shall be complete with cap and base plate.
- (iii) Unless otherwise specified, One six of length of the pole plus 30cm from its base shall be coated with black bituminous paint, both internally and externally. The remaining portion of the pole shall be painted with one coat of red oxide primer on its external surface.

Fabricated poles : Fabricated pole shall be made from Galvanised Iron (GI) pipes or Mild steel (MS) Pipes (seamless or ERW) or fabricated from structural steel or steel sheet as specified.

Paint :

ISI marked paint of approved make and shade shall be used. Primer coats shall be with zinc chromate red oxide paint.

Location of support:

- (i) Pole shall be located strictly as per drawing and / or modified drawings or as directed by the engineer-in-charge. Any modifications, if required due to site conditions, the modified proposal shall be submitted to the engineer in charge for approval of the engineer-in-charge.
- (ii) Pole shall be located along side roads, on road beam, a little away from the road edge and drain.
- (iii) Pole shall not be located in front of entrance to building.
- (iv) Street lighting poles in group housing residential colonies as far as possible, shall be located such that the entrance of the blocks are lit up.
- (v) For street light poles the footpath between main road and a service lane shall be preferred. At each road junction one pole shall be located.

GLASS REINFORCED POLYESTER (GRP) POLES

- (1) THIS SPECIFICATION IS FOR POLES APPLICABLE IN GENERAL, WHERE HEIGHTS OF 2.5M TO 12M ARE REQUIRED.
- (2) GRP POLES SHALL BE MANUFACTURED BY THE CNC 4 AXIAL FILAMENT WINDING PROCESS /Centrifugal casting manufacturing process AND CAN DESIGN WITHSTAND TO WIND SPEED up to 180 KM/Hr and average thickness of 6 to 8mm.
- (3) GRP poles shall be highly resistant to impact deflection and bending, and shall be highly safe in case of a collision, fire resistant (using special resins), electrically non-conductive and safe without grounding.
- (4) FRP/GRP Pole should be flame retardant as per IS 6746. Resin used shall be UV Resistance and 'Pigmented. A highly weather resistant polyurethane coating shall be applied to the pole after applying suitable primer system that ensures proper adhesion of the paint. Minimum Coating thickness shall be 80-100 Microns. Deflection of Pole shall not be exceed more than 10% of the length of pole for the given load.
- (5) The poles shall be either of the burial type or the anchor type, with suitable cable access as shown on drawing details .anchor base plates shall be of galvanized steel/ mild steel equal in construction to flange plates used on steel columns (12mm to 20mm thickness) with four anchor bolt / holes and convenient cable entry, color range shall be submitted with the proposal and color shall be selected by the engineer before approval is granted on the manufacturer.
- (6) **TEST AND APPROVALS FOR GRP COLUMNS SHALL CONFORM TO THE FOLLOWING STANDARDS:**

- (1) Tensile strength : 200 ± 50 Mpa (Testing As Per ASTM D 638)
- (2) Compressive Strength : 200 ± 50 Mpa (Testing As Per ASTM D 695-10)
- (3) Flexural Strength: 200- 600 Mpa (Testing As Per ASTM D 790-10)
- (4) Izod Impact Strength: 150 ± 10 KJ/Sq.Mtr. As Per ASTM D256-10)
- (5) Glass Content: $\pm 50\%$ (Testing As Per ASTM D 2584)
- (6) Water absorption: $< 0.5 \%$ (Testing as per ASTM D 570)
- (7) Die Electric Strength: 6 ± 0.5 Kv/ mm (Testing As Per ASTM D 149)
- (8) Wind load withstand capacity: 180 Kms/ Hr

: TECHNICAL TERMS AND CONDITIONS:

: INSPECTION:

The contractor shall have to give intimation before ten days of dispatching the materials. The tests as per specifications will have to be given by supplier in their shop OR at site to AMC or authorized representative of the AMC / Third party appointed by AMC. All co-operation and testing aids shall be provided to facilities easy inspection by the inspecting authorities.

Representative deputed by the AMC for inspection shall be given full assistance in the form of necessary tools, instruments, equipments and qualified operators to facilitate inspection. AMC reserves the right to call for certificates for all materials and equipments at any stages of manufacture to prove its quality and originality. In the event of prevailing poor quality of goods, noticed during the inspection by the representative of AMC, AMC shall be at liberty to specify additional inspection procedures, if required to ascertain contractor's compliance with the equipment /materials specifications. Even though inspection is carried out purchaser or his representative, such inspection shall not however relieve contractor of all his responsibilities for furnishing equipment conforming to the requirements of the contract, no prejudice, any claim, right or privilege. Which purchase may have, because of the use of defective or unsatisfactory equipment. . All the Charges For inspection shall be Borne by Contractor (T.P.I Charges, Transportation, Lodging etc.) and inspection report will be binding to the bidder for entire work.

2 Factory Acceptance Test For All Bought out items

Client, his consultant and their authorized representative shall have the right to inspect and test or get inspected and tested the goods at the works of the Seller or its sub suppliers any time during manufacture and prior to dispatch and to inspect within a reasonable time after arrival of goods at the ultimate destination and during and after erection, testing and commissioning. The goods shall not be deemed accepted until after the said inspection, testing and commissioning and signing of the Acceptance Certificate. Failure to make any inspection of or payment for or acceptance of goods shall in no way impair client right to reject non-conforming goods or to avail itself of any other remedies to which client may be entitled, notwithstanding client knowledge of the nonconformity, its substantiality in the case of its discovery. In the event of failure of Seller to remove the rejected goods within the time allowed, client shall have the right to dispose of the same at the seller's risk and cost. During the time the rejected goods lie with client awaiting removal by the seller, they will so lie at the seller's risk. All goods rejected by client after receipt at the destination shall be removed by the seller within a reasonable time allowed by client, not exceeding 30 (thirty) days at seller's expense and risk.

The Seller will permit client Inspectors, Consultant and their authorized representatives free access during normal working hours to his works, godown, storage or loading spot etc. and will give them all necessary assistance to perform their task including free use of all accessories, testing and control instruments. The seller shall ensure that the same facilities are granted by his sub-suppliers. Unless specifically stated to the contrary in the order, all expenses relevant to the preparation and performance of testing, inspection and preparation of any test reports or certificates shall be borne by the Seller EXCEPT for the salaries, fees, traveling, lodging and boarding expense of the Consultant's / client's representatives. However, if the visit duration of D&D / client's representatives is extended for the reasons not attributable to D&D/ client, the cost of the extended period of visit shall be borne by the seller.

The sellers shall carry out tests related to performance tests as described in the specifications and specified in the order. All such performance tests shall be at supplier costs. Supplier shall also provide all the tests certificates and documents as demanded by the Inspector for his satisfaction that the order has been executed as per PO specifications. All such certificates, documents in original shall be submitted to the Client before dispatch of material. The goods shall be dispatched from suppliers shop only after written confirmation from clients / or its authorized representative.

The contractor shall consider all cost towards inspection of goods by consultant / EIC at factory / manufacturers works prior to shipping for 2 persons. (Travelling (Air / 1 st AC) /stay etc complete).

3 Safety Codes

Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra labour shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable footholds and

handhold shall be provided on the Ladder and the ladder shall be given an inclination not steeper than 1/4 to 1 (1/4 horizontal and 1 vertical). Safe means of access shall be provided to all working platform and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 meters in length. Width between side rails in a rung ladder shall in no case be less than 30 cm. for ladders upto and including 3 meters in length. For longer ladders this width shall be increased at least 6 mm. for each additional 30 cm. of length. Uniform step spacing shall not exceed 30 cm. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites shall so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lightest to protect public from accidents and shall be bound to bear expenses of defense of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the contractor be paid to compromise any claim by any such person.

Demolition: Before any demolition work is commenced and also during the process of the work:-

All roads and open areas adjacent to the work site shall either be closed or suitably protected.

No electric cable or apparatus, which is liable to be a source of danger over a cable or apparatus used by operator, shall remain electrically charged.

All practical steps shall be taken to prevent danger to persons employed, from risk of fire or explosion or flooding. No floor, roof, or other part of a building shall be so overloaded with debris or any materials as to render it unsafe.

All necessary personal safety equipment as considered adequate by the Engineer-in-charge shall be available for use of persons employed on the site and maintained in a condition suitable for immediate use; and the contractor shall take adequate steps to ensure proper use of equipment by those concerned.

