

GENERAL INSTRUCTIONS**1.0 Scope of work:**

- 1.1 The contractor's scope of work covers supply, installation, commissioning and testing of the complete Electrical installation as specified in material specification, item specification, drawings and schedule of quantities.

2.0 Location:

- 2.1 The works are to be carried out inside the campus of Institute for Plasma Research, Bhat, Gandhinagar. All electrical equipment and gear shall be designed for an average ambient of 50°C with a peak of 55°C and relative humidity 55%.

3.0 Drawings, Specifications & Deviations:

- 3.1 The drawings and specifications lay down minimum standards of equipment and workmanship. In the absence of any deviations, it will be deemed that the tenderer is fully satisfied with the intents of the specifications and drawings and their compliance with the statutory provisions and local codes.
- 3.2 In case of discrepancy between the drawings, BoQ and specifications, the BoQ will prevail and furnish his rates accordingly.
- 3.3 The Contractor shall prepare fabrication and working drawings and all work shall be as per the approved working drawings. Approval of drawings does not relieve the Contractor of his responsibility to meet with the intents of the specifications. All such drawings for approval shall be in duplicate.
- 3.4 Equipment data shall be submitted along with the filled tender. The contractor shall be responsible for any unfilled data of the data sheets and the same shall be executed according to the requirements of the Engineer in charge / Consultant without any extra cost.
- 3.5 All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

4.0 Tools and Spare Parts:

- 4.1 All the tools, tackle, scaffolding and staging require for erection and assembly of the equipment and installation covered by the contract shall be obtained and maintained by the contractor himself. All other materials such as foundation bolts, nuts, anchor fasteners etc. required for the installation of the plant shall also be supplied and included in the contract.

5.0 Testing & Handing over:

- 5.1 The contractor shall carry out tests on different equipment as specified in various sections in the

presence of representatives of clients, Architects and Consulting Engineers in order to enable them to determine whether the plant, equipment and installation in general comply with the specifications.

5.2 All equipment shall be tested after carrying out necessary adjustments and balancing to establish equipment ratings and all other design conditions. At least six sets of readings shall be taken for each item tested and submitted.

5.3 The project shall be handed over after satisfactory testing along with Four sets of documentation along with two sets of soft copy each consisting of :

i) Detailed equipment data as approved by the Consulting Engineers/Employer.

ii) Manufacturer's maintenance and operating instructions.

iii) Set of drawings, showing plant layouts, piping, ducting, cabling etc

iv) Approved Test reading.

v) List of recommended spares.

5.4 Submission of the above documentation shall form a precondition for the final acceptance of the plant and installation and final payment.

6.0 Performance guarantee:

6.1 **All electrical equipment/items shall be suitable for Seismic Zone V.** All equipment and the entire installation shall be guaranteed to yield the specified ratings and design conditions plus/minus 3% tolerance. Any equipment found short of the specified ratings by more than the allowable tolerance as determined by the test readings shall be rejected.

7.0 Defects Liability: (AS MENTIONED IN TERMS AND CONDITIONS)

8.0 Statutory Inspections: (DELETED)

9.0 Payment to civil contractor.

The electrical contractor will have to pay to the civil contractor for any work done on behalf of the electrical contractor like laying of pipes, filling of zarries etc.

10.0 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 also done so that, it is not hazardous to anybody. Any accidents happen because of temporary or permanent installation, it will be entire responsibility of contractor for all compensation to concern parties.

Institute shall not be responsible for such accidents, mistake etc.

11.0 Completion Drawing:

The contractor shall to submit 4 sets of as built drawings showing all electrical arrangement i.e. power and control circuit diagrams, layouts etc. and soft copy of the same.

12.0 GA Drawings

Successful tenderer shall submit General Arrangement drawings for approval of Engineer-in-Charge/consultant before manufacturing of any part of equipments.

13.0 Works to be done by the Contractor

13.1 The contractor shall also furnish 4 copies of detailed installation, operation and maintenance manuals of manufacturers for all items of equipment together with all relevant data sheet, spare parts catalogues, repairs, assembly and adjustment procedure etc.

13.2 The contractor shall furnish such facilities as will be necessary for inspection of the equipment before dispatch at the manufacturer's works and also for witnessing such tests, at the works, if so required by employer/consultant.

13.3 Copies of all documents for routine, acceptance and type test certificates of the equipment carried out at the manufacturers premise shall be furnished to the employer along with supply of equipment.

13.4 The contractor shall coordinate his work and cooperate with other agencies by exchange of all technical information like details of foundation, weight, overall dimensions, clearances and other technical data required for successful and proper completion of his portion of the work in relation to the work of others without any reservation. No remuneration shall be claimed for such cooperation.

13.5 Care shall be taken, while handling/installing the equipment to avoid damage to the building as well as equipment. On completion of installation, the contractor shall arrange to repair all damages to the building and equipment caused during installation so as to bring to the original condition without any extra cost.

13.6 Sealing of all floor openings provided for electrical pipes and cables, from fire safety point of view, after laying the same without any extra cost.

13.7 Testing and commissioning of completed installation.

13.8 All tools and tackles required for handling of equipments and material at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

13.9 The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work. Recessed conduit and other works, which directly affect the progress of building work, should be given priority.

13.10 No structural member in the building shall be damaged / altered, without prior approval. All

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openings provided by others for electrical services shall be grouted / filled by the contractor after installing the cables/conduits etc. as the case may be, by any suitable means as approved by the engineer in charge without any extra cost. All chases required in connection with the electrical works shall be provided and filled by the contractor at his own cost as per instruction of architect to the original architectural finish of the building.

- 13.11 All the electrical works shall be carried out in accordance with the provisions of Indian electricity act, 1910 and Indian electricity rules, 1956 amended up to date(date of call of tender).All components shall confirm to relevant Indian standard specifications, wherever existing, amended up to date.
- 13.12 For all kind of fabricated equipments, the contractor will first submit dimensional detailed drawings for approval before fabrication is taken up in the factory. Suitable stage inspection at factory also will be made to ensure proper use of materials, workmanship and quality control.
- 13.13 All testes prescribed in specification, to be done before, during and after installation, shall be carried out, and the test results shall be submitted to the engineer in charge in prescribed Performa, forming part of the completion certificate.
- 13.14 Completion plan (AS BUILT) drawn to the scale to be submitted for each building with location of main switch board, distribution boards, panels, circuit diagram, conduit layouts, points, outlets, light fixtures etc complete in all respect as per instruction of engineer in charge.

SPECIAL CONDITIONS OF CONTRACT**1. Equipment & Machinery on Work Site**

The contractor shall provide and maintain in working order power driven machines like welding, drilling machine, zarri cutters, meggar, multimeter, continuity tester etc. till the completion of work.

2. The quantity for measurement will be actual quantity used in electrification:

- I) The contractor shall bear all incidental charges for the storage and safe custody of the materials at site at his own responsibility.
- II) The contractor shall make arrangement at the site of works for safe custody of materials to protect from damage by rain, dampness, fire, theft etc.
- III) In case any materials get damaged the contractor shall replace the same at his own cost.
- IV) The contractor shall furnish to Engineer-in-Charge sufficiently in advance a statement showing his requirements of quantities of materials to be supplied by Owner if any and the time when he will require the same.
- V) A day to day account of the material supplied by Owner/Contractor shall be maintained by the contractor in the agreed Performa.

3. Engineer-In-charge will provide operative instructions on regular basis related to project during contract execution period, which are not covered in this tender document. Contractor and his staff at site shall comply all these instructions.**4. Engineer-in-Charge/Consultant approval will be final in all concerned matters.****5. All correspondences between contractor and architect will be through client/PMC.****6. It is required that all insurance formalities & workman's compensation policy should be followed by the contractor.****7. The contractor will have to provide senior Electrical site engineer during the execution of work.****8. The Electrical contractor must be licensed Electrical contractor.****9. The Electrical contractor must have available all kind of necessary equipments at site.****10. All wiring person must be in possession of wireman license.****11. Minimum Criteria for selecting Electrical Sub contractor.**

- 1. The contractor must be government approved as "Class A" licensed Electrical contractor.
- 2. The Electrical contractor must have completed similar nature of work under one project head in last 3 years.

3. The Electrical contractor shall get approval prior to appoint any sub agencies for specialized jobs. Consultant/Engineer in charge has right to reject any contractor at any stage of project.
4. The contractor will have to provide:
 - Details of manpower available with the electrical contractor including years of experience, designation, qualification etc. with supporting documents.
 - List of tools, testing equipments, machinery available with the electrical contractor.
 - Minimum one senior Electrical site engineer B.E. with more then 5 years experience.
 - All wiring person must be a supervisor level grade.
5. Emphasis shall be given to the sub contractor who has already completed similar kind & Magnitude of projects.

MATERIAL SPECIFICATION**SUMMARY PAGE****I. Electrical Works**

A. Material Specification

Section - 1	E-1	LT Switchgear & POWER PANEL
Section - 2	E-2	LT Distribution Board
Section - 3	E-4, 5	LT Cabling and Termination
Section - 4	E-7	Internal Wiring
Section - 5	E-8	Light Fixtures and Fans
Section - 6	E-9	Earthing
Section – 7	E-11	Telephone and Data Distribution

- B. Special Condition for Testing
- C. Mode of Payment
- D. Applicable Standards – IS codes
- E. List of Approved make

ELECTRICAL MATERIAL SPECIFICATION**E - 1 LT SWITCHGEAR & POWER PANEL****1.1 Scope :**

The scope covers supply, installation, testing and commissioning of power panels, incorporating circuit breakers, fuse units, busbars, interconnections, earthing etc., meeting the requirements shown in equipment schedule and the drawings.

1.2 Standards :

AS PER SCHEDULE OF INDIAN STANDARD; ATTACHED WITH THE DOCUMENT.
The PCCs & MCCs shall comply with the latest edition of relevant Indian standards and Indian Electricity rules and regulations. The following Indian Standards shall be complied with:

- | | |
|--------------------|---|
| IS : 4237 : | General requirements for switch gear and control gear for voltage not exceeding 1000 v. |
| IS : 375 : | Switchgear bus-bars, main connection and auxiliary wiring, marking and arrangement. |
| IS : 2147 : | Degree of protection provided by enclosures for low voltage switch gear and control gear. |
| IS : 8197 : | Terminal marking for electrical measuring instrument and their accessories. |
| IS : 2557 : | Danger notice plates. |
| IS : 2516 : | Specification for AC circuit breaker. |
| IS : 1818 : | Specification for AC isolator and earthing switch. |
| IS : 3072 : | Code of practice for installation and maintenance of switchgear. |
| IS : 8623 : | Specification for factory built as symbolize of switch gear and control gear for voltage up to and including 1000v. A.C.& 1200 v. D.C. |
| IS : 8828 : | Miniature Circuit Breaker. |
| IS : 4064 : | Fuse switch and switch fuse unit. |
| IS : 9224 : | HRC fuse unit. |
| IS : 2705 : | Current transformer. |
| IS : 3155 : | Voltage transformer. |

- IS : 3231 : Electrical relay for protection.**
- IS : 1248 : indicating instrument.**
- IS : 722 : Integrating instrument.**
- IS : 6875 : Control switches & push buttons.**
- IS : 2959 : Auxiliary contactor.**
- IS : 1822 : AC motor starters of voltage not exceeding 1000V.**

1.3 TYPE OF LT SWITCH GEAR:

- 1.3.1 All the PCC's / PDB's / MCC's shall be metal clad, totally enclosed, rigid, floor / wall mounted, air - insulation, cubical type suitable for operation on three phase / single phase, 415 / 230 volts, 50 Hz. neutral effectively / Non effectively grounded at transformer and short circuit level not less than 30 MVA at 415 volts.
- 1.3.2 The PCC's / MCC's shall be designed the withstand and heaviest condition at site, with minimum expected ambient temperature of 55 degree celsius, 90 percent humidity and dusty weather.
- 1.3.3 Should confirm to Indian Electricity Act and rules. (as amended up to date) & approval of FIA of India.

1.4 STRUCTURE:

- 1.4.1 The PCCs, MCCs & PDBs shall be metal clad enclosed and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor mounting type.
- 1.4.2 All CRCA sheet steel used in the construction of PCCs / MCCs / PDBs shall be 2 mm thick and shall be folded and braced as necessary to provided a rigid support for all components. Joints of any kind in sheet shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal.
- 1.4.3 The PCCs / MCCs / PDBs shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP-43 for Indoor panels & IP -54 for outdoor panels . Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasket with foam rubber and / or rubber strips and shall be lockable.
- 1.4.4 All panels and covers shall be properly fitted and secured with the frame, and holes in the panel correctly positioned. Fixing screw shall enter into holes taped into an adequate thickness of metal or provided with bolts and nuts. Self threading screws shall not be used in the construction of PCCs / MCCs / PDBs.
- 1.4.5 A base channel of 75 mm x 75 mm x 5 mm thick shall be provided at the bottom.