Those engaged in handling any material, which is injurious to eyes, shall be provided with Protective goggles.

Those engaged in welding works shall be provided with welder's protective-shields.

Stone breakers shall be provided with protective goggles and protective clothing and seated At sufficiently safe intervals.

The contractor shall not employ male or female labour below the age of 18 years.

When work is done near any place where there is risk of drowning, all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

Use of hoisting machines and tackle including their attachments, anchorage and supports shall

Confirm to the following:

- a.) These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good repair and in good working order.
- b) Every rope used in hoisting or lowering materials or as a means suspension shall be of durable quality and adequate strength, and free from patent defects.
- c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years shall be in charge of any hoisting machine including any scaffold winch or give signals to operator.
- d) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all referred to above shall be plainly marked with safe working load. In case of a hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose of testing.
- e) In case of a departmental machine, safe working load shall be notified by the Engineer-in-charge. As regards contractor's machines the contractor shall notify safe working load of each machine to the Engineer-in-charge whenever he brings it to site work and get it verified by the Engineer-in-charge.

Motors gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards; hoisting appliances shall be provided with such means as will reduce to the minimum risk of accidental decent of load adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, insulating mats working apparel such as gloves, sleeves and boots as may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys or other materials, which are good conductors of Electricity.

All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work.

These safety provisions shall be brought to the notice of all concerned by display on a notice board at a prominent place at the work spot. Persons responsible for ensuring compliance with the safety code shall be named therein by the contractor.

To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the contractor shall be open to inspection by the Engineer-in-charge or his representatives and the Inspecting Officers.

Notwithstanding the above conditions 1 to 14 the contractor is not exempted from the operation of any other Act or Rule in force.

If the height at which the contractor is working is more than 12 feet then the staff should wear safety helmet and tie himself with softy belt, client/ architect have all right to ask the contractor to stop wire if the safety condition are not fulfilled.

4 Testing of Installation

1.0 SCOPE

This chapter describes the details of tests to be conducted in the completed internal Electrical installations, before commissioning.

1.1 GENERAL

Tests

On completion of installation, the following tests shall be carried out:-

- 1 Insulation resistance test.
- 2 Polarity test of switch.
- 3 Earth continuity test.
- 4 Earth electrode resistance test.

Witnessing of tests

Testing shall be carried out for the completed installations, in the presence of and to the satisfaction of the Engineer-in-charge by the contractor. All test results shall be recorded and submitted to the Department.

Test instruments

All necessary test instruments for the tests shall be arranged by the contractor if so required by the Engineer-in-charge.

1.2 INSULATION RESISTANCE

1.2.1 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, and except in earthed concentric wiring, all lamps in position, or both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure, provided it need not exceed 500 volts for medium voltage circuits. Where the supply is derived from a three wire D.C. or a polyphase A.C. system, the neutral pole of which is connected to earth either directly or through added resistance, the working pressure shall be deemed to be that which is maintained between the phase conductor and the neutral.

1.2.2 The insulation resistance shall also be measured between all the conductors connected to one pole, or phase conductor of the supply, and all the conductors connected to the neutral, or to the other pole, or phase conductors of the supply with all the lamps in position and switches in "off" position, and its value shall be not less than that specified in sub-clause 16.2.3.

1.2.3 The insulation resistance in mega ohms measured as above shall not be less than 12.5 mega ohms for the wiring with PYC insulated cables, subject to a minimum of 1 mega ohm.

1.2.4 Where a whole installation is being tested, a lower value than that given by the formula, subject to a minimum of 1 mega ohm, is acceptable.

1.2.5 A preliminary and similar test may be made before the lamps etc. are installed, and in this event the insulation resistance to earth should not be less than 25 mega ohms for the wiring with PYC insulated cables, subject to a minimum of 2 mega ohms.

1.2.6 The term "outlet" includes every point along with every switch, except that a switch combined with a socket outlet, appliance or lighting fitting is regarded as one outlet.

1.2.7 Control rheostats, heating and power appliances and electric signs may, if required, be disconnected from the circuit during the test, but in that event the insulation resistance between the case or frame work, and all live parts of each rheostat, appliance and sign, shall be not less than that specified in the relevant Indian Standard Specifications, or where there is no such Specification, shall be not less than one mega ohm.

1.3 POLARITY TEST OF SWITCH

1.3.1 In a two wire installation, a test shall be made to verify that all the switches in every circuit have been fitted in the same conductor throughout, and such conductor shall be labeled or marked for connection to the phase conductor, or to the non-earthed conductors of the supply.

1.3.2 In a three wire or a four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted in a conductor which is labeled, or marked for connection to one of the phase conductors of the supply.

1.3.3 The installation shall be connected to the supply for testing. The terminals of all switches shall be tested by a test lamp, one lead of which is connected to the earth. Glowing of test lamp to its full brilliance, when the switch is in "on" position irrespective of appliance in position or not, shall indicate that the switch is connected to the right polarity.

1.4 TESTING OF EARTH CONTINUITY PATH

The earth continuity conductor, including metal conduits and metallic envelopes of cables in all cases, shall be tested for electric continuity. The electrical resistance of the same along with the earthing lead, but excluding any added resistance, or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

1.5 MEASUREMENT OF EARTH ELECTRODE RESISTANCE

1.5.1 Two auxiliary earth electrode, besides the test electrode, are placed at suitable distance from the test electrode (see figure 14). A measure current is passed between the electrode 'A' to be tested and an auxiliary current electrode 'C', and the potential difference between the electrode 'A' and auxiliary potential 'B' is measured. The resistance of the test electrode 'A' is then given by:

$$R=V/I$$

Where,

R - Resistance of the test electrode in ohms,

V - Reading of the voltmeter in volts.

I - Reading of the ammeter in amps.

1.5.2 (i) Stray currents flowing in the soil may produce serious errors in the measurement of earth resistance. To eliminate this, hand driven generator is used.

(ii) If the frequency of the supply of hand driven generator coincides with the frequency of stray current, there will be wandering of instrument pointer. An increase or decrease of generator speed will cause this to disappear.

1.5.3 At the time of test, the test electrode shall be separated from the earthing system.

1.5.4 The auxiliary electrodes shall be of 13 mm diameter mild steel rod driven upto 1 m into the ground.

1.5.5 All the three electrodes shall be so placed that they are independent of the resistance area of each other. If the test electrode is in the form of a rod, pipe or plate, the auxiliary current electrode 'c' shall be placed at least 30 m away from it, and the auxiliary potential electrode 'B' shall be placed mid-way between them.

1.5.6 Unless three consecutive readings of test electrode resistance agree, the test shall be repeated by increasing the distance between electrodes A and C upto 50 m, and each time placing the electrode B midway between them.

1.5.7 On these principles, "Megger Earth Tester", containing a direct reading ohm-meter, a hand driven generator and auxiliary electrodes are manufactured for direct reading of earth resistance of electrodes.

1.6 TEST CERTIFICATE

On completion of an electrical installation (or an extension to an installation), a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as given in Appendix 'E' in addition to the test certificate required by the local Electric Supply Authorities.

5. FORM OF COMPLETION CERTIFICATE

- I) I/We certify that the installation detailed below has been installed by me/us and tested and that best of my/ our knowledge and belief it complies with Indian Electricity Rules 1956, as well as the Contract Specifications.

Electrical Installation at :-

Voltage and system of supply :- 3 phase 440Volts, AC ,50Hz

1) Particulars of work :-

A) Internal Electrical Installation

	No	Total Load	Type or system of wiring
I) Light point			
II) Fan point			
III) Plug point			
a) 3 pin 5Amp :-			
b) 3 pin 15Amp :-			
c) Others			
B) If the work involves installation of under ground cable:-			
I) Total length of underground cable & its size:-			
II) No. of joints:		End Joint:-	
		Tee Joint:-	
		St. through joint:-	

II) Earthing:-

- I) Description of earth electrodes:-
- II) Number of earth electrodes:- .
- III) Size:-

III) Test Results of wiring :-

- a) Insulation resistance

- I) Insulation resistance of the whole system of conductors to earth Mega ohms

- II) Insulation between the phase conductor and neutral

Between phase R and neutral	>	Mega ohms
Between phase Y and neutral	>	Mega ohms
Between phase B and neutral	>	Mega ohms

III) Insulation resistance between the phase conductors in case of poly phase supply

Between phase R and neutral	>	Mega ohms
Between phase Y and neutral	>	Mega ohms
Between phase B and neutral	>	Mega ohms

b) **Polarity Test**

Polarity of non linked single pole branch switches :-

c) **Earth continuity test**

Maximum resistance between any point in the earth continuity conductor including metal conduits and main earth lead < ohms

d) **Earth electrodes resistance**

Resistance of each electrode :-

i)	Ohms
ii)	Ohms
iii)	Ohms
iv)	Ohms

e) **Lightning Protective System**

Resistance of the whole of lightning protective system to earth before any bonding is effected with earth electrodes and metal in / on the structure ...<ohms

6. SPECIAL CONDITIONS OF CONTRACT

1 GENERAL

The complete Electrical Installation shall be carried out in strict accordance with the regulations of the electricity supply authority, Institution of Electrical Engineers, ISI Standards, fire Insurance Company insuring the building and national code of practice.

The standard conditions of contract are meant to amplify the specifications, schedule of quantities and drawings and the more stringent of the above shall apply should there be any ambiguity or inconsistency. The contractor should report the same to the Architect/Consultant and obtain clarification before submitting his tender.

All Equipments, cables etc. shall be adequately rated to suit the climatic conditions experienced in this country.

Clause in this specification shall apply equally throughout.

2 ORDERING

As soon as possible after the contractor receives written notification of the acceptance of his tender he shall order all the materials and equipment required to complete the contract. He shall submit to the consultant the detailed summary of all the orders placed, providing the details about the name of Supplier/Vendor, make of equipment, date of order and forecast of delivery date at site.

3 STANDARD OF MATERIALS

When the material and equipment is specifically described named in the specifications, it is so named or described for the purpose of establishing a standard of materials and workmanship to which the contractor must adhere. The Contractor must quote with the material as listed in the make of materials list attached later in the document. The Contractor may submit with his tender a list indicating any alternative make of material that he proposes to install. Before installing such a make the contractor shall take permission from the consultant. All materials condemned by the consultant as not approved for use are to be removed from the premises and suitable material shall be delivered and installed in their place at the expense of the Contractor. If alternatives are not offered during the tender stage then the contractor will be deemed to have submitted his tender based on all materials and equipment specified or shown on the drawings and therefore no alternative manufacturer or supplier of such material and equipment specified or shown will be considered after the contract is awarded if however the material or equipment specified or shown on the drawing is not available due to any genuine reason. The contractor shall prior to order get the written approval of the consultant for the particular material/equipment.

The Contractor shall be responsible for the safe custody of all material and shall insure them against theft damage by fire earthquake etc. A list of materials and equipment together with a sample of each shall be submitted to the consultant as directed by him within 30 days of the award of the contract.

All materials required for the works shall be new and the best of their respective kinds and shall be of uniform pattern. All materials shall be suitable for use in temperatures of 50oC with comparative humidity.

The protective finishes detailed as follows must be provided on all materials and apparatus used on this contract to ensure that no deterioration is caused by the local climatic conditions.

All materials shall be inspected by the Contractor to ensure that finishes are in accordance with this specifications.

- A** The interior fittings in all distribution boards and control units shall be properly painted.
- B** All holes in distribution boards and similar equipment shall be blanked off to protect from dust and vermin where ventilation is necessary holes are to be neatly covered.
- C** All cable entry holes on switchgears and similar equipment shall be fitted with PVC/Rubber Bushings.

The material supplied by the client or other agencies shall be properly inspected by the contractor before accepting so that any damage thereafter is the liability of the contractor.

4 WORKMANSHIP

The workmanship and method of installation shall confirm to the best standard practice. All work shall be performed by skilled tradesman to the satisfaction of the Consultant/Architects. Helpers shall have qualified supervision.

Any work that in the opinion of the consultant does not confirm to the best standard practice shall be removed and reinstated at

the Contractor's expense permits certificates and licenses must be held by all tradesman for the type of work in which they are involved where such permits certificates and licenses exist under government legislation.

5 PROCEDURE

Throughout all stages of work the contractor shall maintain a close liaison with the consultant and with all other contractors involved in the work.

Site work shall commence immediately with the start of building work and shall proceed expeditiously in harmony with the building work so as not to delay the latter in any way. All plant to be supplied and work to be done under this specification shall be manufactured and executed in the manner set out in this specification or where not so set out the reasonable satisfaction of the consultant and all the contractors works on site shall be carried out in accordance with the such reasonable directions as the consultant may give.

The contractor in the interest of the work shall furnish a bar chart based on the chart furnished by the civil contractor stating all the starting and completion dates clearly in the format that consultant approves or in the format of the civil bar chart.

The contractor shall also furnish the time chart showing the material procurement marking the ordering date and the delivery date of the material on site. In case of delay in delivery of material at site the contractor may be asked to furnish proper reason for the delay.

The contractor if at all feels necessary shall attach the drawing schedule requirements with the tender documents.

6 PERMITS

The Contractor shall obtain all necessary permits prior to work commencement for the excavation of cable trenches etc. in the areas where it is suspected that existing services are present the contractor shall carry out excavation work by hand. He shall also obtain the necessary permits from the respective authorities prior to working on major items of the switchgear. All application permits shall be made in writing with a copy to the consultant.

7 TEMPORARY AND TRIAL USAGE

It shall be understood and agreed that temporary and trial usage by the employer of any device, machinery, apparatus, equipment or any other work or materials supplied under this contract before final completion and written acceptance of the item by the employer it is further understood and agreed that the employer shall have privilege of such temporary and trial usage as soon as the contractor shall claim that the said work is completed and in accordance with the drawings and specifications and to the manufacturer's instructions and for such reasonable length of time as the consultant shall deem suitable for making a complete and thorough test of the apparatus or system under test.

No claim for the damage will be made by the contractor for the injury to or breaking of any parts of the works which have been placed under test whether this damage has been caused by weakness, flaw or inaccuracy of structural parts or by defective material or workmanship of any kind whatsoever.

8 CLEANING

Before operating any of the systems the contractor shall clean out all rubbish and dirt upon completion of the contract the contractor shall ensure that all items of plant are left in a clean and tidy condition.

9 SETTING OUT OF WORKS

The specification and schedule of rates shall be considered as part of this contract and any work materials shown on the schedule and not called for in the specifications or vice-versa shall be executed as if specifically called for in both.

The Contractor at his own expense shall set out all his hard works and take all his measurements and dimensions required for the erection of his materials on site making and modifications in detail to the consultant before proceeding and must allow in his tender for all such modifications and for the provision of any sketches or drawings related there to.

The position of all DB's Panels, Cable routes, fixtures, Wiring Systems, Service Outlets and control Switches shown on the drawings are to be assumed as being correct for the purpose of tendering final positions of these must be agreed with the consultant before installation.

The data given here in and on the drawings is as exact as could be secured but its complete accuracy is not guaranteed. The drawings are for the guidance of the contractor, exact locations, distances and levels will be governed by the site conditions.

10 AS BUILT DRAWINGS / SHOP DRAWINGS

Contractor shall make all necessary shop drawings indicating conduit / cable tray routes / qty's / sizes; cable schedule, circuiting details etc complete before starting the works and get approval of consultant / EIC.

At the completion of the works and before issue of the certificate of virtual completion, the contractor shall submit to the

consultant 4 sets (HARD AND SOFT FORMAT) of layout drawings drawn at approved scale indicating the complete wiring system as installed. These drawings must provide the following minimum information:

- A Run and size of conduits, inspections, junction and pull boxes.
- B Size of conductors in the conduits.
- C Location and rating of sockets and switches controlling the light and power outlets.
- D Location and details of distribution boards, mains, switches, switchgear, main panel and other particulars.
- E A complete wiring diagram, as installed and schematic drawings showing all connections in the complete electrical system.
- F Location of outlets, junction boxes, sizes of various conduits for telephones.
- G Location of all earthing stations, routes, sizes of all earthing conductors, manholes, layout of earth link strips, etc.
- H Layout and particulars of all cables.
- I Necessary drawings with prints for approvals from local / govt. authorities.