- 1.4.6 PCCs / MCCs /PDBs shall arranged in multi-tier formation. The PCCs / MCCs / PDBs shall be of adequate size with a provision of 20 percent spare space to accommodate possible future additional switch gear. The size of the PCCs / MCCs / PDBs shall be designed in such a way that the internal space is sufficient for hot air movement, and the electrical component dose not attain temperature more than 40 degree celsius. If necessary openings shall provided for natural ventilation, but the said openings shall be screened with fine weld mesh.
- 1.4.7 Knockout holes of appropriate size and number shall be provided in the PCCs / MCCs/ PDBs in conformity with number, and size of incoming and outgoing conduits / cables.
- 1.4.8 Alternatively the PCCs / MCCs / PDBs shall provided with removable sheet plates at top and bottom to drill holes for cable / conduit entry at site.
- 1.4.9 The PCCs / MCCs / PDBs shall be designed to facilitate easy inspection, maintenance and repair.
- 1.4.10 The PCCs / MCCs / PDBs shall be sufficiently rugged in design and shall support the equipment without distortion under normal and short circuit condition, they shall be suitable braced for short circuit duty.
- 1.5 PROTECTION CLASS:**
- All the indoor PCCs / MCCs / PDBs shall have protection class as IS.
- 1.6 PAINTING:**
- All sheet steel work shall undergo a process of decreasing pickling in acid, cold rinsing, phosphating, pesivating and then sprayed with a high corrosion resistant primer. The primer shall be backed in an oven. The finishing treatment shall be by application. Three coats of synthetic enamel paint of approved colour shall be applied by spray and stoves in dust free atmosphere or the panel shall be powder coated.
- 1.7 CIRCUIT COMPARTMENT:**
- 1.7.1 Each circuit breaker and switch fuse units shall be housed in separate compartments and shall be enclosed an all sides. Sheet steel hinged lockable door shall be duly inter locked with the breaker / switch fuse units in ON and OFF position. Safety interlocks shall be from being drawn out when the breaker is in ON position.
- 1.7.2 The door shall not form as integral part of the drawout position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tires in a vertical section.
- 1.8 INSTRUMENT COMPARTMENT:**
- Separate and adequate compartment shall provided for accommodating instruments, indicating lamp, control contactors, relays and control fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, switch fuse units, busbars and connections.**

1.9 BUSBARS

- 1.9.1 The busbar shall be air insulated and made high quality, high conductivity, high strength copper and as per relevant IS code. The busbar shall of three phases and neutral system with separate neutral and earth bar. The busbar and interconnection between busbar and various components shall be of high conductivity, hard drawn, electrolytic copper. The busbar shall be of rectangular cross section designed to withstand full load current for phase busbar and full rated current for neutral busbar and shall be extensible type on either side. The busbar shall be rated for the frame size of the main incoming breaker but in any case not less than 200 amp capacities. The busbar shall have uniform cross section throughout the length.
- 1.9.2 The busbar and interconnection shall be insulated with heat shrinkable PVC sleeves and be colour coded in red, Yellow, Blue and Black to identify the three phases and neutral of the system. The busbar shall be supported on unbreakable, non hygroscopic DMC insulated supports at sufficient close interval to prevent busbar sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 50 KA RMS symmetrical for one second and a peak short circuit withstand of 105 KA minimum.
- 1.9.3 The busbar shall be housed in a separate compartment. The busbar shall be isolated with 3 mm thick bakalite sheet to avoid any accidental contact. The busbar shall be arranged such that minimum clearance between the busbar are maintained as per below.
- | | | |
|----------------------------|---|-------------------|
| Between phases | : | 27 mm min. |
| Between phases and neutral | : | 25 mm min. |
| Between phases and earth | : | 25 mm min. |
| Between neutral and earth | : | 23 mm min. |
- 1.9.4 All busbar connection shall be done by drilling holes in busbars and connecting by chromium plated brass bolt and nuts. Additional cross section of busbar shall be provided in all PCCs / MCCs / PDBs to cover-up the holes drilled in the busbars. Spring and flat washers shall be used for tightening the bolts.
- 1.9.5 All connection between busbar and circuit breaker / switches and between circuit breaker/ switches and cable terminals shall be through solid copper strips of proper size to carry full rated current. These strips shall be insulated with insulating strips.
- 1.9.6 Busbar shall be of sufficient cross section so that a current density of 160 A/ Sq.cm (1000 A/ sq. inch) is not exceeded at nominal current rating for copper bus bars.

1.10 ELECTRICAL POWER & CONTROL WIRING CONNECTION

- a) Terminal for both incoming and outgoing cable shall be suitable for 1100 volts grade, aluminum/copper conductor PVC insulated and sheathed, armoured cable and shall be suitable for connections of solder less sockets for the cable size as indicated on the appended drawing for the PCCs, MCCs, PDBs.
- b) Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.

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- c) Both control and power terminals shall properly be shrouded.
- d) 10% spare terminal shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block so that not more than one outgoing wire connected per terminal.
- e) Terminal strip for power and control shall preferably be separated from each other by suitable barriers of enclosures.
- f) Wiring inside the module for power, control protection and instrument etc. shall be done with use of 660/1100 confirming to IS 694 and IS 8130. Power wiring inside the starter module shall be rated for full current rating of contactor, but not less than 4 sq mm cross section area. **For current transformer circuits, 2.5 sq mm copper conductor wire shall be used. Other control wiring shall be done with 2.5 sq mm copper conductor wires.** Wires for connections to the door shall be flexible. All conductors shall be crimped with solder less sockets at the ends before connections are made to the terminals.
- i) Control power for the motor starter module shall be taken from the respective module switchgear outgoing from R phase and Neutral. Control wiring shall have control fuse (HRC type).
- j) **Particular care shall be taken to ensure that the layout of wiring neat and orderly. Identification ferrules shall be filled to all the wire termination for ease of identification and to facilitate and testing.**
- k) "CUPAL" washers shall be used for all copper and aluminum connections.
- k) Final wiring diagram of the PCC, MCC, PDB power and control circuit with ferrules number shall be submitted along with the PCC/MCC/PDB as one of the documents.

1.11 TERMINALS

The outgoing terminals and neural link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformer for instrument metering shall mounted on the disconnecting type terminal blocks. No direct connection of incoming and outgoing cables to internal components connection of the distribution board is permitted, only one conductor may be connected in one terminal.

1.12 WIREWAYS

A horizontal PVC wire way with screwed covers shall provided at the top to take interconnecting control wiring between different vertical sections.

1.13 CABLE COMPARTMENT

Cable compartment of adequate size shall be provided in the PCCs, MCCs, PDBS for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate support shall be provided in the cable compartment shall be brought out to terminal blocks in the cable compartment.

1.14 EARTHING

- a) Copper earth busbar of 25 mm x 3 mm shall be provided in the PCCs, MCCs, PDBs for the entire length of panel. The frame work of the PCCs, MCCs, PDBs shall be connected to this earth busbar. Provisions shall be made for connection from earth busbar to the main earthing bar coming from the earth pit on both side of the PCCs, MCCs, PDBs.
- b) The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp and the clamp shall be ultimately bounded with the earth bar.

1.15 LABELS

Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

1.16 NAME PLATE

- a) A name plate with panel designation in bold letter shall be fixed at top of the central in panel. A separate name plate giving feeder details shall be provided for each feeder module door.
- b) Inside the feeder compartment, the electrical component, equipments, accessories like switchgear, contactor, lamp, relays etc. shall suitably be identified by providing stickers.
- c) Engraved name plates shall preferably be of 3 ply, (red-white-red or black-white-black) lamicold sheet. However black engraved perplex sheet name plates shall also be applicable. Engraving shall be done with square groove cutters.
- d) Name plate shall be fastened by counter sunk screws and not by adhesives.

1.17 DANGER NOTICE PLATE

- a) The danger plate shall be affixed in a permanent manner on operating side of the panel.
- b) The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.
- c) The danger notice plate in general shall meet to requirements of local inspecting authorities.
- d) Overall dimension of the danger notice plate shall be 200 mm wide and 150 mm high. The danger notice plate shall be made from minimum 1.6 mm thick mild steel sheet and after due pretreatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.
- e) The letter, the figure, the conventional skull and bones shall etc. shall be positioned on the plate as per recommendations of IS : 2551-1982.

- f) The said letter, the figure and the sign of skull and bones be painted in single red colour as per IS : 5-1978.
- g) The danger plate shall have rounded corners. Locations of fixing holes for the plate shall be decided to suit design of the panel.
- h) The danger notice plate, if possible, be of ISI certification mark.

1.18 INTERNAL COMPONENTS

- a) The PCC / MCC / PDB shall be equipped complete with all type of required number of air circuit breakers, switch fuse unit, contactor, relays, fuses, meters, instruments, indicating lamps, push buttons, equipment, fittings, busbar, cable boxes, cable glands etc. and all the necessary internal connections /wiring as required and as indicated on relevant drawings. Components necessary for proper complete functioning of the PCC / MCC / PDB but not indicated on the drawings shall be supplied and installed on the PCC / MCC / PDB.
- b) All part of the PCC / MCC/ PDB carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at any part of the PCC / MCC / PDB.
- c) All units of the same rating and specifications shall be fully interchangeable.

1.19 INSPECTIONS

Each equipment should inspect and witness by client & consultant.

- a) The PCC / MCC / PDB shall be inspected and checked as per inspection manual of the PCC / MCC / PDB manufacturer.
- b) Various electrical components and accessories of the PCC / MCC / PDB shall be checked as per drawing for the respective PCC / MCC / PDB.
- c) The PCC / MCC / PDB shall be checked for rigid mounting, earthing connections, proper rating and size of components, internal wiring, etc.
- d) All mechanical fasteners and electrical connections shall be checked and tightened before installation.
- e) Type test certificates for all ACB for similar rating shall be submitted.
- f) Test :
 - a) Prior to dispatch of the PCC / MCC / PDB following tests shall be carried out.
 - b) Mechanical endurance test shall carried out by closing and opening of all the ACB's, MCB's switches etc.
 - c) Over voltage and Insulation resistance test shall be carried out between phases and between phase

to earth bus, keeping the isolating switch in ON position. Similar test shall be carried out keeping the isolating switch in closed position.

- d) All the interlocks, controls and tripping mechanism of the switch gears shall be tested for their proper functioning.

1.20 COMPONENTS :

A) GENERAL

- a) The type, size, and rating of the components shall be as indicated on the relevant drawings.
- b) While selection of the capacity of the components resulting from the prevailing conditions like room temperature shall be allowed for the Thermal and magnetic trip rating shall be compensated for the ambient temperature.
- c) The rating indicated on the drawings are rating anticipated at prevailing site condition.

B) MINIATURE CIRCUIT BREAKER:

Miniature circuit breakers shall be quick make and break and break type conform with British standard BS : 3871 (Part-I) 1965 and IS :8825 (1996). The housing of MCBs shall be heat resistant and having a high impact strength. The fault current of MCBs shall not be less than 10000 amps, at 230 volts. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical "ON" and "OFF" indications.

The circuit breaker dollies shall be of trip free pattern to prevent closing the breaker on a fault current.

The MCB contact shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with magnetic fluid plunger relay 3 as for over current and short circuit protection. The over load or short circuit devices shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCB's shall be tested and certified as per Indian Standard, prior to Installation.

C) FUSE:

Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with IS : 2000-1962 and having rupturing capacity of not less than 35 MVA at 415 Volts. The backup fuse rating for each motor / equipment. HRC fuses shall be of English Electric make or approved equal.

D) AIR CIRCUIT BREAKER:

The ACB shall meet with IS : 2516 part I, II and III. Each pole of the ACB's shall be equipped with and over current, earth fault and short circuit release. The ACB's shall be equipped with under voltage trip also. The trip devices shall be direct acting.

Disconnecting devices of approved type shall be provided to facilitate the removal of the circuit breakers from the housing for test and maintenance purpose.

The ACB's shall have an arc quenching device on each pole. The ACB's shall have an auxiliary contacts for signaling, interlocking etc. The ACB's shall have slow close facilities for checking contact operation and contact gap adjustment.

All contacts subject to arcing shall be tipped with arc resisting material. main contacts shall be silver plated, multi-finger and spring loaded type. Facilities shall be provided to isolate the circuit breaker for inspection purpose.

Interlocks shall be provided to :

Prevent the breaker from being isolated unless it is in the "OFF" position.

Prevent the breaker from being racked in to the service position unless it is in the "OFF" position.

Prevent the breaker from being accidentally pulled completely "OFF" the guide rail. Safety shutters of an insulation material shall be provided to prevent access to all live contacts, when the breaker is in the inspection position or completely withdrawn.

Facilities shall be provided for earthing the circuit breaker.

Air circuit breaker shall be capable of clearing the maximum fault current which can occur.

The breaker plates shall have an ON-OFF indicators, spring charge indicators, provision to padlock manual handle and provision to lock drawout mechanism. Electrically operated breaker shall have provision for emergency manual closing by inserting a tool through the fuse plate. A control isolating switch shall be provided on the fuse plate to isolated the supply to the charging motor.

E) MOULDED CASE CIRCUIT BREAKER:

The MCCB shall be air break type and having quick make quick break with trip free operating mechanism.

Housing of the MCCB shall be of heat resistant and flame retardant insulating material.

Operating handle of the MCCB shall be in front and clearly indicate ON / OFF / TRIP positions.

The electrical contact of the circuit breaker shall be of high conducting non deteriorating silver alloy contacts.

The MCCB shall be provided with thermal / magnetic type bi-metal over load release and electro-magnetic short circuit protection device. All the releases shall operate on common trip busbar so that in case of operation of any one of the releases in any of the three phases, it will cut off all the three phases and thereby single phasing of the system is avoided.

The MCCB whenever called for in the appendix drawings shall provide an earth fault relay.

The MCCB shall provide two sets of extra auxiliary contacts with connections for additional controls at future date.

The electrical parameters of the MCCB shall be as per the descriptions given in the appended drawings. All MCCB should be with breaking capacity of $I_{cs}=100\% I_{cu}$.

F) CONTACTORS :

The contactor shall meet with the requirements of IS: 2959 and BS: 775.

The contactors shall have minimum making and breaking capacity in accordance with utilization category AC 3 and shall be suitable for minimum class II intermittent duty.

If the contactor forms part of a distribution board then a separate enclosure is not required, but the installation of the contactor shall be such that it is not possible to make an accidental contact with live parts.

G) LOAD MANAGER:

The load manager should be 192 x 144 mm size having facility to read voltage current harmonics power parameters. It should contain real time clock. The meter should be field programmable and to generate high / low profile for all power parameters with date & time, also able to store previous period integrated data. The meter should have RS 485 port for networking purpose. All the programming should be pass word protected.