Above indicates the general requirement. However, contractor must include all information desired by the client and Architects/Consultants in the final as built documents. Guidance for the preparation of as built document shall be had from the consultant.

11 MANUFACTURER'S INSTRUCTIONS

Where manufacturer's have furnished specific instructions, relating to the materials used in this job for covering, paints etc which are not specifically mentioned in this documents, manufacturer's instructions shall be followed.

12 GUARANTEE

At the close of the work and before issue of the final certificate of virtual completion. The contractor shall furnish written guarantee indemnifying the Architect/Consultant against defective materials and workmanship for a period as mentioned in the schedule of fiscal aspects. The contractor shall hold himself fully responsible for reinstallation or replacement, free of cost to client the following :

Any defective work or material supplied by the Contractor.

Any material or equipment damage or destroyed as a result of defective workmanship by the Contractor.

13 SAFETY OF MATERIAL

The Contractor shall provide proper and adequate storage facilities to protect all materials and equipment, including those issued by the owner against damage from any cause whatsoever.

14 COMPLETION CERTIFICATE

On completion of the Electrical Installation a certificate shall be furnished by the Contractor counter signed by the licensed supervisor, under whose direct supervision the installation was carried out.

The certificate shall be in the prescribed form as required by the local authority.

The contractor shall be responsible for getting the Electrical installation inspected and approved by the local authorities connected.

15 ENGINEER AND FOREMAN

The Contractor shall employ a competent fully licensed, qualified full time electrical Engineer and foreman to direct the work of Electrical Installation in accordance with drawings and specification.

The foreman shall be available full time on site to receive instruction from Architect/Consultant or his nominee in the day to day activities throughout the duration of the contract the foreman shall correlate the progress of work in connection with all relevant requirements of the supply authorities.

16 LIASIONING WITH LOCAL SUPPLY COMPANY

The contractor shall be responsible for all the liaisoning work with the supply company. However, all the technical assistance required for the same may be furnished by the consultant. The contractor has to fill the necessary forms and submit test reports so as to ensure that the supply is available in time. The contractor shall prepare necessary drawings for the approval of the concern government departments and has to get the necessary permissions for supply and D.G. sets etc.

17 SPECIFICATIONS AND SCHEDULE

The specification and schedule of rates shall be considered as part of this contract and any work or materials shown on schedule and not called for in this specifications or vice versa shall be executed as if specially called for in both. The drawings indicate the extent and general arrangement of the fixtures, controlling switches, wiring system etc. and are essentially diagrammatic. The drawing indicates the points of termination of conduit runs and are suggestive of the routes to be followed.

18 SUPERVISION

Supervision shall be by a competent person experienced in the nature of the work to be undertaken. This person shall be available on site for the full period of works. The Engineer may demand at any time during the contract the replacement of the contractor's personnel who fails to satisfy this requirement of competent.

19 TOOLS AND EQUIPMENTS

The Contractor shall provide all necessary Jointing Equipment, tools, Portable power tools, test equipment etc which will be required to carry out the Electrical work. All the zarri work, except in unavoidable circumstances, shall be done with a zarri cutter.

This includes all heavy duty equipments such as Cranes, Lorries, etc. for site delivery and fixing.

The contractor must have minimum following instruments:

- 1) 1000 / 500 V Meggar.
- 2) Clip on meter.
- 3) Earth tester.
- 4) Lux meter.
- 5) Zarri Cutter.
- 6) Multi Meter.
- 7) Drill machine upto 25 mm dia.
- 8) Ladders suitable for 30 ft. and above.
- 9) All safety equipments like helmet, safety rope etc.
- 10) Complete set of spanners, screw drivers etc.

20 SITE STORAGE

The contractor shall be responsible for the safe storage of materials on site. This includes ensuring that all equipment is handed to the client in sound undamaged order.

The Contractor shall be responsible for safe storage of materials on site, and liable for their replacement. The Contractor would be required to maintain a watch man on site an this shall remain Contractors Choice.

21 SPARES

The Contractor shall prepare a schedule of manufactures recommended for spares for one year maintenance.

22 OPERATING AND MAINTENANCE MANUALS

The Contractor shall furnish two sets of operating manuals which shall include services maintenance instructions and circuit diagram for each item of equipment.

23 SITE CONDITIONS

The Contractor shall take all necessary action to acquaint himself fully with site conditions. Any conditions at tendering stage will not be accepted.

After the contract is awarded the Contractor shall acquaint himself fully with existing services and obtain all necessary information to avoid any damage to the services during excavation etc.

24 LABELS AND NOTICES

On all switchgear identification name plates shall be fitted these will identify the substation and/ or outgoing ways. The labels shall be made on indestructible non deteriorating material with lettering engraved in black or white background except where otherwise specified. Fixing shall be by means of rivets or screws in addition to any adhesive. All labels shall be English/Hindi /mother language as directed by the Consultant. All pillars and mini feeder pillars in addition to identification labels shall have each way identified by a label to the same specification fitted in the feeder pillar. An indestructible "Danger 415 volts" plates should be fitted externally with a double flush danger

signal. The letters to be 12 MM height minimum in signal red.

In addition each distribution board shall have a typed chart detailing particulars of the circuits controlled which shall be fixed to the inside of the door. The details shall include the circuit load, description, the type and rating of the protection device, and the cable size. A sheet of transparent rigid plastic shall be used to completely cover the chart to prevent damage.

25 PACKING AND RECEIPT OF MATERIAL

The contractor shall take every possible measure including appropriately strong packing, proper supervision of loading and offloading and proper transportation by the most suitable route to ensure the safe delivery to site of plant and equipment. The Contractor shall keep at site up-to-date record of all materials received and fully annotated with details of the carrier and condition of equipment on arrival.

26 RECORDING OF WORK

The contractor shall keep a diary and a set of drawing recording the progress of the works and details of all instruction received. These shall be available for the consultant upon request. The contractor's site representative will submit a written report every two weeks outlining the progress of the work including work completed to date. The review of the work completed and the bar chart submitted shall be done weekly and the difference in the two shall be submitted to be Consultant specifying the reasons for the difference.

On completion of work the contractor has to submit detailed reconciliation statement of all electrical materials. The loss of material shall be recovered at prevailing market rate for the material supplied by the client or other agency.

The contractor shall take permission from the employer before he takes all the unused material from the site on completion of work.

27 MARKING OUT

Routes and positions of systems, and positions of all electrical equipment shall be marked out by the contractor and approved by the Engineer before such items are installed.

These items shall be installed in the positions shown on the drawings, but reasonable variations may be made on site with the consent of Engineer.

28 FIXING

Screws fixing brick concrete or similar materials which necessitates plugging shall be made using steel woodscrews into plugs in rotary drilled holes.

Items of switch fuse gear, cable racks and trays etc. shall be fixed using corrosion resistant steel bolts fitted with expanding collars, e.g. 'Anchor Fastener' set into rotary drilled holes of the correct size all such bolts shall be provided with one number wide flange washer and one heavy spring washer.

29 CONTRACTORS RATES

The Contractors rates must be included the cost of transportation of materials to the site. All taxes such as sales tax, Excise and Octroi etc. and the fixing or placing in position for which the items of work is intended to be operated.

The contractor shall quote in English, in words and figures, the amount tendered by him in the Form of Schedule of rates forming part of the tender document in such a way that interpolation is not possible. The amount for each item shall be worked out and entered and requisite totals given for all items. The tendered amount for the work shall be entered in the Tender and duly signed by the tenderer.

The contractor shall include in rates quoted all expenses (travelling / lodging / boarding) for inspection of goods at manufacturer's workshop for two persons from client / consultants office.

If some discrepancies are found between the rates in words and figures or the amounts shown in the tender following procedure shall be followed:

a When there is difference between the rates in figures and words, the rate in words shall be taken as correct.

b When the rate quoted by the tenderer in figures and words, tallies, but the amount is incorrect, the rate quoted by the tenderer shall be taken as correct.

C When it is not possible to ascertain the correct rate, in the manner prescribed above, the rate as quoted in the words shall be adopted.

The contractor shall be liable to furnish the rate analysis for the rates quoted by them, if the architect/consultants find the rates to be non-workable and ask for the analysis.

Labour rates not quoted for the items / or rates for extra items shall be decided 15 days prior to the start of the work as per the procedure listed in schedule of fiscal aspects. However, looking to the urgency of the work, if it is required to execute the item without the settlement of rate, then the rate for the same item will be finalised before making the payment.