H) CURRENT TRANSFORMER:

Where ammeter are called for, CT's shall provided for current measuring. Each phase shall be provided with separate CT of class I accuracy and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS : 2705 - 1964 as amended up to date.

I) PUSH BUTTON:

The push button unit shall comprise of the contact element, a fixing holder, and push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps. continuous current rating. The actuator shall be of stranded type and colour as per its usage for ON, OFF and Trip.

J) INDICATING LAMP:

Indicating Lamp shall be transformer operated low voltage rated and shall supplied complete with translucent covers to diffuse the lamp light.

Colour shade for the indicating lamps shall be as below:

ON indicating lamp	:	Red
OFF indicating lamp	:	Green
TRIP indicating lamp	:	Amber
PHASE indicating lamp	:	Red, Yellow, Blue.

J) Technical Specifications for Single Phase & Three phase Electronic Energy Meter of Class 1.0 Accuracy:**1.0 SCOPE**

This specification covers the design, engineering, manufacture, testing and calibration at manufacturer's works before dispatch, packing, supply and delivery of Class 1.0 accuracy, electronic energy meter, suitable for connection to LT

A) Single phase 2 wire 240V system

B) Three phase 3-phase, 4- wire 415V system

The static whole current electronic meter shall offer current range of 5-30 A, 10-60A (first digit indicates the Basic Current & second digit indicates the Maximum Current of the respective meters) for tariff purposes, as per requirement given in this specification.

2.0 STANDARDS APPLICABLE

Unless specified elsewhere in this specification, the performance & testing of the meters shall conform to the following Indian/International standards, to be read with upto-date and latest amendments/revisions thereof.

S. No.	Standard No.	Title
1	IS 13779 read with its latest amendments	Specification of AC Static Watt hour meters class 1.0 & 2.0
2	CBIP Report No.88 (revised July 1996) read with latest amendments	Specification for AC Static Electrical Energy Meters

3.0 CLIMATIC CONDITION

The meters to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions. Meters shall be capable of maintaining required accuracy under hot, tropical and dusty climate.

- i) Maximum Ambient Air Temperature in shade : 50°C
- ii) Minimum Ambient Air Temperature : -10°C.
- iii) Relative Humidity 100% : 95% (non-condensing)
- iv) Minimum Relative Humidity : 100%

4.0 SUPPLY SYSTEM

System	1 Phase 2 Wire	3 Phase 4 Wire
Rated voltage (Vref)	240 V – Phase to Neutral	433 V – Phase to Phase
Rated Basic Current (Ib)	Basic current 5/10/10 Amps (Ib), Maximum current 30/60/100 Amps (I max)	Basic current 5/10/10 Amps (Ib), Maximum current 30/60/100 Amps (I max)
Rated Frequency	50 Hz	50 Hz

5.0 POWER SUPPLY VARIATION

The meter should be suitable for working with following supply system variations.

System	1 Phase 2 Wire	3 Phase 4 Wire
Specified range of operation	70% to 120% of reference Voltage i.e. 240 V	70% to 120% of reference Voltage i.e. 415 V
Frequency	50Hz+/-5%	50Hz+/-5%

6.0 ACCURACY

Class of accuracy of the meter shall be 1.0. The accuracy shall not drift with time.

7.0 POWER CONSUMPTION

7.1 Voltage Circuit: The active and apparent power consumption in each voltage circuit including the power supply of meter at reference voltage, reference temperature and reference frequency shall not exceed 1.5 Watt and 8 VA respectively

7.2 Current Circuit: The apparent power taken by each current circuit at basic current, reference frequency and reference temperature shall not exceed 4 VA.

11.0 GENERAL & CONSTRUCTIONAL REQUIREMENTS

11.1 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured.

- a) Personal safety against electric shock
- b) Personal safety against effects of excessive temperature.
- c) Protection against spread of fire
- d) Protection against penetration of solid objects, dust & water

11.2 The meter shall be designed with application specific integrated circuit and shall be manufactured using SMT (Surface Mount Technology) components. Power supply and voltage divider circuits may be of PTH technology.

11.3 All insulating material used in the construction of meters shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion during operating life by providing suitable protective coating.

11.4 The meter shall conform to the degree of protection IP 51 for protection against ingress of dust, moisture and vermin's.

11.5 The meter shall be capable of providing phase to phase protection upto 450V.

11.6 The meter shall be supplied with a transparent extended terminal block cover (ETBC). The ETBC shall not be easily detachable from the base and preferably be secured to the base using a hinging arrangement.

- 11.7 The meter-base, meter cover, terminal block and ETBC shall be made of unbreakable, high grade, fire resistant, reinforced, non-flammable, polycarbonate or equivalent high grade engineering plastic.
- 11.8 The meter cover shall have a fully transparent window. The window shall be of transparent, high grade UV stabilized engineering plastic for easy reading of all the displayed values/parameters, and observation of operation indicator. The window shall preferably be an integral part of meter cover.
- 11.9 The meter cover shall be sealable to the meter base with at least 2 nos. seals. Also terminal cover shall have provision for sealing with at least one seal.
- 11.10 The terminal block shall be made of high grade non-hygroscopic, fire retardant, low tracking, fire resistant, reinforced poly-carbonate or equivalent high grade engineering plastic with terminal holes of minimum dia 8.5 mm and shall be suitable to accommodate the insulation of the conductors, meeting the requirement of IS 13779 /CBIP technical report-88.
- 11.11 The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Meter shall have 2 screws in each terminal for effective clamping of cables. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The clearance and creepage distance shall conform to relevant clause of IS 13779/CBIP technical report No.88.
- 11.12 The meter shall be compact in design. The entire construction shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.
- 11.13 The meter shall have 3 fixing holes, one at top and two at bottom. The top hole shall be such that the holding screw is not accessible to the consumer after fixing the meters. The lower fixing screws shall be provided under the sealable terminal cover.
- 12.0 **ANTI-TAMPER FEATURES**
- The meter registration shall be immune to reversal in current direction. The meter shall have anti-tamper features
- 13.0 **DISPLAY**
- 13.1 The measured value(s) shall be displayed on a Liquid Crystal display (LCD) register. The height of the digit shall be minimum 8.5 mm. The KWh energy registration shall take place with 6 complete digits. The display shall have backlit capability for easy reading.

13.2 The data should be stored in non-volatile memory (NVM). The non-volatile memory should retain data for a period of not less than 10 years under un-powered condition. Battery back-up memory will not be considered as NVM.

13.3 The register shall be able to record and display starting from zero, for a minimum of 1500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

13.4 In addition to providing serial number of the meter on the display plate, the meter serial number shall also be programmed into meter memory for identification through communication port for CMRI/meter reading print out.

14.0 DISPLAY SEQUENCE

The meter shall display the required parameters in two different modes as follows:

A) Auto Display Mode:

The following parameters hereinafter referred to as “Billing Parameters” (B.P) shall be displayed in an auto-cycle mode, in the following sequence:-

LCD Test

Real Time

Date

Cumulative Active energy (forwarded) reading (kWh)

Instantaneous Load (KW)

Billing period counts

Each parameter shall be on meter display for 10 seconds and the time between two auto-cycles shall be 120 seconds.

B) Push Button Mode:-

In addition to the auto display mode parameters, the following parameters shall be displayed on pressing the push button

C) LCD Test

Real Time

Date

Instantaneous voltage, current

The meter shall also be capable of offering a high resolution display which shall enable conducting of dial testing by the user in the shortest possible time and as a minimum, the meter shall be capable of offering a resolution of 4 digits after decimal (and 2 digits before decimal) for the high resolution KWh display.

15.0 COMMUNICATION PORT

The meter should have a galvanically isolated optical communication port for data communication . Adequate sealing provision shall be provided.

16.0 MARKING OF THE METER

The marking on the meter shall be in accordance with relevant clauses of IS 13779.

The basic marking on the meter nameplate shall be as follows:

- a) Manufacturer's name & trade mark
- b) Type Designation
- c) No. of phases & wires
- d) Serial number
- e) Year of manufacture
- f) Reference Voltage
- g) Rated Current
- h) Principal unit(s) of measurement
- i) Meter Constant (imp/kwh)
- j) Class index of meter
- k) "Property of _____"
- l) Purchase Order No. & Date

17.0 CONNECTION DIAGRAM & TERMINAL MARKINGS

The connection diagram of the meter shall be clearly shown on terminal cover.

18.0 OUTPUT DEVICE

The meter shall have a test output accessible from the front and capable of being monitored with suitable testing equipment while in operation at site. The test output device shall be provided in the form of LED output.

E – 2 L T DISTRIBUTION BOARDS**1.1 Scope:**

It includes Supply, Installation, Testing and Commissioning of Distribution Boards standard company fabricated or to be fabricated by fabricator.

1.2 Standards:

IS: 8623: Distribution Boards

1.3 Distribution Boards:

- a) Distribution boards along with the controlling MCB's/Fuse or Isolator as shown shall be fixed in an M.S. Box with hinged door suitable for recessed mounting in wall. Distribution boards shall be made of minimum 18 SWG steel sheet duly rust inhibited through a process of de-greasing, acid pickling, phosphating and powder coated to an approved colour of adequate micron rating duly approved by architect/consultant.

Three phase boards shall have phase barriers and a wire channel on three sides. Neutral bars shall be solid tinned copper bars with tapped holes and chase headed screws. For 3 phase DB's, 3 independent neutral bars shall be provided for per phase isolation in addition to main neutral links.

- b) Conduit knockouts shall be provided as required/shown on drawings and the entire board shall be rendered dust and vermin proof with necessary sealing gaskets. The top and bottom side of DB should be detachable.
- c) All DB's shall be internally pre-wired using copper insulated Busbars of appropriate rating. Bus bars shall be suitable for the incoming switch rating and sized for a temperature rise of 35° C over the ambient. Each board shall have two separate earthing terminals. Circuit diagram indicating the load distribution shall be pasted on the inside of the DB as instructed. One earthing terminal for single phase and two terminals for 3 phase DB's shall be provided with one earth strip connecting the studs and the other earth link should be provided with base insulator in such a way that link should in contact with body of distribution board.

1.4 RCCB/RCBO:

- a) The RCCB should suffices all the requirements of IS as per code IS - 12640 (Part I) - 2000. The RCA should be current operated and not on line voltage.
- a) The RCCB/RCCB should ensure mainly the following functions.
- 1) Measurement of the fault current value.
 - 2) Comparison of the fault current with a reference value.
- c) The RCCB/RCBO should have a torroidal transformer which has the main conductors of primary (P - N) which check the sum of the current close to zero. All metal parts should be inherently resistant to corrosion and treated to make them corrosion resistant. It should be truly current operated. It should

operate on core balance toroidal transformer. It's accuracy should be $\pm 5\%$. It should operate even in case of neutral failure. It should trip at a present leakage current within 30 M.S. It's enclosure should be as per IP 30. It's mechanical operation life should be more than 20,000 operations. It should provide full protection as envisaged by IE rules - 61-A, 71 - EE, 73 - EE, 1985 and also rule 50 of IE rule 1956. It should conform to all national and international standards like IS, BS 4293 - 1983, CEE 27 (International commission Rules for the approved of electrical equipment).

1.5 MCB/ Isolators:

Miniature circuit breakers shall be quick make and break and break type conform with British standard BS : 3871 (Part-I) 1965, IEC 898-1995 and IS :8828 (1996). The housing of MCBs shall be heat resistant and having a high impact strength. The fault current of MCBs shall not be less than 10000 amps, at 230 volts. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical "ON" and "OFF" indications.

The circuit breaker dollies shall be of trip free pattern to prevent closing the breaker on a faculty current. Tightening torque at terminals shall be not less than 2.5 Nm. Power losses should not be more than as specified in IEC 898-1995.

The MCB contact shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with magnetic fluid plunger relay 3 as for over current and short circuit protection. The over load or short circuit devices shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCB's shall be tested and certified as per Indian Standard, prior to Installation.

For protection of electric circuits with equipment that does not cause surge current (i.e. lighting and socket outlet circuits) 'B' curve MCB to be used in which magnetic releases operates between 3 and 5 In.

For protection of electric circuits with equipment that cause surge current (i.e. inductive and motor circuits) 'C' curve MCB to be used in which magnetic releases operates between 5 and 10 In.

For protection of electric circuits with equipment that cause surge current (i.e. transformer, heavy start motors circuits) 'D' curve MCB to be used in which magnetic releases operates between 10 and 15 In.

Isolators shall confirm to IS 13947-3 and IEC 60947-3.

1.6 Voltage Surge Protector Devices (SPDs):

SPDs (Surge Protection Devices) shall be of Type II for DB level internal Protection (Class S, 8/20 microseconds waveform, UP-1.4KV, I_{max} 15KA) and DIN-rail type (Unless & otherwise specified).

SPDs shall be tested in accordance with the requirements of IEC 61643-1. SPDs shall be suitable for TT, TNC, TNS or TNC-S earthing systems. SPDs shall provide protection between line to earth (common mode), neutral to earth (common mode) and line to neutral (differential mode).

SPDs shall be of the "withdrawable cartridge" type. The base of the SPDs shall be able to accept

cartridges of different discharge ratings of I_{max}: 15kA, 20kA, 40kA & 65kA (8/20 microseconds waveform).

Optional auxillary contacts for remote indication shall be integrated in the base of the SPDs to eliminate possibility of wrong installation. SPDs shall limit the transient let-through voltage of not more than 1.4kV in accordance to IEC 60364.

Protection against SPDs short-circuit (in the event of end-of-life of SPDs or/and short circuit at 50hz like neutral disconnection, inversion of Neutral /line,...) shall be provided by a dedicated miniature circuit breaker that has been tested to co-ordinate with the manufacturer's SPDs in accordance to IEC 60364.

Type 1 for Increased protection at Panel level (Class I, 8/20 microseconds waveform, UP-1.2KV, I_{max} 40KA) SPDs shall be installed in the All Floor panel of installation/building fitted with a lightning rod. Type 1 SPDs shall be rated limit of 40kA per phase in accordance to IEC 61643-1 appendix A & IEC 62066 clause 12.3.2.1.

E – 4, 5 L T CABLING AND TERMINATION**1.1 Scope :**

The scope consists of Supply, laying, tesing and commissioning of L.T. XLPE Cable and its termination.

1.2 Standards :

AS PER SCHEDULE OF INDIAN STANDARDS; ATTACHED IN THE DOCUMENT

1.3 Cables:

- A) LV POWER CABLES will be 1100 Volts grade single / multicore standard aluminum conductor extruded XPLE insulated with extruded PVC inner sheath outer sheath made of FRLS PVC compound conforming to IS-7098 part-1. Single core will be used for DC application. Cables in buried insulation shall be armoured type.
- B) Control cables will be 1100 Volts grade multicore minimum 2.5 sqmm cross section standard copper conductor minimum 7 strands PVC insulated inner extruded sheathed and other sheath made of extruded FRLS PVC compound conforming to IS-1554 part-1. . Cables in buried insulation shall be armored type.
- C) All cables shall be new without any kind or visible damage. The manufacturers name, insulating material, conductor size and voltage class shall be marked on the surface of the cable at every 600 mm centers.

1.4 Cable joints and termination:**A) Connectors :**

Cable terminations shall be made with copper/Aluminium Heavy duty long neck copper crimping lugs only crimped type solderless lugs for all aluminium cables and stud type terminals. For copper cables copper crimped solderless lugs shall be used.

Crimping shall be done with the help of hydraulically operated crimping tool. All cable lugs should be long neck type only.

B) Cable Glands :

Cable glands shall be of heavy duty brass single compression type as specified. Generally single compression type cable glands shall be used for indoor protected locations and double compression type shall be used for outdoor locations. Glands for classified hazardous areas shall be CMRS approved.

C) Ferrules :

Ferrules shall be of self sticking type and shall be employed to designate the various cores of the control cable by the terminal numbers for ease in identification and maintenance.

D) Cable joints :

Kit type joint shall be done and filled with insulating compound. The joint should be for 1.1 KV grade insulation.

1.5 HEAT / FIRE RESISTANT COATING OF CABLE

Supply and application of intumescent based coating on cables/ cable tray using CP 678 firestop cable coating of HILTI India Pvt Ltd, along the horizontal runs at every 6 mtr for 1 mtr and full length in case of vertical runs .The coating shall have a density in the range of 1.2 to 1.4 Kg/ L. The coating shall be non-toxic, asbestos and halogen free and shall have good mechanical strength. The coating shall comply with IEC 332 part 3 (1992)

Cable coating should be **Hilti make cat No CP678 or equivalent.**

E- 6 CABLE TRAY**1.1 Ladder type cable tray**

The cable tray shall be fabricated out of 2 mm thick slotted/ perforated MS 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 galvanized or painted as specified.

- 1.1.1 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 and cable tray shall be scraped and removed before the installation.
- 1.1.2 The permissible uniformly distributed load for various type of cables trays and for different supported span shall be as per IS.
- 1.1.3 The width of the cables tray shall be chosen so as to accommodate all the cables 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 1000mm.
- 1.1.4 Factory fabricated bends, reducers, tee / cross junction. Etc shall be provided as per good engineering practice. The radius of bends, junctions etc. shall be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.
- 1.1.5 The cable tray shall be suspended from the ceiling slab with the help of 10 mm dia MS round or 25 mm x 5 mm flats at specified spacing. Flat type suspenders may be used for channels up to 450 mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angle 50 mm x 50 mm x 5mm at the bottom and as specified. These shall be grouted to the ceiling slab at the other and through an effective means, as approved by the Engineer – in – charge, to take the weight of the cable tray with the cables.
- 1.1.6 The entire tray (except in the case of galvanized 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.
- 1.1.7 The cable tray shall be bonded to the earth Terminal of the switch bonds at ends.
- 1.1.8 The cable tray 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.
- 1.1.9 The ladder type of cable tray shall be fabricated of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a center to center spacing of 250 cm as per IS.

1.2 Perforated type cable tray

The cable tray shall be fabricated out of slotted/ perforated MS 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 galvanized or painted as specified. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mmx50x6mm as two longitudinal members, with cross bracings between them by 50mmx5mm flats welded/bolted to the angles at 1 m spacing . 2mm thick MS perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

- 1.2.1 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 and cable tray shall be scraped and removed before the installation.

- 1.2.2 The maximum permissible uniformly distributed load for various all the cables trays and for different supported span are given in Table IV. The sizes shall be specified considering the same.
- 1.2.3 The width of the cables tray shall be chosen so as to accommodate all the cables 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.
- 1.2.4 Factory fabricated bends, reducers, tee / cross junction. Etc shall be provided as per good engineering practice. The radius of bends, junctions etc. shall be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.
- 1.2.5 The cable tray shall be suspended from the ceiling slab with the help of 10 mm dia MS round or 25 mm x 5 mm flats at specified spacing (based on table III) Flat type suspenders may be used for channels up to 450 mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angle 50 mm x 50 mm x 5mm at the bottom and as specified These shall be grouted to the ceiling slab at the other and through an effective means, as approved by the Engineer – in – charge, to take the weight of the cable tray with the cables.
- 1.2.6 The entire tray (except in the case of galvanized 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.
- 1.2.7 The cable tray shall be bonded to the earth Terminal of the switch bonds at ends.
- 1.2.8 The cable tray 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.

1.3 Hot Dip GI Wire cable tray

1.3.1 Surface treatments for wire cable trays and related accessories:

- 1.3.1.1 HOT DIP GI Wire, min. dia of GI wire should be 4.5mm dila. it shall be manufactured "T-welded"safety edge. Trays shall be constructed with 50 x 100 mm mesh configuration.
- 1.3.1.2 Trays should be match with Standard EN ISO 1461: at least 360 h of SST.

1.3.2 Performance Level:

- 1.3.2.1 All trays shall be arranged and positioned on the site itself in accordance with the Manufacturer's instructions.
- 1.3.2.2 The deflection of the wire cable tray must be no more than 1/200th of the distance between two supports and tested in accordance with the standard IEC 61537.
- 1.3.2.3 Wire cable trays must be designed with an optimum span of 1.5 m, taking into account the maximum carrying capacity authorized by the manufacturer.
- 1.3.2.4 The positive contribution made by the wire cable tray in terms of reducing electromagnetic interference must be demonstrated by tests certificates performed by COFRAC certified independent laboratories.
- 1.3.2.5 The reliability of the wire cable tray for Category 6 communication cables must be demonstrated by tests certificates of an independent laboratory.
- 1.3.2.6 Assemblies with specific fire-resistant properties must have an E30-E90 certificate issued by an approved laboratory in accordance with the tests described in the standard DIN 4102-12

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1.3.3 Couplers:

- 1.3.3.1 For the purpose of assembling the various wire cable tray, only fast coupling systems or screw-based (CE25/CE30) systems must be used. These must be designed, mechanically tested and supplied by the wire cable tray manufacturer.
- 1.3.3.2 The electrical resistance of the joints must not exceed 50 mΩ and must be tested in accordance with the procedure described in the standard IEC 61537

1.3.4 Supports:

- 1.3.4.1 Only supports, brackets or hangers designed, mechanically tested and supplied by the wire cable tray manufacturer must be used. The loading capacities of the brackets and the hanger torques must be tested in accordance with the standard IEC 61537.

1.3.5 Earthing:

- 1.3.5.1 To enable earthing every 15 m, bimetal terminals or tin-plated aluminium connectors must be used. These must be recommended and tested by the manufacturer.

1.4 Anchor Fastener

Anchor fastener shall be Hilti make and it will be install as per standard instruction from supplier / manufacturer and install in proper manners.

For Slab / RCC : Hilti make – Cat No. HKD-E M10/40 or HSV M8/75 or equivalent as per requirnmnts

For Wall / Bricks : Hilti make – Cat No. HRD-UGT 10x80/10

- 1.4.1 All installation of Anchor fastener has been approved by Hilti Technical staff and certified the same.
- 1.4.2 If require, 1% of total quantity Pull out test will be carried out at site.
- 1.4.3 Electrical contractor has to submit Material Test Certificate / Material Safety Data Sheet (MSDS) for all material to be used for hanging of cable tray.

E – 7 INTERNAL WIRING**1.1 Scope:**

The scope covers supply, laying, testing and commissioning of wiring in rigid PVC pipes, Switches, Sockets and accessories.

1.2 Standards:

AS PER SCHEDULE OF INDIAN STANDARDS, ATTACHED IN THE DOCUMENT

1.3 Rigid and Flexible conduits:

- A) All conduits shall be rigid PVC having minimum wall thickness of medium gauge 1.6 to 1.8 approved by F.I.A. & I.S.I. All rigid pipe and its accessories shall be of suitable material complying with IS: 3419-1989 and IS: 9537 (Part 5) 2000 for flexible conduits.

The conduits shall be circular in cross-section and designated by their nominal outside diameter. Minimum thickness of walls shall be as follows:

- a) Upto 38 mm. diameter - minimum 1.8 mm. wall thickness.
- b) Above 40 mm. diameter - minimum 2.2 mm. wall thickness.

The maximum number of PVC insulated copper conductor cables of 650/1100V grade confirming to IS: 694-1990 that can be drawn in one conduit of various sizes shall be as specified.

- B) 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.

1.4 Accessories:

- A) **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.**

1.5 Wires:

- A) All wires shall be single core multi-strand/ flexible copper or single strand Copper FRLS type PVC insulated as per IS: 694 and shall be 660 V\1100 V grade.
- B) All wires shall be colour coded as follows:

<u>Phase</u>	<u>Colour of wire</u>
R	Red
Y	Yellow

B	Blue
N	Black
Earth	Green (insulated)
Control (If any)	Grey
All off wires	same as Phase wire

- C) Both end of wires should be terminated with adequate size copper crimping type lugs and ferrules as per instructions of engineer in charge.

1.6 Outlets switches & Sockets:

- A) Switches shall be moulded plate type flush piano type with silver-coated contacts. Sockets shall be multipin pin with switch and plate type cover. Combination of multiple switch units and sockets should be used to minimize the switch boxes. All screws shall be brass – chromium plated and shall be counter sunk type with half round head or flat headed.
- B) For heavy duty, metal clad sockets with M.C.B/ Isolator mounted in a galvanized steel box shall be provided.
- C) The switch boxes shall be made of either rigid PVC moulding or mild steel or cast iron on all sides except at the front. PVC boxes shall comply with the requirements laid down in IS: 14772-2000. These boxes shall be free from internal roughness. Wall thickness of PVC boxes shall not be less than 2 mm. Clear depth of the box shall not be less than 60 mm and this shall be increased suitably as per requirements. An earth terminal with stud and washer shall be provided in each MS boxes for termination of protective conductors.
- D) All the fan boxes shall be of cast iron type only with minimum wall thickness of 3 mm.

1.7 Additional requirements

1.7.1 Making Chase

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. Chase shall be done with machine cutter only. In the case of building under construction, the conduits shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick/ RCC work, special care shall be taken to fix the conduit and accessories in position along with the building work.

1.7.2 Fixing conduits in chase

The conduit pipe shall be fixed by means of staples, J-hooks, or by means of saddler, not more than 60 cm apart or by any other approved means of fixing. All threaded joints of conduit pipes shall be treated with some approved preservative compound to secure protection against rust.

1.7.3 Fixing conduits in RCC work (slab / wall / floor etc)

The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same. Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius, which will permit easy drawing in of conductors. Location of inspection/ junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

At either side of the bends, saddles/staples shall be fixed at a distance of 15 cm from the center of the bends.

1.7.4 Fixing of inspection boxes

As far as possible inspection boxes shall be avoided or to be minimized as much as possible. If necessary suitable inspection boxes to the minimum sizes shall be provided to permit inspection and to facilitate replacement of wires with prior approval of engineer in charge. These shall be mounted flush with the wall or ceiling concrete with minimum depth of 65 mm for slab and as per IS: 2667 – 1988 for other places.

1.7.5 Fish Wire

To facilitate subsequent drawing of wires in the conduit, GI fish wire of 1.6mm /1.2mm (16/18 SWG) shall be provided along with the laying of the recessed conduits.

1.7.6 Earthing

A protective earth conductor shall be drawn inside the conduit in all distribution circuits to provide for earthing of noncurrent carrying metallic parts of the entire installation. These shall be terminated on the earth terminal in the switch boxes, and/or earth terminal blocks at the distribution boards. Gas or water pipes shall not be used as protective conductors (earth medium). Every sub main will have earth continuity conductor to run along with sub main wiring. Every circuit will have its earth continuity conductor to run along with circuit wiring. In case of 3 phase sub main wiring two earth continuity conductor shall be provided.

E – 8 LIGHT FIXTURES AND FANS**1.1 Scope:**

The scope covers supply, installation, testing and commissioning of different types of light fixtures, fans and exhaust fans.

1.2 Standards:

AS PER SCHEDULE OF INDIAN STANDARDS.