30 ARCHITECTS / CONSULTANTS DECISIONS

Matters not covered by the specification given in the contract as a whole shall be covered in the relevant ISI codes. If such codes for a particular subject have not been framed, the decision of the Architect/Consultant shall be final.

The work shall be carried out under the direction and supervision of the architect / consultant or their representative at site who shall guide the representative of contractor from time to time. On acceptance of the tender, the contractor shall intimate the name of the representative who would be supervising the construction and would be responsible for taking instructions for carrying out the work.

The Architects / consultants or their representative at site shall have access to the workshops of the successful tenderer so as to ensure themselves of the quality of material and workmanship.

The Architects / Consultants decision with regard to the quality of material and workmanship will be final and binding any material rejected by the Architect / Consultant shall be immediately removed by the contractor.

31 DEFECTS LIABILITY PERIOD

This period of 12 months, shall be in force from the date of “Virtual completion” and minor defects if any shall be corrected / rectified within 24 hours and major defects within 3 day which shall develop during this period. However, if the same are not rectified by the Contractor within the period mentioned above the clients with the concurrence of the Architects shall get the work done at the risk and the cost of the Contractor.

32 OCCUPYING PART AREAS

If the owner wants to occupy areas in part, the Contractor shall have to complete the work of these areas in consultation with the owner and handover the same to the employer without affecting any of the clause of the contract agreement.

33 TEMPORARY WIRING

Whenever any temporary wiring is done, it has to be done so that all precaution for safety is taken and temporary wiring shall be done so that, it is not hazardous to anybody. Any accident due to temporary or permanent wiring or installation shall be the responsibility of the contractor and compensation shall be paid by the contractor to all the concerned.

Annual operation and Comprehensive Maintenance of Electrical, ELV System

ELIGIBILITY CRITERIA:

The Maintenance Contractor shall employ technically qualified and competent persons for operation and maintenance for execution and supervision of the works.

The contractor shall comply with the provisions of all labour legislation including

The requirement of –

- a) The payment of Wages Act
- b) Employers liability Act, including P.F Act, Gratuity Act, etc.
- c) Workmen's Compensation Act.
- d) Contract Labour (Regulation and Abolition) Act,
- e) Apprentices Act
- f) Any other act or enactment relating thereto and rules formed there under from Time to time.

The contractor shall have to keep the bank saved, harmless and indemnified against claims if any of the workmen and all costs and expenses as may be incurred by the bank in connection with any claim that may be made by any workmen.

TERMS & CONDITIONS OF THE CONTRACT

The Contractor should ensure to comply with all the provisions of Labour Act / State / Central Govt. agreed procedures. The Contractor shall be solely responsible for compliance to provisions of Various labour and industrial laws and all statutory obligations such as minimum wages as per Central Govt. rules ,allowances, compensations, EPF, Bonus, gratuity, ESIC, etc. relating to workers provided to the Ahmedabad Muni.Corporation. The Ahmedabad Muni.Corp. Shall have no liability in this regard.

The Contractor shall ensure to get the Police verification for all the manpower deployed by them and the contractor should ensure that the manpower deputed should bear good moral character. All personnel provided by the Contractor will be on the payrolls of the Contractor / Company and there will be no Employee and Employer relationship between the personnel engaged by the Contractor and the Ahmedabad Muni. Corp.

That the Contractor will not sub-contract or permit any other person to perform any of the work or services agreed to without prior permission from the Ahmedabad Muni. Corp.

The Contractor shall ensure the availability of a reliever for weekly off and a substitute is provided if a person is absent. The Contractor should arrange for replacing his workmen to give weekly off to his workmen as per the labour rules.

Contractor's personnel or their family members shall not be allowed to stay / reside at site.

SAFETY, SECURITY, ETC.

That the Ahmedabad Muni.Corp. shall not be liable for any compensation in case of any fatal injury /death caused to any other Contractor's employees while performing / discharging their duties / visiting premises for inspection or otherwise. The contractor shall alone be fully responsible for safety and security & insurance or life insurance of their personnel who is working on the operation and maintenance works.

In no case, safety norms shall be violated. Even in case of urgency, when temporary rectification is done, etc. no such compromise is allowed as regards to safety provisions.

The Contractor agrees that its personnel shall comply with security regulations in effect from time to time at the premises and externally for materials belonging to you at all times. The Contractor alone shall be fully responsible for safety and security & insurance or life insurance of their personnel who are working at site.

They shall be responsible for any periodic statutory inspection to be carried out on the equipment necessary test report and certificate rectification of defects, pointed during such inspection etc.

Contractors should follow all safety norms and provide necessary safety equipment at their own cost. In case of any accident during the maintenance of the equipment leading to injuries /damages to human beings equipment and / or loss of life, the contractor shall be fully responsible for setting all claims and indemnify the Centre against any claims arising out of such accidents. Consequent damages to other systems will however be recoverable from the contractor.

The Contractor should issue a valid Company Identity cards to all their staff personnel who will be providing services under this contract.

The Contractor shall provide and ensure sufficient personal protection gears like safety shoes, hand gloves, full body safety belts, ladders, etc. Are being worn by their workers while carrying out works.

The Contractor shall ensure that necessary tools and equipment like Multi-Meter, Megger Meter, phase sequence meter, Tongue tester, lug crimping machines, Spanner Kit, Screw Driver Kit, Ladders, Ratchet Kit, etc. are always available at site for the purpose of attending breakdowns on emergency basis. All the tool kits and meters should be of an ISI marked wherever applicable and the required numbers are to be made available by the Contractor.

The Electrician shall report to the authority while entering & exiting the premises. All personnel of Contractor will be subjected to a thorough physical checking while coming and leaving the colony. Those persons so deputed will sign in the Register for arrival and departure at the site.

PAYMENT TERMS:

Payment of AMC shall be made post monthly basis after effecting necessary deductions like TDS, penalty for shortcomings etc.

There would be no increase in rates payable to the Contractor during the Contract period. In-case of renewal after the initial contract period the minimum wages component only will be revised considering the changes in the Central Govt. minimum wages, if any. For eg. If there is a variation of 5% in the labour wages at the time of renewal from the wages prevailing at the time of tender finalisation, only the labour wages will be considered proportionately.

Payment of wages to all the workers engaged by the contractor should be through an Account maintained with any Scheduled Commercial Bank.

SPARES:

Spares required for routine maintenance of electrical equipment like switching accessories, lighting accessories, switch gears, etc. shall be supplied / borne by contractor and keep necessary required inventory of spares.

The rates shall be all inclusive of establishment as well as spares and consumables as per schedule of work. The contractor is required to assess the probable quantity of all types of spares and consumables likely to be required for replacement for keeping all the installations in good working conditions and include the lump sum cost of these spares & consumables. Nothing extra on any account shall be payable over and above the approved all-inclusive comprehensive rates of the contract.

The consumables and spares shall be of best standard quality purchased from the original manufactures or authorized dealers only and shall be approved by the concerned authority before use. The Authority may direct the contractor to use consumables of its choice from the listed/approved vendors.

All spares and consumables shall be arranged by the contractor for which nothing extra shall be payable.

A list shall be prepared by the Contractor for major & minor spares consumables and the decision of Ahmedabad Muni. Corp. regarding the major /minor consumables shall be final.

Replaced parts/ spares, used materials etc. will be property of contractor. It is his responsibility to disposed of immediately.

DELAY IN WORKS AND PENALTY

If work is not done as per above schedule or any system is not functioning then a penalty @ rate of Rs.500 /- per day shall be imposed on contractor for each location separately and will be deducted from the AMC amount due to the contractor and if unsatisfactory performance is continued for more than two days as felt by the Centre and AMC is liable to be terminated and final decision for this shall rest with the concerned Authority.

If the contractor is NOT able to locate and rectify the fault and the reasons attributable to non-performance of contractor as assessed by officials nominated by, the penalty clause is applicable as System remained non-functional for 2 hrs. or more. The penalty will be Rs.500/-per day.

If contractor is not able to rectify the fault then the same may be got done through some other agency at the risk and cost of contractor failing which the same amount will be deducted from AMC bill in addition to the penalty as

stipulated above will also be imposed. However, the decision of the Ahmedabad Muni.Corp.in this regard shall be final and binding.