1.3 Type of fixtures:**1.3.1 General Requirement:**

- 1.3.1.1 All fixtures shall be complete with accessories necessary for installation whether so detailed under fixture description or not.
- 1.3.1.2 Fixture housing, frame or canopy shall provide a suitable cover for the fixture outlet box or fixture opening.
- 1.3.1.3 Fixtures shall be installed at mounting heights as detailed on the drawings or instructed on site by the Architects/Consultants.
- 1.3.1.4 Fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the fixture. Design of hangers and method of fastening other than shown on the drawings or herein specified shall be submitted to the Architect/Consultant for approval.
- 1.3.1.5 Pendant fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation as per Architect's/Consultant's instructions.
- 1.3.1.6 Flush mounted and recessed fixtures shall be installed so as to completely eliminate light leakage within the fixture and between the fixture and adjacent finished surface.
- 1.3.1.7 Fixture mounted on outlet boxes shall be tightly secured to a fixture stud in the outlet box. Extension pieces shall be installed where required to facilitate proper installation.
- 1.3.1.8 Fixture shall be completely wired and constructed to comply with the regulations and standards for Electric Lighting Fixtures, unless otherwise specified. Fixtures shall bear manufacturer's name and the factory inspection label unless otherwise approved.
- 1.3.1.9 Wiring within the fixture and for connection to the branch circuit wiring shall be not less than 1.0/1.5 sq.mm. copper for 250 volt application. Wire insulation shall suit the temperature conditions inside the fixture and wires bypassing the choke shall be heat protected with a heat resistant sleeve.
- 1.3.1.10 Metal used in lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with the specification or 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 burrs and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

- 1.3.1.11 Ferrous metal shall be bonderized and given a corrosion resistant phosphate treatment or other approved rust inhibiting prime coat to provide a rust-proof base before application of finish.
- 1.3.1.12 Non-reflecting surfaces such as fixture frames and trim shall be finished in baked enamel paint.
- 1.3.1.13 Light reflecting surface shall be finished in baked white enamel having a reflection factor of not less than 80%. All parts of reflector shall be completely covered by finish and free from irregularities. After finish has been applied and cured, it shall be capable of withstanding a 6 mm radius bend without showing sign of cracking, peeling or loosening from the base metal. Finish shall be capable of withstanding 72 hours exposure to an ultraviolet sun lamp placed 10 cm from the surface without discoloration, hardening or warping and retain the same reflection factor after exposure. Test results shall be furnished for each lot of fixtures.
- 1.3.1.14 Fixture with visible frames shall have concealed hinged and catches. Pendant fixtures and lamp holders shall be provided with ball type Algiers or similar approved means. Recessed fixtures shall be constructed so as to fit into an acoustic tile ceiling or plaster ceiling without distorting either the fixture or the ceiling plaster rings/flanges shall be provided for plaster ceiling. Fixtures with hinged diffuser doors shall be provided with spring clips or other retaining device prevent the diffuser from moving.
- 1.3.1.15 Detailed catalogue cuts for all fixtures, or, if so required by the Architect/Consultant sample fixtures shall be submitted for approval to the Architect/Consultant before orders for the fixtures are placed. Shop drawings for non-standard fixture types shall be submitted for approval to the Architect/Consultant.
- 1.3.1.16 Recessed fixtures shall be constructed so that all components are replaceable without removing housing from the ceiling.
- 1) Lamps shall be supplied and installed in all lighting fixtures furnished under this contract. All lamps shall be rated for 250 volts.
 - 2) Lamps used for temporary lighting service shall not be used in the final lighting of fixtures units.
 - 3) Lamps shall be of wattage and type as shown on the drawings and schedule. Where not shown, the details shall be ascertained from the Architect/Consultant before procurement.
 - 4) Lamps for permanent installation shall not be placed in the fixtures until so directed by the Architect/Consultant, and this shall be accomplished directly before the building portions are ready for occupation.

1.3.2 Fluorescent fittings:

- 1.3.2.1 Only single and/or two lamp ballast shall be used in any one fixture. Ballast shall be completely enclosed inside sheet steel casing and shall have a corrosion - resistant finish. Ballast shall contain a thermosetting type compound not subject to softening or liquefying under any operating conditions

or upon ballast failure. Compound shall not support combustion. All ballast shall be of high power factor compensated to above 0.9PF. Ballast temperature and sound rating shall be specified by the manufacturer and guaranteed. Ballast shall be for operation at the voltages and frequencies indicated and under temperature conditions prevailing in the various locations of the premises. Tapped ballast is preferred.

1.3.2.2 All fluorescent fixtures shall be provided with separate wiring channel with cover plate and an earth terminal. All screws shall be chromium brass screws. Lamp and starter holders shall be out of tough moulded plastic with spring loaded rotor type contactors rendered shock and vibration proof. Condensers shall be low loss paper impregnated hermetically sealed complying with IS 1969-196 . Internal wiring shall be neatly clipped and where by passing the ballast, a suitable heat resistant barrier or sleeve shall be provided.

1.3.2.3 Surface mounted fixtures longer than two feet shall have one additional point of support besides the outlet box fixture stud when installed individually. Pendant individually mounted fixtures four feet long and smaller shall be provided with twin stem/conduit hangers. Stems shall have ball aligners or similar devices and provided for a minimum of 25 mm vertical adjustment. Stems shall be of appropriate length to suspend fixtures at required mounting height.

1.3.2.4 Lamps shall have bi-pin bases and a minimum approximate rated and guaranteed life of 6000 hrs. Colour spectrum of light shall be equivalent to 'Philips White'. Lamp starter and ballast shall match the lamp.

1.3.3 Incandescent fittings:

1.3.3.1 Incandescent fittings shall be of the type generally specified on the drawings. Contractor should have sample approved by Architects/Consultant before procurement.

1.3.3.2 Incandescent fixtures shall be equipped with porcelain, medium base, screw type sockets for lamps up to and including 200 watt and mogul screw type pin type base for lamps 300 watt and over.

1.3.3.3 Re-lamping the fixture shall be possible without having to remove the fixture from its place.

1.3.3.4 Incandescent lamps shall be inside frosted/or clear type as required by the Architect/Consultant.

1.3.4 Ceiling Fans:

1.3.4.1 Ceiling fans shall be complete with fan suspension stem canopies and regulators. 30 cm suspension stem shall be standard accessory and stems shall be heavy duty galvanized steel tubes to IS 1239-1958.

1.3.4.2 Fans shall be mounted on a pre-embedded hook with hard rubber isolator. Regulators shall be no-step type mounted in the switch box. The box in all such cases shall be large enough to accommodate the regulator and switches. One sample box with top cover shall be got approved before procurement.

E – 9 Earthing**1.0 SCOPE OF WORK:**

The scope of work shall cover supply, laying, installation, connecting, testing and commissioning of:

- 1.1 copper/galvanized/aluminium/chemical or Electrode type Earthing station.
- 1.2 Earthing G.I./Aluminum/copper strips from earthing station to equi-potential bar.
- 1.3 Earthing G.I./ Aluminum/ copper strips/ wires from equi-potential bar to lay feeder mains and circuit to connect power panels, DBs, switchboards etc.
- 1.4 Bonding of Non-current carrying parts, and metallic parts of the electrical installation.
- 1.5 Provide inter connection between all earth pits of same type.

2.0 STANDARDS

- 2.1 The following standards and rules shall be applicable:

- 1) IS: 3043 - 1966 Code of practice for Earthing.
- 2) Indian Electricity Act and Rules

- 2.2 All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the British Standard Codes of Practice in absence of Indian standard.

3.0 GENERAL

All the non-current carrying metal parts of the electrical installation and mechanical equipments shall be earthed properly. The metal conduits, trucking, cables armoured and sheath, electric panels boards, lighting fixtures, ceiling and exhaust fan and all other parts made of metal shall be bonded together and connected by means of specified earthing system.

An earth continuity conductor shall be installed with all the feeders and circuits and shall be connected from the earth bar of the panel boards, to the conduit system, earth stud of the switch box, lighting fixture, earth pin of the socket outlets and to any metallic wall plates used. All the enclosures of motors shall be also connected to the earthing system.

4.0 TYPE OF EARTHING STATION**4.1 ELECTRODE / CHEMICAL TYPE EARTHING STATIONS:**

- 4.1.1 The substation earthing and equipment earthing shall be done with details given in earthing scheduled in BOQ & Drawing.

- 4.1.2 The earthing station shall be as shown on the drawing.
- 4.1.3 The earth resistance shall be maintained with suitable soil treatment as shown in the drawing.
- 4.1.4 The resistance of each earth station should not exceed the limit specified in IS : 3043.
- 4.1.5 The earthing grid and the earthing conductors shall be of copper strip of size as mentioned on the drawing.
- 4.1.6 The block masonry chamber with Cast Iron hinged cover shall be provided for housing the termination block as shown in the drawing.
- 4.1.7 The hardware and other consumable for earthing installation shall be of copper/brass, as per details shown in the drawing.
- 4.1.8 GROUNDING: The grounding system shall incorporate the following individual components or a combination of the following:
- Deep driven copper bonded steel core ground rod/ Copper Plate / Copper Rod as central injection point for flow of fault current which is securely connected to the lower end of the down conductor.
 - The use of ground resistance improvement material shall be applied in order to reduce the resistivity levels of the grounding system and maintain a constant low resistivity. The grounding system shall be maintenance free.

Maintenance Free Earthing System consists of following material:

- Copper Bonded Earth Rod- Length 1.5Mtr/3Mtr Dia. 5/8"
- Ground Rod Clamp – For Earth Termination.
- Ground Resistance Lowering Compound.

The Copper bonded earth rods are made in accordance with national and international standards such as BS6651, BS7430 and UL467. Threads are rolled onto the rod ensuring an even copper covering which eliminates the risk of chipping whilst driving.

Description: Threaded Copper bonded Earth Rod

Material: Carbon steel rod bonded with Copper

Length: 1.5Mtr./3Mtr

Rod Diameter (Actual): 5/8"

Weight: 1.92kg / 4Kg.

A low resistance, non corrosive earth enhancing compound designed for use in standard soil conditions is to be used for these earthings. This compound shall have following characteristics:

- Will not dissolve or leach away with time
- Maintains constant resistance for the life of the earthing system.
- Effective in normal soil conditions.
- No maintenance required

Ground Resistance Improvement Powder to be used which shall not wash away under seasonal conditions and therefore provides a permanent presence in working to improve and maintain the integrity of the earthing system.

U-Bolt Rod Clamp.

Description: Suitable for clamping earth rods to tape or round conductor.
Suitable for Rod Diam. : 5/8" & Copper Tape Size: 25mm x 3mm
Weight: 90 gm.

5.0 INSTALLATION AND CONNECTION:

- 5.1 The plate \ pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 2.5 M below finished ground level.
- 5.2 The plate \ pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall \ column.
- 5.3 The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.
- 5.4 G.I. pipe for watering, shall run from top edge of the plate \ pipe electrode to the mid level of block masonry chamber.
- 5.5 Top of the pipe shall be provided with G.I. funnel and screen for watering the earth \ ground through the pipe.
- 5.6 The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing.
- 5.7 The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.
- 5.8 Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.

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- 5.9 The earth conductors (Strips / Wires copper/ Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Mild Steel Zinc Passivated screws \ bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level.
- 5.10 The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.
- 5.11 Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.
- 5.12 The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

6.0 EARTH LEADS AND CONNECTIONS:

- 6.1 Earth lead shall be bare copper or galvanized steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. Galvanized steel buried in the ground shall be protected with bitumen and Hessian wrap or polytene faced Hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is at least 8 mm away from the wall surface.
- 6.2 The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

7.0 EQUIPMENT EARTHING:

All apparatus and equipment transmitting or utilizing power shall be earthed in the following manner. Copper/G.I. earth strips/wires shall be used unless otherwise indicated in the Schedule B.

8.0 POWER TRANSMISSION APPARATUS

- 8.1 Metallic conduit shall not be accepted as an earth continuity conductor. A separate insulated / bare earth continuity conductor of size 50 % of the phase conductor subject to the minimum and maximum shall be provided.

	Copper	Aluminum	G.I.
Minimum(sqmm)	2.5	4.0	6
Maximum(sqmm)	75	100	200

The earth continuity conductor be drawn inside the conduit shall be insulated.

- 8.2 Non metallic conduit shall have an insulated earth continuity conductor of the same size as for metallic conduit. All metal junction and switch boxes shall have an inside earth stud to which the earth conductor shall be connected. The earth conduct or shall be distinctly coloured (Green or Green/Yellow) for easy identification.
- 8.3 Armoured cable shall be earthed by two distinct earth connections to the armouring at both the ends and the size of connection being as for the metallic conduit.
- 8.4 In the case of Unarmoured cable, an earth continuity conductor shall either be run outside along with the cable or should form a separate insulated core of the cable.
- 8.5 Three phase power panel and distribution boards shall have two distinct earth connections of the size correlated to the incoming cable size. In case of single phase DB's a single earth connection is adequate.

9.0 UTILIZING EQUIPMENT:

- 9.1 Three phase motors and other three phase apparatus shall have two distinct earth connections of the size equal to 50% of the connecting cable subject to the following:

	Copper	Aluminum	G.I.
Minimum(sqmm)	6.5	10	20
Maximum(sqmm)	75	10	200

- 9.2 For single phase motors and apparatus, the single earth connection shall be provided of the above size. For all light fittings and fans a single earth connection with 1.5 sqmm copper or equivalent size shall be provided.
- 9.3 All street light poles shall have an earth stud and shall be connected to the cable armouring using 6.5 sqmm copper or equivalent unless shown otherwise. For street lighting poles planted in ground, 2.4 M long 10 SWG bare copper wire shall be coiled and buried with every fourth pole in addition to connection to cable armouring.
- 9.4 An equipment earthing grid shall be established as shown in the drawing. All earth connections to all panels, DB's and equipment shall be connected to the nearest point of the earthing grid.

10.0 TEST:

- 10.1 The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS: 3043.
- 10.2 The following earth resistance values shall be measured with an approved earth meggar and recorded.
- 1) Each earthing station
 - 2) Earthing system as a whole
 - 3) Earth continuity conductors
- 10.3 Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 Ohm in each case. This is responsibility of contractor to get the final value for resistance.
- 10.4 Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.
- 10.5 All tests shall be carried out in presence of the consultant..