SCOPE OF WORK – ELECTRICAL & ELV Systems

All the Electrical works should be carried out through qualified licensed Electricians only. Contractor should deploy person with minimum qualification of I.T.I. passed in Electrical or above and having experience of minimum 05 (five) years in handling Electrical works. Electricians should be Govt. licensed with a minimum experience of 2 (two) years in the Electrical maintenance field. The LT equipment shall be operated only by the qualified licensed Electrician having suitable experience in handling LT installations. The Contractor shall carry out all

Repairs and maintenance services in agreed to with the help of qualified persons who are totally familiar with the work they are required to perform

Manpower is to be deployed as one person in a shift on all the days of the year (including Holidays and Sundays, comprising of two shifts) for daily operation and preventive / breakdown maintenance of electrical, CCTV and Fire Alarm installations and equipment. Supply of manpower is daily (including Holidays and Sundays, comprising of three shifts) on all the 365 days for daily preventive / breakdown maintenance of electrical installations and equipment. The Contractor personnel should be available in the premises throughout the entire working hours. However, if the maintenance contractor feels that more expertise is required to carry out the above work, they may deploy additional experts at their discretion. Ahmedabad Muni. Corp. will not pay any additional amount for the additional manpower. However, in-case of major breakdown Bank may consider reimbursing the cost of the manpower on case to case basis. The Contractor shall also carry out the repairs / maintenance on holidays as well as on Sundays.

The Contractor shall maintain the pumps, motors and electrical installation to keep them in working condition, every day. The contractor shall also attend to all complaints of the premise from time to time on daily basis.

The contractor shall arrange to attend the complaints relating to repair & replacement such as fused bulbs, tubes, fuses, damaged MCB, sockets, wiring, switches, connections, fans, exhaust fans, etc. in the community Hall, Pump house and office areas, Street lights in the compound.

Operation of lighting installations (Street poles, Common areas), Hall Sign boards, water pumps, etc. during shifts... All the external lights such as street lights, area lights, garden lights, and common area lights, pump room lights (as also all internal lights / office lights in case of office premises) shall be cleaned once in three months by the Contractor personnel or as and when required. However if any such light is too dirty so that illumination of light is restricted or filled with insects, then it shall be cleaned by the Contractor personnel immediately, whether falling in three months schedule or not and if any defect noticed, then it should be rectified to prevent entry of dirt, insects etc.

If for any reason any equipment is required to be repaired from any outside agency or in any workshop, the same shall be arranged by the agency at his own cost with in the quoted prices.

Maintenance work Check List

Regular servicing and maintenance of the electrical fittings and the fixture.

Maintaining the power panels, power points and light fixture.

Attending to the faults properly.

Check, whether all points are working.

Inspect all the wirings regularly.

Check ingress of moisture.

Check functions and connections of all indicators.

Check fault trip/over current/ over voltage/short circuit functioning

Check the switches operation is free and proper.

Switch on/off as per requirement.

Preventive maintenance for all electric panels for lighting and fire alarm panel, power, Emergency lighting, MCCBs, main switches, CCTV workings, etc.

Checking of wire as well as cables and contacts for loose connection.

Cleaning of all electrical contacts in main switches fuses and isolators, fan fittings

Shutdown shall be arranged as and when required but with prior intimation

Maintenance log book at site for all the history. Check the panel and smoke detectors

Check fire Extinguishers, PA system, CCTV, and Access control etc. Liaison with Govt. Authorities as and when required.

WATCH & WARD

Watch and Ward of their material, machineries and system etc. till end of the contract shall be the sole responsibility of the contractor and pilferage etc. shall be entirely to his account.

DAMAGE CAUSED TO INSTALLATION

In case of any damage caused to the installation due to negligence, carelessness or inefficiency of staff of the firm the contractor shall be responsible to make good the loss. Decision of the Authority shall be final & binding on the contractor.

Emergency Telephone Numbers

The Maintenance Contractor shall provide an emergency telephone number for normal and out of hour's operations with a maximum of two hour response time

During any breakdowns to essential utility services like cable fault etc. A telephone connection will be provided along with telephone instrument. The Maintenance Contractor shall make regular payments of bills etc. for the same.

Records of inspection operation and maintenance/ repairs etc.

The MC shall provide printed comprehensive logbook as per certified standards

and procedures, containing tables for daily record of all critical schedules, temperatures, pressures, humidity, power consumption, starting, stopping times of various equipment's, daily record of unusual observations.

Annual operation and Comprehensive Maintenance of HVAC SYSTEM

GENERAL CONDITIONS OF CONTRACT

DEFINITIONS

In this Contract the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires.

- (a) The 'Corporation / Employer' shall mean Ahmedabad Municipal Corporation.
- (b) 'Engineer' shall mean any Engineer or other official of AMC who may be authorized by the Corporation to carry out the functions of any Engineer.
- (c) 'Engineer's representative', shall mean any Engineer, Consulting Engineer or Assistant appointed from time to time by the Engineer to perform the duties of the Engineer.
- (d) 'Contractor' shall mean the firm, company or organization undertaking work of Operation and

Maintenance of complete HVAC system and shall include all their legal representatives.

- (e) 'Contract' shall mean the agreement between the Employer and the Contractor along with the Specification and all documents incorporated therein by reference and all documents incorporated by these Conditions of Contract.
- (f) 'Contractors Obligations' shall mean the obligation to perform in its entirety and shall, without limitation, include the Operation and Maintenance and repairing/replacing of Complete HVAC system...
- (g) 'Plant' shall mean all the Electro-Mechanical equipment's of HVAC system.
- (h) 'Services' shall mean Operation and Maintenance and repairing / replacement of HVAC equipment's for installation.
- (i) 'Date of Taking Over' shall mean the date of issue of the 'Taking over certificate' under the contract.
- (j) 'Facility' shall mean the entire plant including the buildings, structures, ramps, pits, instrumentation, fencing, lighting, testing equipment's such as fixed & ring spanner sets, pipe wrenches, hammers etc.
- (k) 'Government Authority' shall mean any Indian entity, authority or body exercising executive, legislative, judicial, regulatory or administrative functions including, without limitation, any government authority, agency, department, board, commission or instrumentality of Indian or any political subdivision thereof, court, tribunal, arbitrator or self-regulatory organization.
- (l) 'Law' shall mean and include all the provision of all Indian statues, regulations, ordinances, codes, official or other standards, administrative or other rules, judgments awards and degrees of, or agreements with, any Government, semi-Government or quasi-Government Authority as currently in effect or as may be in effect from time to time and / or as may be amended or supplemented from time to time.
- (m) 'Operation and Maintenance' shall mean that operation with comprehensive repairing maintenance of HVAC system that has been executed under SITC HVAC work for site at Ahmedabad. With all electrical & mechanical equipments for one year as per tender terms, condition and specification with good engineering practices without any extra cost quoted in the price bid of the tender.
- (n) 'Operation and Maintenance obligations' shall mean the obligation of the Contractor pursuant to the Agreement to operate the facility on and from the Date of handing over until the date of completion of this Agreement.
- (o) 'Operation and Maintenance Period' shall mean the period starting on the Date of handing over and continuing till the term of the Agreement.

2. OPERATION

- 2.1 The contractor shall operate and maintain Comprehensive Maintenance work of Complete HVAC system as per scheduled time as per instruction by AMC official or Engineer in charge regularly.
- 2.2 The Contractor shall operate and utilize all the control and monitoring systems, provided and if found to be necessary and if approved by the engineer, shall make adjustments within the operating range of the control system and equipment so that the plant operation matches the requirement.

3 MANPOWER

- 3.1 The contractor shall provide necessary personnel and labour, duly qualified and experienced necessary to operate and maintain all equipment's safely and efficiently for the Contract Period.
- 3.2 The qualifications and capability of the Contractor's personnel shall be appropriate for the task they are assigned to perform. The staff / worker provided shall be fully trained in the operation and maintenance of the HVAC related equipment's. Before being given responsibility for operating any part of the Plant. If in the opinion of the engineer, any member of the Contractors staff / worker is considered to be insufficiently skilled or otherwise inappropriate for the task he is required to perform, he shall be replaced by the Contractor with a person with the appropriate skills and experience for the task, to the approval of the Engineer.

- 3.3 The contractor will be required to submit to the Annexure of his Employees (Manpower) with their full name, address, qualifications, experience with date and time of his duty along with qualification certificate.
- 3.4 The CV/Resumes of the Contractors all personnel shall be submitted to the Engineer in Charge for acceptance at least 7 days before the anticipated commencement of the operation and Maintenance and Comprehensive repairing / replacing work period. Any change of personnel shall be promptly informed to the Engineer within a day's time. Normal time duty hours for the contractor's operation personnel may be modified as necessary and agreed by the Engineer.

4. SAFETY

4.1 The Contractor shall be responsible for maintaining highest standard of security and safety on Site and also for its manpower during operation and maintenance contract period.

4.2 The Contractor's duties with respect to security and safety shall include the following

(a) Utilize security and safety awareness procedures in every element of operation and maintenance. (b)

Give emphasis to site including:

(I) Safe working and safety procedures as per rules and regulations of Governments and electrical inspector or other local statutory body regarding use of protective clothing, gloves, boots and helmet etc.

(ii) Cleanliness of HVAC equipment's.

Awareness of hazardous conditions and accident reporting and necessary compliance.

5. INSURANCE

5.1 The Contractor shall indemnify the Employer against all losses and claims in respect of

(a) Death of or injury to any person, or

(b) Loss of or damage to any property (other than the works) Which may arise out of in consequent of the Operations of the Facility and the rectifying of any defects therein, and against all claims proceedings, damages costs, and expenses whatsoever in respect thereof or in relation thereto.

5.2 The Employer shall not liable for or in respect any damages or compensation payable to any workman or other person in the employment of the Contractor or any Sub-contractor, resulting from any act or default of the contractor, his agents or servants.

6. PLANT VISITS

The Employer reserves the right to arrange the visits of VIP's dignitaries, public representatives and other persons of Social or Political repute, any organization students as and when necessary, to the Medical College/Hospital. The Contractor shall offer full co-operation to the Corporation on the occasions of such visits

7. COMPLETION OF THE CONTRACT

At the time of completion of contract or if the contract is terminated, all the installations, works and equipment placed under the contractor's responsibility shall be handed over to the Employer, at no cost, in good

working order. The Employer may perform any inspections, tests or expert appraisals he shall consider necessary with a view to checking that the property is in good working order and will certify to that effect to the contractor while taking over.

SPECIAL CONDITIONS OF CONTRACT

1.0 SCOPE OF MAINTENANCE

- 1.1 Maintenance of the HVAC system of Propose Building as applicable in this contract means that all Electro-Mechanical Services included in the schedule of work are kept in operational and healthy and clean condition.

Wherever maintenance schedule is prescribed, the same is carried out and breakdowns are attended promptly.

- 1.2 Specific details of O & M activities with regard to each service are spelt out under section pertaining to that service. In case of minor addition / alteration to the installation / existing equipment the Operation and maintenance of such addition shall be done by the firm without any extra cost.
- 1.3 After the contract period is over the installation has to be duly handed over to AMC or next agency in the presence of AMC authority, in healthy condition. The contractor shall be responsible for any discrepancies vis-a-vis the status of installation at the start of work plus any modification carried out during the currency of the contract.
- 1.4 The contractor shall not sublet the work or part thereof; however, services of specialized agencies for specific works can be obtained with the permission of AMC.

2.0 METHODOLOGY AND STAFF

- 2.1 In case of faults beyond the capacity of the staff provided as above, contractor shall immediately provide extra specialized work force so as to attend to the fault in minimum reasonable time or as instructed by the Engineer-in-charge during the validity of contract.
- 2.2 Shut down for maintenance shall be taken with prior approval of the department.
- 2.3 The workers engaged by firm should maintain proper discipline and good behavior with occupants. The firm shall remove such workers from the site whose behavior is found improper. Engineer-in-charge decision in this regard shall be final.
- 2.4 The contractor will issue necessary ID card to the employee.
- 2.5 The labour engaged by the contractor shall wear uniform as approved by Engineer-in-Charge.
- 2.6 The vendor agrees that it shall at all times indemnify AMC against all claims for compensation under the provisions of any law for the time being in force or in respect of any person employed by it in carrying out the contract. Further, such staff will have no right to claim employment from AMC.
- 2.7 Firm should have round the clock contact landline/mobile telephone number. In case of Emergency, contractor and authorized engineer / supervisor shall be made available at site on short notice from engineer in charge and make all efforts to make the situation normal at the earliest.
- 2.8 A complaint register shall be maintained as per instruction of Engineer-in-charge of AMC and shall be kept upto date at the enquiry by the firm and the same shall be available for checking & verification.
- 2.9 The agency will provide the workers with necessary Testing and safety equipments along with the mandatory first aid box/kit.

2.10 The Maintenance Staff shall have the tool kit bag as per the site requirement.

3.0 MATERIALS

3.1 Replacement of defective/damaged material by the vendor shall be on like by like / Approved make basis and at his cost.

3.1.1 Dismantled materials shall be returned to the Department except those items for which the replacement is supplied by the agency.

4.0 DAMAGES TO AMC INSTALLATION:

4.1 Any damage to the installations/building during the O&M period due to the carelessness on the part of maintenance staff shall be the responsibility of firm and be replaced/rectified by him without any extra cost to AMC.

4.1.1 Any accident or damage during maintenance/operation will be the responsibility of the agency and AMC will not be liable for any claim, compensation, penalty etc. on this account or on account of non observance of any other requirement of law relevant to this work.

5.0 TERMINATION OF CONTRACT

5.1 Right is reserved by AMC for terminating the contract by giving one month notice due to serious

default. This includes major break down or accident due to negligence on the part of firm, failure to attend breakdown, disobedience and abandoning the site etc. In such a case full performance guarantee shall be forfeited by AMC The decision of Dy.City Engineer (Streetlight/cProjects) in this regard shall be final and binding.

5.2 If the firm fails to rectify the initial faults in all the electromechanical services indicated at the time of handing over within specified time reckoned from the date of taking over of maintenance, AMC reserves the right to terminate the contract without any further notice and /or to carry out the work at risk and cost of the agency.

6.0 Record of preventive maintenance and testing of equipment etc. carried out has to be readily available at site, failing which firm shall be liable of non execution of its liability under contract. If felt necessary Engineer-in-Charge has power to modify preventive / testing schedule. The joint inspection report to be kept in the complaint register of main site.

GENERAL AND ROUTINE MAINTENANCE

SCOPE OF WORK

The Scope of work as mentioned below are the minimum expected from the firm / agency/ contractor apart from break down maintenance and any other work required for operation and comprehensive maintenance in proper way as per the operation and maintenance manuals of respective equipments and as per good engineering practices will be required to be done under this scope of work.

- 1 Clean of makeup tank, filters and strainers.
- 2 Cleaning of equipments and tightening of belts as and when required.
- 3 Maintaining of proper record of preventive maintenance
- 4 Maintaining of proper log sheet of running of plant
- 5 Recording of complains received and attending the same and closing the complain as per format supplied by the RCB
- 6 Descaling /chemical cleaning of condenser tubes once in a year or whenever required

- 7 Checking and setting of controls four times in a year.
- 8 Replacement of oil and cleaning of filter
- 9 Topping of refrigerant whenever required
- 10 Replacing any defective controls in mechanical/electrical system whenever found defective
- 11 Rectification of leak if any and testing the system with nitrogen pressure and decommissioning after vaccumization.
- 12 Attending problems of any nature in compressors, motors, controls, Outdoor Unit and Indoor unit and other All Accessories.
- 13 Carrying out off season preventive maintenance once a year
- 14 Caring out work of overhauling rewinding motors for Indoor unit
- 15 Greasing, motors,

- 16 Decaling of valves and repairing coil of Indoor Units.
- 17 Replacement of defective belts, pulleys, blowers, shafts, bearings, of Indoor unit's whenever found defective.
- 18 Replacement of defective ACB's, switches, fuses, contactors, starters, indicating lamps, controls, wires and lugs.
- 19 Any works, other than indicated above but required essentially for proper functioning of the equipment's.
- 20 Air blowing of equipment panel, motors,
- 21 Check for any loose connection in all equipment and rectification of same.
- 22 General Cleaning of all equipment's
- 23 The Contractor shall adopt preventive maintenance check's schedule as per relevant equipment standard manufacturer's recommended guidelines
- 24 Greasing of bearing and lubricating all moving parts as per the schedule
- 25 Tightening of all loose nut-bolts and other fasteners
- A. WORK TO BE DONE ON EVERY DAY BASIS:
 1. The readings of the suction and discharges for Copper Pipe of Measure Refrigerant , oil pressure, oil & gas level, suction and .shall be checked and recorded in the LOG-BOOK (provided by firm/agency/contractor) on hourly basis. Necessary action is to be taken if the readings are not normal.
 2. To check all the electrical motors and their bearings for abnormal noise / heating and to take necessary action if found normal.