11.0 METHOD OF MEASUREMENT:

- 11.1 Provision of earthing station complete with excavation, plate, earth lead upto chamber, earth link in the chamber, electrode, GI watering pipe, Salt, Charcoal, soil treatment to achieve the earth resistance less than 4 ohm, masonry chamber with cast iron cover etc. shall be treated as one unit of measurement.
- 11.2 The following items of work shall be measured and paid per unit length covering the cost of the earth wires/strips, clamps, labour etc.
- a) Main equipment earthing grid and connection to the earthing stations.
 - b) Connection to the power panels, DB etc.
- 11.3 The cost of earthing the following items shall become part of the cost of the item itself and no separate payment for earthing shall be made.
- a) Light fittings - form part of installation of the light fitting.
 - b) Conduit wiring, cabling - should form part of the wiring or cabling.
 - c) Street lighting - should form part of the street light poles.

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E-9 Miscellaneous (Fire Stop system Material)

1.0 Scope :

1.1 The scope of work covers the supply, installation and testing of Fire Stopper as specified in BOQ.

2.0 Standards :

As per Applicable standard Specification of Fire stopper material supplier.

All installation of Anchor fastener has been approved by Hilti Technical staff and certified the same.

3.0 Material :

a) Fire Resistant Mortar

Fire resistant, cement based mortar with thermal insulating properties .The product shall be tested for withstanding Zone 4 earthquake when tested in accordance with acceleration time history waveform VERTEQII as per IEC 60068 and Telcordia Technologies GR-63-Core 2006-03. The product shall be age tested for 30 years as per Dafstb and DIBT standards. The product shall be tested and approved by third party agencies such as UL, FM and LPCB. The product shall bear the UL and FM approval logo on the packing.

b) Fire Stop System

Providing & Supplying Passive Firestop system. Fire barrier coating of 1 mm thickness should be apply on Mineral wood board (density min. 150 kg/cu. meter) and fill the remaining gap around entrants with suitable filler of depth same as mineral wool panel thickness to provide 2 hour fire rating on solid structure (wall- min. 80 mm, floor- min. 150 mm thickness) when subject to test conditions of BS 476: part 20:1987 and after age testing to DafStb guidelines. Cables and cable tray should be coated with above same coating up to minimum length of 300 mm to prevent spread of fire. Fire barrier coating and filler should be approved to international test standard like BS 476 and tested by FM, LPC, BRE, and WFR. For wall opening the Board system should be used on both sides of the wall and for floor opening it should be used only on one side.

c) Fire Stop System

Providing and supplying versatile intumescent expanding foam. The product shall be tested for withstanding Zone 4 earthquake when tested in accordance with acceleration time history waveform VERTEQII as per IEC 60068 and Telcordia Technologies GR-63-Core 2006-03. The product shall be age tested for 30 years as per Dafstb and DIBT standards. The product shall provide water tightness when tested for W rating as per UL standards and shall be tested for providing a sound insulation of 50 when tested in accordance with ASTM E 90. The product shall be tested and approved by third party agencies such as UL, FM and LPCB. The product shall bear the UL and FM approval logo on the packing.

4.0 Mode of measurement :

As specified in BOQ.

E-11 TELEPHONE, DATA, CCTV & TELEVISION DISTRIBUTION**1.0 SCOPE OF WORK**

- Complete installation shall be done in accordance with installation practices for a well structured cabling system, using components from a single vendor to ensure consistent and assured performance. The structured cabling distribution network shall serve as a vehicle for transport of data, video and voice telephony signals over a common network throughout the network.
- Installation, termination and identification of wiring between station outlets and networking rack shall be considered part of the contractor's work.
- Wiring utilized for data and voice communications shall originate at networking racks and terminate at IOs terminated at wall.
- Cables and terminations shall be provided and located as shown and in the quantities indicated on the drawings.
- All cables and terminations shall be identified at all locations. All cables shall terminate in an alphanumeric sequence at all termination locations.
- All balanced twisted pair cable terminations shall comply with, and be tested to TIA/EIA568-C.2 standards for Category 3, Category 5e & Category 6 installations.
- The contractor carrying out the SITC shall make the system entirely operational for its intended use, by addition of components specific to its make/model even if not specifically mentioned in the BoQ.

Supported Applications, but not limited to:

- Ethernet Applications – wired Ethernet and wireless as per IEEE 802.11a/b/g/n and 802.11ac
- IEEE 802.3af Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)
- Telecom – BRI, PRI and Digital Subscriber Loop (DSL) Applications
- Voice, Video and ISDN Applications

References & Standards, but not limited to:

- TIA / EIA
- International Electro technical Commission (IEC)
- European Committee for Electro technical Standardization (CENELEC)
- National Fire Protection Association (NFPA)

- Wherever there is reference to multiple standards and/codes, the ones most recent and most stringent shall apply.

It shall be the responsibility of the installer and OEM manufacturer to ensure that:

- The Passive Components of structured cabling distribution network will be free from manufacturing defects in material and workmanship under normal and proper use;
- All Passive Components in the structured cabling distribution network shall meet or exceed the relevant component specification of the TIA 568-B series and ISO/IEC 11801: 2002 standards;
- The structured cabling distribution network compliant channels will meet or exceed the Guaranteed Channel Performance as per relevant standards in the structured cabling distribution network Performance Specifications in effect at the time of installation.
- The site will be duly certified by OEM for a period of 25 years from the date of issuance of the registration certificate or installation, whichever is earlier.

The Items, and the Specifications for the same in this section, applies to the following:

- Category 6 Data Networking UTP Cable and associated components such as CAT6 patch panels – 16/24/48 ports, IOs/RJ45 jacks, CAT6 patch cords, Face plates & SMBs
- Networking Racks – for termination of networking cables

Installation:

- All cables shall be on cable racks and neatly stitched together.
- The connection at the tag blocks shall be silver soldered of IDC type so as to achieve minimum contact resistance gas tight connection.
- The final branch connections with single pair cables in conduits and the maximum number of cables in each conduit shall be as follows :

Conduit Diameter	Inch/mm.	Max. No. of cables
1"	25	3 Nos. Of CAT6 cables
1½"	40	5 Nos. Of CAT6 cables

1.1 JELLY FILLED ARMORED TELEPHONE CABLES – 10/20/50/100/ 500/1000 PAIRS:

- a) All multi core cables and wires shall be of tinned copper conductor of not less than 0.5 mm diameter and shall be color coded twisted pairs with rip cord.
- b) The conductor resistance shall be less than 150 ohms per KM and the insulation resistance between the conductors shall be not less than 50 mega ohms and the nominal capacitance measuring about 0.1 microfarad per kilometer.

- c) Cables which are laid underground or locations subject to dampness and flooding shall be filled with polyethylene compound and shall have sufficient protection against moisture and water ingress.
- d) All armoring shall be of galvanized steel wires and protected against corrosion by an outer sheath of PVC in the case of indoor cables and polyethylene in the case of outdoor cables. Outer sheathing must be fire retarding and anti-termite.
- e) The Jelly Filled armored cable (JFA) shall be of 30/50/100/ 500__pairs' capacity as required and suitable for direct burial application.
- f) Physical Specifications:
 - Gauge of Conductor: 23/24 AWG
 - Material: Annealed soft electrolytic copper wire monolithic
 - Operating Temperature: -20 Deg. C to + 80 Deg. C
 - Current Resistance: Minimum 90 ohm/mile

1.2 TAG BLOCKS OR KRONE BLOCKS

- The telephone tag blocks shall be suitable for the multi core telephone cables and shall have two terminal blocks, cross connect type. All incoming and outgoing cables shall be terminated on separate terminal blocks and termination shall be of insulation displacement type (IDC) to provide silver soldered gas tight connection. The cross connecting jumpers shall be insulated wires of same diameter and terminated using impact tool for gas tight connection. Screw connected.
- The tag blocks shall be mounted inside fabricated sheet steel boxes with removable hinged over's and shall be fully accessible. The enclosure shall be painted with 2 coats of red oxide and stove enamelled.

1.3.1 2 CORE CAT 3 EQUIVALENT CABLE FOR TELEPHONE/VOICE

- a) All 2 core cables shall be of tinned copper conductor of not less than 0.5 mm diameter and shall be color coded twisted pairs with rip cord.
- b) The conductor resistance shall be less than 150 ohms per KM and the insulation resistance between the conductors shall be not less than 50 mega ohms and the nominal capacitance measuring about 0.1 microfarad per kilometer.
- c) Each conductor consists of a round wire of annealed high conductivity copper, smoothly drawn with uniform diameter and resistance.

1.3.1.1 RJ 11 INFORMATION OUTLET (IO) FOR TELEPHONE/VOICE

- a) RJ 11 IOs shall meet or exceed Category 6A transmission requirements for connecting hardware, as specified in TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard and ISO/IEC

11801:2002 Second Edition, CENELEC EN 50173, and TIA/EIA568B

- b) The RJ 11 I/Os shall be backward compatible with Category 3 cords and cables.
- c) The RJ 11 I/Os shall be of a universal design supporting T568 A, B & C wiring.
- d) The RJ 11 I/Os shall be either a part 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/Tx and 1.2 Gbps ATM.
- e) RJ 11 I/Os 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. Multicoloured identification labels shall be available to assure accurate installation.
- f) As an option, the RJ 11 I/Os shall be capable of being installed at either a 45° or a 90° angle in any modular faceplate, frame, or surface-mounted box avoiding the need for special faceplates by using matching suitable components
- g) The RJ 11 I/Os shall allow universal A/B type wiring and labelling.
- h) The Category 6A outlets shall be capable of being installed at either a 45° or a 90° angle in same manufacturer supplied modular faceplate, frame, or surface-mounted box avoiding the need for special faceplate.
- i) The RJ 11 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.
- j) The RJ 11 I/Os shall be made from high impact thermoplastic and shall be UL and c UL rated.
- k) The Insulation Displacement connectors must accept solid as well as stranded wire.
- l) Physical Specifications:
 - Dimensions: H x W x D: 2.0 cm x 2.0 cm x 3.1 cm
 - Plastic Material: High-impact, flame retardant, thermoplastic
 - Flammability Rating: UL-rated 94 V-0
 - Contact Material: Copper Alloy
 - Plating: Gold over nickel
 - Nominal Solid Conductor

- Diameter: 0.40 mm to 0.64 mm (26 to 22 AWG)
- Nominal Stranded Conductor Diameter: 0.51 mm to 0.64 mm (24 to 22 AWG)
- Insulation Size: 0.76 mm to 1.17 mm
- Insulation Types: All plastic insulates, including: PVC, irradiated PVC, Polypropylene, PTFE, Polyurethane, Nylon and FEP

m) Electrical Specifications:

- Insulation Resistance: 500 mega ohms minimum
- Current Rating: 1.5 A at 68°F (20°C)
- TIA/EIA Category: 3
- Dielectric Withstand Voltage: 1000 VAC RMS, 60 Hz minimum, contact-to-contact and 1,500 VAC RMS, 60 Hz minimum to exposed conductive surface

1.3.2 CATEGORY 6A UTP CABLE FOR DATA

- a) Cable should meet or exceed the TIA Category 6A / ISO Class E attenuation specification, NEXT requirements in ISO/IEC 11801, CENELEC EN50173 and TIA/EIA 568C.
- b) CAT 6A UTP balanced twisted pair cable shall conform to the Category 6A component specifications and the installed channels shall comply with the ANSI/EIA/TIA 568C.2-1 Category 6A and ISO/IEC 11801 Class E Channel Performance Specification
- c) All balanced twisted pair cable and apparatus shall conform to the Category 6A component specifications and the installed channels shall comply with the Category 6A Performance Specification up to the maximum 100 meters (328 feet) length, including up to 6 connection points.
- d) The high performance Category 6A UTP cable shall be of the traditional round design with Mylar bisector tape
- e) There should not be any limitation for minimum length of Cat 6A Channel (should not have high resonance problem in shorter channels).
- f) The Category 6A, 4 pair UTP channel shall support emerging high-bandwidth applications, including 1 Gbps Ethernet, potentially 1.2 Gbps ATM and 2.4 Gbps ATM, IEEE 1394B S400, Multi-Tasked Split Screen Computing, Virtual Holographic Video Conferencing, Instant Access Telemedicine, 3D CAD/CAM Engineering, Internet-Intranet Communications/Commerce, as well as all 77 channels (550 MHz) of analog broad band video
- g) Category 6A cable shall perform on 400 % margin and at least 6 db NEXT

- h) The Category 6A cable and components shall be electrically backward compatible with existing Category 3, 5, and 5e
- i) Should be UL verified as Category 6A / ETL listed as Category 6A, i.e., The 4 pair UTP cable shall be UL® and c (UL®) Listed Type CMP (plenum) or CM (non-plenum)
- j) Should have thin bisector tape for additional performance benefits
- k) Performance guaranteed to meet or exceed Category 6A specifications to 500 MHz
- l) Performance guaranteed up to 6 connections in any length channel configuration up to 100 meters
- m) CAT 6A UTP indoor cable shall consist of 23 AWG polyethylene, insulated conductors, twisted into four pairs and shall be of the traditional round design with bisector tape and jacketed with a non-plenum polyethylene jacket.
- n) Category 6A NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT and return loss extrapolated to 250 MHz
- o) Cable should be capable of delivering potentially in excess of 1.2 Gbps to the workstation in accordance with application standards.
- p) 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, Ethernet IEEE 802.3 1000BASE-T, TIA-854-A 1000BASE-TX, 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, Building Automation System applications.
- q) Transmission: The balanced twisted pair cable channel performance shall be guaranteed up to the maximum 100 meters (328 feet) length, including up to 6 connection points.
- r) The cable jacket shall comply with Article 800 NEC for use as a plenum or non-plenum cable. The 4 pair UTP cable shall be UL® and c (UL®) Listed Type CMP (plenum) or CMR (non-plenum)
- s) The Category 6A UTP Ethernet Cable and Category 6A Channel Components shall be manufactured by a single manufacturer. The manufacturer shall warrant the Category 6A channel cable, components, and applications for a period of 20 years.
- t) Physical Specifications:
 - Nominal Outside Diameter: 0.334 in (8.55 mm)
 - Bend Radius 1.5" (3.8 cm); Plenum: 1.4" (3.6 cm)
 - Gauge of Conductor: 23 AWG

u) Electrical Specifications:

- Maximum DC Resistance: 9.38 Ohms/100 m
- Maximum DC Resistance Unbalance: 4% max

v) Compliance to Electrical Standards as follows:

- ANSI/TIA/EIA 568C.2-1 Category 6A
- ISO/IEC 11801: 2002 (Edition 2) Class E
- CENELEC EN50173: 2002 (Edition 2) Category 6A

1.3.2.1 CATEGORY CAT 6A INFORMATION OUTLET (IO)

- a) Category 6A IOs shall meet or exceed Category 6A transmission requirements for connecting hardware, as specified in TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801:2002 Second Edition, CENELEC EN 50173, and TIA/EIA568B
- b) The Category 6A IOs shall be backward compatible with category 6A, Category 5E, 5 and 3 cords and cables.
- c) The Category 6A IOs shall be of a universal design supporting T568 A, B & C wiring.
- d) The Category 6A IOs shall be either a part 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/Tx and 1.2 Gbps ATM.
- e) Category 6A IOs 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. Multicoloured identification labels shall be available to assure accurate installation.
- f) As an option, the Category 6A IOs shall be capable of being installed at either a 45° or a 90° angle in any modular faceplate, frame, or surface-mounted box avoiding the need for special faceplates by using matching suitable components
- g) TIA Category 6A/ISO Class E NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT and return loss extrapolated to 250 MHz.
- h) The Category 6A IOs shall be available in at least 3 colours for identification with different applications such as Data, Voice, IP voice etc.
- i) The category 6A IOs shall allow universal A/B type wiring and labelling.

- j) The Category 6A outlets shall be capable of being installed at either a 45 or a 90 angle in same manufacturer supplied modular faceplate, frame, or surface-mounted box avoiding the need for special faceplate.
- k) The Category 6A 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. Multicoloured identification labels shall be available to assure accurate installation.

l) The Category 6A IOs shall be made from high impact thermoplastic and shall be UL and c UL rated.

m) The Insulation Displacement connectors must accept solid as well as stranded wire.

n) Physical Specifications:

- Dimensions: H x W x D: 2.0 cm x 2.0 cm x 3.1 cm
- Plastic Material: High-impact, flame retardant, thermoplastic
- Flammability Rating: UL-rated 94 V-0
- Contact Material: Copper Alloy
- Plating: Gold over nickel
- Nominal Solid Conductor Diameter: 0.40 mm to 0.64 mm (26 to 22 AWG)
- Nominal Stranded Conductor Diameter: 0.51 mm to 0.64 mm (24 to 22 AWG)
- Insulation Size: 0.76 mm to 1.17 mm
- Insulation Types: All plastic insulates, including: PVC, Polypropylene PTFE, Polyurethane, Nylon and FEP

o) Electrical Specifications:

- Insulation Resistance: 500 mega ohms minimum
- Current Rating: 1.5 A at 68°F (20°C)
- TIA/EIA Category: 6
- Dielectric Withstand Voltage: 1,000 VAC RMS, 60 Hz minimum, contact-to-contact and 1,500 VAC RMS, 60 Hz minimum to exposed conductive surface
-

1.3.3 RG 6/RG 11 cable for television

The scope of work shall cover supply, installation, commissioning and testing of :

- Television cables
 - Television wiring in conduits
 - The connection at the splicer/junction boxes shall be made with end sockets as to achieve minimum contact resistance.
 - The final branch connections with single cables in conduits and the maximum number of cables in each conduit shall be as follows :
- | | |
|--------------------|--------------------|
| • Conduit diameter | Max. No. of cables |
| Inch / mm. | |
| 3/4" / 20 | 1 no RG 6 / 11 |
| 1" / 25 | 2/3 nos. RG 6 /11 |
| 1 1/4" / 32 | 6 Nos. RG 6 /11 |

1.4 FACE PLATE FOR INFORMATION OUTLET (SINGLE / DUAL)

- a) Faceplate should contain slots that cover the screws to house labels and covers.
- b) Labels and covers should be included with the face plate as required.
- c) Faceplate outlet opening should be numbered on both sides for installation & maintenance identification.
- d) Should have provision of blank to fill the unused outlet openings.
- e) Should be made from high impact, flame retardant, UL rated 94 V-0 thermoplastic.
- f) The modular face plate shall be used to mount or install CAT 6A CAT 5/3 information outlets.
- g) The modular shall be available in single, dual and quad arrangement in single gang.
- h) All faceplates material (Plastic) shall meet the specifications of High-impact, flame retardant, UL-rated 94 V-0, thermoplastic. The dimensions shall be co-ordinate with project authorities as per actual site requirements.

E-12 FIRE DETECTION & ALARM SYSTEM**1.1. SCOPE OF WORK**

- a) A intelligent reporting, microprocessor controlled fire detection shall be installed in accordance with the specifications and drawings.
- b) Cable laying should also cover an excavation work, if required
- c) The System shall comprise of the initiating devices such as the smoke / Heat / Combination Sensors, Manual Pull Stations etc.
- d) Notification Appliances shall include Directional Sounder cum Strobes.
- e) All the above components shall be connected by unarmoured 2 core 1.5 SQMM cable for internal areas in MMS PVC grade conduits for physical protection. For external areas armoured 2 core 1.5 SQMM cable should be used.
- f) The scope shall include laying of the cables described above, citing of the various components to the direction of the architects and consultants, networking and programming to achieve the desired functionality.
- g) The system shall be designed such that each signalling line circuit (SLC) is limited to only 80% of its total capacity at initial installation.
- h) Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
- i) On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signalling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
- j) Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
- k) When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:
 - The System Alarm LED shall flash.
 - A local piezo electric signal in the control panel shall sound.
 - All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.
 - This specifications covers the requirements of design, supply of materials, installation, testing and commissioning of Aspirating Smoke Detection System. The system shall include all equipment's, appliances and labour necessary to install the system, complete with highly

sensitive LASER-based Smoke Detectors with aspirators connected to network of sampling pipes.

- The Bidder shall also make provision in the Aspirating Smoke Detectors to trip AHU and to shut fire dampers in the event of fire through the relay contacts
- The aspiration system should be integrated with the existing fire detection system.
- The smoke/heat detectors should be looped from the existing fire alarm panel.

1.2. CODES AND STANDARDS

- NFPA CODE 70 (NEC) NFPA 72 Fire Alarm Code NFPA 101 Life Safety Code
- National Building Code of India, 2005.
- Fire Industry Association (FIA), Code of Practice for Design, Installation, Commissioning & Maintenance of Aspirating Smoke Detector (ASD) Systems
- NEC Standards, US

1.3. APPROVALS

- The system shall have proper listing and/or approval from the following nationally recognized agencies:
 - UL Underwriters Laboratories Inc
 - FM Factory Mutual
- The Fire Alarm Control Panel and all transponders shall meet the modular listing requirements of Underwriters Laboratories, Inc.
- Each sub-assembly, including all printed circuits, shall include the appropriate UL modular label.

1.4. DETAILED DESCRIPTION OF THE SYSTEM COMPONENTS:

BASIS OF DESIGN

- Multi sensor detectors, other modules & response indicators, sounders, MCPs and aspiration system, etc. must be compatible in all aspects (hardware, software, programming, etc.) with IPR's existing intelligent addressable fire alarm and detection system of NOTIFIRE Make with Model no. NFS2-3030.
- The system shall be provided with Addressable fire alarm initiating, annunciating and control devices.
- The detectors & devices should be looped from the existing loop of building Fire Alarm Panel (Notifire - NFS2 -3030.)
- The addressable and intelligent system shall be such that smoke sensors, thermal sensors, manual call points, etc., can be identified with point address.
- Cable laying should also cover an excavation work, if required

- The FAS shall be able to recognize normal and alarm conditions, below normal sensor values that reveal trouble condition, and above normal values that indicate either a alarm condition or the need of maintenance.
- Read-out or address an actual detector location. The operator shall also be able to adjust alarm and alarm thresholds and other parameters for the smoke sensors.
- Provide a maintenance/pre-alert/fault alarm capability at smoke sensors to prevent the detectors from indicating a false alarm due to dust, dirt etc.
- Provide alarm verification of individual smoke sensors. Systems that perform alarm verification on a zone basis shall not be acceptable. Alarm verification shall be printed on the printer at the Control Station's printer to enhance system maintenance and identify possible problem areas.
- Provide local numeric point address and LED display of device and current condition of the point.
- Each detector shall use state-of-the-art Microprocessor Circuitry with error, detector self-diagnostics and supervision programs.
- The detection of the fire shall be taken at the detector level.
- Multi-Criteria Detectors shall be offered where by the system logic activation is based on any three inputs from the detector i.e. smoke, fixed heat or rate of rise heat.
- Provide outputs that are addressable, i.e. outputs shall have point address. The operator shall be able to command such points manually or assign the points to Logical Point Groups (Software Zones) for pre-programmed operation.
- In the event of a fire alarm, but not in a fault condition, the following action shall be performed automatically.
 - The System Alarm LED on the main fire alarm control panel shall flash.
 - A local piezoelectric signal in the control panel shall sound.
 - The LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises..
 - The audio portion of the system shall sound the proper signal (tone or voice) to the appropriate zones.
 - All system output programs assigned via control-by-event programs that are to be activated by a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
- The system shall store a record of alarm, supervisory and trouble events in non-volatile history file. This file shall contain the most recent 3000 events, with time and date of each event. It shall be possible to select the number of events to be viewed in the history file by date, so the entire file does not have to be downloaded. The history file shall remain intact in the event of a loss of AC and battery power.

- The system shall be capable of being expanded and field reprogrammed at any time up to the predetermined maximum capacity of the system, without the requirement to return the operating system to the factory for program changes. All field programming shall be done by an authorized manufacturer's representative.
- Intelligent, Analog and Addressable input devices shall receive power and communication protocol signals over a single pair of wires per channel (SLC) from the control unit.
- Each channel (SLC) shall support Minimum of 159 or more analog and/or addressable devices.
- Channels shall be field programmable for NFPA 72(1993) Style 4 and 6 operations, with capability for Style 7 when used with approved loop isolation units.
- Photoelectric, Laser and Thermal detectors shall be of the Intelligent, analog addressable type, and shall provide dual level alarm and pre-alarm reporting. Pre-alarm shall serve as early warning of an impending alarm condition, and shall generate a trouble condition in the panel.
- Each detector head shall incorporate a microprocessor which provides for distributed system intelligence. The micro shall provide full monitoring and control of the device with memory for storage of pre-set sensitivity levels and other detection device parameters. For security purposes and system integrity no mechanical addressing switches shall be allowed for field devices. All setting of device parameter shall be done electronically.
- System Power shall be adequate to accommodate all connected addressable and analog input devices in alarm simultaneously and shall be capable of operating all connected addressable output relays while all addressable inputs are in alarm. Prior to owner / contractor acceptance of installed system, manufacturer or his representative shall demonstrate 100% system alarm status with no loss of performance.
- Activation of any manual alarm station or any other approved alarm initiating device (excluding Automatic Fire Detectors which will be described later) shall immediately result in the following:
 - Display the alarm condition on the LCD Displays of all the Peer-to-Peer networked Panels, Network Repeaters and Slave Repeaters, Touch Screen Displays.
 - Visual alarm signals shall be provided as indicated on the plans.
 - System shall shutdown/redirect all HVAC system fans, dampers, etc.; close fire doors, recall elevators, etc., in accordance with the schedule provided and with appropriate local/national code.
 - Operation of the system alarm silence switch shall silence all alarm audible connected to the system, with the exception of circuits programmed for the non-silence water flow feature. When properly configured, a silence command shall not extinguish visual alarm appliances. Circuits containing alarm visual circuits shall not be silent except upon system reset.
 - The system alarm LED and all other associated alarm displays shall remain illuminated until the alarm condition has been corrected and the panel has been reset.
 - A connected system printer (if supplied) shall record all the status changes that take place within the fire protection system, including alarm / trouble restoration. All status changes shall be logged.

- The activation of an Automatic Fire Detector shall provide for all operations.
- Alarm Verification per device in accordance with NFPA 72 - 1993 and UL 864.
- Positive Alarm Sequence in accordance with NFPA 72 -1993 and UL 864.
- Analog-Addressable smoke detectors shall be equipped with a Day/Night Sensitivity Mode which may be selected by either manual or automatic input.
- Because certain smoke detector environments change from day (occupied) upto night (unoccupied), a more sensitive or Night setting may be desirable. Adjustable sensitivity smoke detector values shall be distinctly identified in the system memory and by display.
- Supervisory conditions shall cause a distinct annunciation at the panel. The system printer shall record supervisory events in a manner consistent for all status changes.
- The fire alarm panel shall fully supervise its operation. The physical opening or cutting of the wiring to any initiation, alarm indicating, signalling line, or associated supervisory monitoring circuit shall cause distinct annunciation via the LCD display.
- Analogue signals from detectors shall be processed in such a way as to discriminate, as far as possible, between sources of fire and false alarms, and shall identify detectors that are becoming dirty. As a minimum, multi-state indications, i.e. normal, fire, fault and pre-alarm warning, shall be provided for each detector.
- It shall be possible to interrogate detectors to determine their analogue values and display these on the alphanumeric display of each control panel. There shall be the facility to display an individual detector's value separately as well as values of all detectors together. It shall also be possible to set a value and display the addresses of all those detectors with values above that value.
- The controlling software of the system shall be configured to group detectors and manual call points into zones.
- Output signals, for example, to sounder circuits and interfaces, corresponding to individual device inputs and/or their related zones, shall be configurable in the controlling software of the system. They shall be freely assignable; i.e. each input shall be capable of being programmed to operate any, some, or all outputs.
- It shall be possible to modify the configuration of zones and reconfigure the relationship between inputs and outputs. This shall be site programmable.
- The system shall be immune to EMC-related interference. In particular, the Contractor shall take into account the use of VHF/UHF radio communication systems, mobile telephones, pagers and computers, and other electrical equipment used in the building.