3. To drain out water and clean the Inverter Ductable AC Plant Room as and when required / scheduled.
4. The inside ambient conditions i.e. DB, WB & RH of all the Inverter Ductable AC Unit's shall be recorded on hourly basis. Filters of the Indoor unit etc. are to be cleaned regularly as per schedule. The Filters installed at different places are to be given special attention.
5. The temperature of each room shall also be measured for any corrective action especially in Laboratory & Animal room's area and these are to be recorded in LOG- BOOK.
6. Any other work required by the equipment for proper functioning.

B WORK TO BE DONE ON WEEKLY BASIS:

1. To check the refrigeration system.
2. To clean all the strainers and the filters of the Indoor unit
3. To check the lugs/ thimbles/ terminal points of the electrical motor, switches, starters single phase preventers and the indication lights etc.
4. To check the alignment / looseness of all the belts driven equipment and rectify if required.
5. Filters of Indoor Unit etc. are to be cleaned regularly as per services maintenance schedule.

C. WORK TO BE DONE ON MONTHLY BASIS:

1. To check Balancing for Fan.
2. To check the solenoid valve, safety controls Mechanical, Electrical/ Electronics
And the inter-locking of the various equipment.
3. To check and clean the Filter of the Inverter Ductable AC Unit.

D. WORK TO BE DONE AFTER EVERY THREE MONTH:

1. To check and lubricate (if required) the bearing of the motors and keep the proper record.
2. The check the motors and All Other Accessories to take the necessary action if required.
3. To check and reset the relays and controls, and to maintain the proper record. Carry out servicing of the main switches/ACB, s as required. To tighten all screws, nuts, bolts of the Electrical Power / control system.
4. Check the quantity of Air flow from various out lets in each Room/ Area as per drawing and do adjustments of dampers etc. as and when required.

E. WORK TO BE DONE HALF YEARLY:

1. Clean Quarterly Service Outdoor Unit.
2. Check the overload by measuring the amperage, check anti-recycle timer and operation of the electrical interlock, and voltage across the compressor terminal.
3. To tighten the clamps of cooling tower blades.
4. Cleaning of starters of all motors during winter shutdown.
5. De-scale the condensers,
6. Check the functioning of all controls and reset if requires.
7. Clean the cooling tower fills.

F WORK TO BE DONE YEARLY:

1. Check dampers operation for freeness in operation clean and lubricate.
2. Check for obstructions loose boards' fallen insulation on air ducts.
3. Clean all wirings for loose contacts and rectify.

4. Drain all water from pipe lines and fill fresh water. Do not keep water lines without water.
 5. Change the oil in oil sump. Renew filter and check oil temperature control.
 6. Inspect starter contracts are shield, transformer, and motor terminals, check connection in starter, tighten motor terminal control circuit terminals.
 7. Inspect, calibrate and adjust to original specification all safety and operating controls including low temperature and high- pressure cut outs, motor protector, oil pressure control, and fan temp. Control.
 8. Chemical cleaning of cooling coils twice in a year during winter shutdown after six months and de-scaling of butterfly & hand valves.
 9. Meggar all the motors & electrical panels during winter shutdown.
 10. One time painting of all equipment's their bases, panels base, Outdoor Unit Stand, and their bases, support channels etc. with one coat of metal primer and one coat of enamel paint as per colour preferred by NIB
- G. OTHER WORK:
1. Overhauling of Compressor/ chillers as and when required by the OEM's engineer as per service schedule and obtaining their clearance / report (This work are under separate AMC contact).
 2. Oil/ refrigerant to be provided as and when required for proper functioning of HVAC Plant systems.
 3. Check electrical overload protection system and other electrical system.
 4. Any other requirement to keep the whole HVAC Plant systems in proper, healthy running condition as per operation and maintenance manual of various equipment's.
 5. Validation/Calibration Certificates of all instruments to be submitted with NIB as its mandatory.

E-7:- SCHEDULES & APPENDIX

EXPERIENCE OF TENDERER

Tenderer shall furnish in the form given below Annexure-A the details of similar or equivalent or bigger capacity plant which are being / have been operated and maintained by them.

ANNEEXURE-A:-OPERATION & MAINTENANCE EXPERIENCE OF HVAC SYSTEM FOR Proposed Building

S. N.	Name of Project	Name of plant with location & address	Value of Contract in Rs.	Estimated Cost	Duration of Operation of contract of		Whether project under litigation (Yes/No) & reasons there of
					Date of Start	Date of Completion	
1	2	3	4	5	6	7	8

Note: - If required separate sheet can be used for more details.

BRIEF DESCRIPTION OF EQUIPMENTS INSTALLED IN PROPOSED BUILDING-ENTIRE WORK AND EQUIPMENTS EXECUTED AND HANDED OVER TO CLIENT UNDER SITC WORK OF HVAC SYSTEM UNDER THIS TENDER

Signature of the Tenderer

Name:

Company's seal

Date:

TENDER FORM FOR SECURITY DEPOSIT FOR OPERATION AND COMPREHENSIVE
MAINTENANCE SERVICE CONTRACT

(Bidders are required to fill up all blank spaces in this Bid Form)

The Municipal Commissioner

AMC,

Sir,

We have visited the site and examined the Bid Documents, Conditions of Contract, Specifications, Schedules, Annexure, Preamble to Price Schedules including Amendments if any to the above, for the execution of the above Contract, we the undersigned offer to carry out operation, maintenance and comprehensive repair/replacement of the whole of the said Works for three years from the date of work start as given in Conditions of Contract, Specifications, Price Schedules, Annexure, Appendix, Bidding Documents, the Lump sum fixed price for Operation and Maintenance for a period of three years is given in price schedules or such other sum as may be ascertained in accordance with the Conditions.

I / We agree that

1 (a) If we fail to provide required facilities to the Employer's representative or any other person /agency by the employer to perform on his behalf for carrying out O & M and Comprehensive repair/replacement work

OR

(b) If we fail to execute operation & Comprehensive Maintenance work as per tender directed by AMC officials according to the conditions/stipulations of the Contract, AMC will be at liberty to take any action including termination of Contract and impose at his absolute discretion any penalties, and/or reject the work or may process for blacklist the bidder's name.

2. We agree to abide by this Bid for a period of 120 days from the last date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before the expiry of that period.

3. In the event of our Bid being accepted, we agree to enter into a formal Contract Agreement with you incorporating the conditions of Contract thereto annexed but until such agreement is prepared this Bid together with your written acceptance thereof shall constitute a binding Contract between us.

4. We agree, if our Bid is accepted, to furnish 5% Security Deposit for amount of Operation and Comprehensive Maintenance Service Contract for three years.

5. We understand that you are not bound to accept the lowest or any Bid you may receive.

Dated _____ day of _____ 20__ .

_____ (Signature) _____ (Name of the person)

(In the capacity of)

Company Seal

(Name of firm)

Duly authorized to sign Bid for and on behalf of (Fill in block capitals)

Note:- I HAVE ALSO GONE THROUGH TECHNICAL SPECIFICATIONS FOR THE ITEMS AND UNIT (AS PER STANDARD P.W.D. TECHNICAL SPECIFICATION FOR THE ITEMS & UNIT AND ALSO I HAVE THE BOOK OF THE SAME) AND AGREE TO ABIDE BY THEM. IN CASE OF WHERE THERE IS NO TECHNICAL SPECIFICATION FOR THE ANY ITEMS AVAILABLE, SPECIFICATION GIVEN BY THE ENGINEER-IN-CHARGE / MANUFACTURER'S STANDARD SPECIFICATION SHALL BE FOLLOWED AND FOR THE SAME I AGREE TO ABIDE BY THEM.

Seal and Signature of the Bidder