- The system shall be installed in accordance with the manufacturer's instructions. In particular, the Contractor shall take due note of, and shall comply with, the manufacturer's instructions on circuit design, minimum signal strengths, loadings and end-of-line terminations, where appropriate.

WIRING ARRANGEMENTS

- It shall be the responsibility of the Contractor to determine the number of loops and other circuits required for the system.
- Where the system is distributed, the network linking the control panels shall be capable of being extended in the future to link to further compatible control panels. The capacity of the network shall be expandable by 25%

CIRCUIT DESIGN

- Each detection loop shall originate and terminate at the control and indicating equipment.
- The number of loops required for the system shall be determined on the basis of device capacity, total loop length and the area of coverage of each loop. The maximum area coverage per loop shall not exceed 10,000m².
- Each loop shall incorporate a minimum of 25% spare device capacity for possible future use. The spare capacity shall relate to manual call points, detectors, sounder and beacons (where relevant) and loop interfaces in any combination.
- All wiring shall be monitored for faults.
- Loop wiring shall tolerate a single open-circuit fault without affecting any device on the same loop. Loop wiring shall also tolerate multiple open-circuit or short-circuit faults in one area, without affecting the devices in any other area or on any other loop or circuit.
- Removal of a device from a loop shall not cause any remaining devices in the system to become inoperative.
- It shall be possible to disable detectors on the system. The controlling software shall permit individual detector disablement and detector group disablement. As a minimum, a group shall correspond with the detectors in a particular zone. Group detector disablement shall not render manual call points in the same area inoperative.
- Short-circuit isolators shall be provided at the beginning and end of each loop. Also, a single short circuit or open-circuit fault on an automatic fire detector circuit shall neither disable protection within an area of more than 2,000m², nor on more than one floor of the building plus a maximum of five devices (automatic detection, manual call points, sounders or a combination of these) on the floor immediately above and five devices on the floor immediately below that floor.
- Where the system is distributed, the network between control panels shall be configured as a loop and shall be capable of tolerating a single open- or short-circuit without loss of communication

between panels. It shall be a 'peer to peer' network that is not wholly dependent on a single, centralized processor or panel. In the event of failure of the network, each control panel on the network shall be capable of operating in a 'stand-alone' mode and thus generating fire alarm warnings in response to activation of a device connected to it.

FALSE ALARMS

- Great care shall be taken, at the design stage, to minimize the likelihood of false alarms occurring in the new or modified system.
- Devices shall be of types appropriate to the local environment. For example, optical smoke detectors shall not be installed in areas where there is likely to be steam or dust present. Also, manual call points shall be fitted with transparent hinged covers where there is the possibility of accidental operation, e.g. in kitchens or service areas.

SYSTEM ARCHITECTURE

- The system shall have a centralized structure. The locations of control and indicating equipment shall be as shown on the Contract Drawings.
- A centralized system has one set of control and indicating equipment in a single location in the building. (The control panel may also be connected to repeater or mimic panel(s) elsewhere in the building.) This means that all detection loop wiring, and separate sounders wiring (if appropriate) will emanate from the centrally located control and indicating equipment. Centralized systems are suitable where the lengths of loop and sounder cables do not become excessive because of the size of the building.

MAIN COMPONENTS

- All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signalling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.
- All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

CABLING

- Wiring shall be in accordance with local, state and national codes (NBC of India, IS 2189, NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of

conductors shall be as recommended by the fire alarm system manufacturer, but not less than 1.5 Sq. mm for initiating device circuits and signalling line circuits, for notification appliance circuits.

- The Cables used shall be annealed tinned copper conductor XLPE / Elastomeric Insulated insulated

ACKNOWLEDGE SWITCH

- Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition. In addition, the FACP shall support Block Acknowledge to allow multiple trouble conditions to be acknowledged with a single depression of this switch.
- Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
- Signal Silence Switch:
 - Depression of the Signal Silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition. The selection of notification circuits and relays that are silence able by this switch shall be fully fielded programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

DRILL SWITCH

- Depression of the Drill switch shall activate all programmed notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

SYSTEM RESET SWITCH

- Depression of the System Reset switch shall cause all electronically latched initiating devices to return to their normal condition. Initiating devices shall re-report if active. Active notification appliance circuits shall not silence upon Reset. Systems that de-activate and subsequently re-activate notification appliance circuits shall not be considered equal. All programmed Control-By-Event equations shall be re-evaluated after the reset sequence is complete if the initiating condition has cleared. Non-latching trouble conditions shall not clear and re-report upon reset.

LAMP TEST SWITCH

- The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

SCROLL DOWN KEYS

- There shall be Scroll Display keys for FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and other events. Depression of the Scroll Display key shall display the next event in the selected queue allowing the operator to view events by type.

PRINT SCREEN

- Depression of the PRINT SCREEN switch shall send the information currently displayed on the display to the printer.

LOOP (SIGNALLING LINE CIRCUIT) CONTROL MODULE

- The Loop Control Module shall monitor and control a minimum of 318 or more intelligent addressable devices. This includes 159 or more intelligent detectors (Ionization, Photoelectric, or Thermal) and 159 or more monitor or control modules.
- The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.
- The Loop Control Module shall provide power and communicate with all intelligent addressable detectors and modules on a single pair of wires. This SLC Loop shall be capable of operating as a NFPA Style 6 (Class B) circuit.
- The SLC interface board shall be able to drive an NFPA Style 6 twisted shielded circuit up to 12,500 feet in length. The SLC Interface shall also be capable of driving an NFPA Style 6, no twist, no shield circuit up to 3,000 feet in length. In addition, SLC wiring shall meet the listing requirements for it to exit the building or structure. "T"-tapping shall be allowed in either case.
- The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

ENCLOSURES

- The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
- The back box and door shall be constructed of 0.060 steel with provisions for electrical cables connections into the sides and top.

- The door shall provide a key lock and include a transparent opening for viewing all indicators. For convenience, the door shall have the ability to be hinged on either the right or left-hand side.
- The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

AUXILLARY FIELD POWER SUPPLY - ADDRESSABLE

- The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24VDC power. The power supply shall also include and charge backup batteries.
- The addressable power supply for the fire alarm system shall provide up a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 5 amps of 24 volt DC general power. The power supply shall have an additional .5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 7.0 - 25.0 amp hour batteries.
- The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as two Class "A" and two Class "B" or four Class "B" only circuits. All circuits shall be power-limited per UL 864 requirements.
- The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.
- The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.
- The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signalling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire. Data on the SLC shall be transmitted between 24 VDC, 5 VDC and 0 VDC at approximately 3.33k baud.
- The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
- The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of eight or sixteen hours shall be Dip-switch selected.

- The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be Dip-switch selectable.
- The addressable power supply mounts in either the FACP back box or its own dedicated surface mounted back box with cover.
- Each of the power supply's four output circuits shall be DIP-switch selected for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
- The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24VDC power, the circuit shall be individually supervised when an end-of- line relay is used.
- When selected for Notification Appliance Circuits, the output circuits shall be individually DIP-switch selectable for Steady, March Time, Dual Stage or Temporal.
- When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
- The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
- An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

FIELD CHARGING POWER SUPPLY (FCPS)

- The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.
- The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power.
- It shall include an integral charger designed to charge 7.0 amp hour batteries and to support 60 hour standby.
- The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
- The FCPS shall include an attractive surface mount back box.
- The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.

- The FCPS include power limited circuitry, per 1995 UL standards.

SYSTEM CIRCUIT SUPERVISION

- The FACP shall supervise all circuits to intelligent devices, transponders, annunciators and peripheral equipment and annunciate loss of communication with these devices. The CPU shall continuously scan above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate which device or devices are not responding and print the information in the history buffer and on the printer.
- Transponders that lose communication with the CPU shall sound an audible trouble and light an LED indicating loss of communications.
- Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall be supervised for off-normal position.
- All speaker and emergency phone circuits shall be supervised for opens and shorts.
- Each transponder speaker and emergency phone circuit shall have an individual ON/OFF indication (green LED).

FIELD WIRING TERMINAL BLOCKS

- All wiring terminal blocks shall be the plug-in/removable type and shall be capable of terminating up to 12 AWG wire. Terminal blocks that are permanently fixed to the PC board are not acceptable

REMOTE TRANSMISSIONS

- Provide local energy or polarity reversal or trip circuits as required.
- The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.
- Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.
- Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

SPECIFIC SYSTEM OPERATIONS

- Smoke Detector Sensitivity Adjust: Means shall be provided for adjusting the sensitivity of any or all analog intelligent smoke detectors in the system from the system keypad or from the keyboard of the video terminal. Sensitivity range shall be within the allowed UL window.

- Alarm Verification: Each of the Intelligent Addressable Smoke Detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification function shall be programmable from 5 to 50 seconds and each detector shall be able to be selected for verification during the field programming of the system or anytime after system turn-on. Alarm verification shall not require any additional hardware to be added to the control panel. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
- System Point Operations : Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.
- System output points shall be capable of being turned on or off from the system keypad or the video terminal.
- Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:
 - Device Status.
 - Device Type.
 - Custom Device Label. Software Zone Label. Device Zone Assignments.
 - Analog Detector Sensitivity.
 - All Program Parameters.
 - System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system statuses:
 - System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.
 - The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.
 - Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.
 - If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
 - The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personnel when a detector is at 80% of its alarm threshold in a 60 second period.

ADDRESSABLE DEVICES

- Addressable devices shall provide an address-setting means using rotary decimal switches / Soft Programming.
- Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type address switches.
- Detectors shall be Analog and Addressable, and shall connect to the existing fire alarm control panel's signalling Line Circuits.
- Addressable smoke and thermal detectors shall provide dual (2) status LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of the detector LEDs can be programmed off via the fire control panel program.
- The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity can be automatically adjusted by the panel on a time- of-day basis.
- Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
- The detectors shall be ceiling-mount and shall include a separate twist-lock base which includes a tamper proof feature.
- The following bases and auxiliary functions shall be available :
 - Sounder base rated at 85 DBA minimum.
 - FORM-C Relay base rated 30VDC, 2.0A
 - Isolator base
- The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
- Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

ADDRESSABLE PULL BOX (MANUAL STATION)

- Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

- All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
- Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

INTELLIGENT PHOTOELECTRIC SMOKE DETECTOR

- The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
- The detector SHALL NOT respond to refrigerant gas.

INTELLIGENT MULTI SENSOR

- The intelligent multi sensor detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smouldering fires and thermal properties all within a single sensing device.
- The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
- The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.
- The detector SHALL NOT respond to refrigerant gas.

INTELLIGENT THERMAL DETECTORS

- Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signalling line circuit.

ADDRESSABLE DRY CONTACT MONITOR MODULE

- Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.

- The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.
- The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
- For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

ADDRESSABLE CONTROL MODULE

- Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay.
- The control module shall mount in a standard 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box, or to a surface mounted back box.
- The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
- Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised, UL listed remote power supply.
- The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

ISOLATOR MODULE

- Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
- If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
- The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

- The isolator module shall mount in a standard 4-inch (101.6 mm) deep electrical box or in a surface mounted back box. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

PROGRAMMABLE ELECTRONIC SOUNDER

- Electronic sounders shall operate on 24 VDC nominal.
- Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.
- Shall be flush or surface mounted as shown on plans.

STROBE LIGHTS

- Shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:
 - The maximum pulse duration shall be 2/10 of one second
 - Strobe intensity shall meet the requirements of UL 1971.
 - The flash rate shall meet the requirements of UL 1971.

ALPHANUMERIC LCD TYPE ANNUNCIATOR

- The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
- The LCD annunciator shall display all alarm and trouble conditions in the system.
- An audible indication of alarm shall be integral to the alphanumeric display.
- The display shall be UL listed for fire alarm application.
- It shall be possible to connect up to 32 LCD displays and be capable of wiring distances up to 6,000 feet from the control panel.
- The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection and shall be capable of distances to 6,000 feet. Each terminal mode LCD display shall mimic the main control panel.
- The system shall allow a minimum of 32 terminal mode LCD annunciators. Up to 10 LCD annunciators shall be capable of the following system functions: Acknowledge, Signal Silence and Reset, which shall be protected from unauthorized use by a keyswitch or password.

- The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

DESIGN REQUIREMENTS FOR ASPIRATION SYSTEM

- Aspiration system must be compatible in all aspects (hardware, software, programming, etc.) with IPR's existing intelligent addressable fire alarm and detection system of NOTIFIRE Make with Model no. NFS2-3030.
- Shall consist of a highly sensitive LASER-based smoke detector, aspirator and filter.
- It shall have a display featuring LEDs and a Reset/Isolate button. The system shall be configured by a Programmer that is either portable or PC based.
- The system shall allow programming of:
 - Up to three smoke threshold alarm levels;
 - time delays;
 - faults including airflow, detector, power, filter as well as an indication of the urgency of the fault;
 - three relay outputs for remote indication of alarm and fault conditions.
- It shall consist of an air sampling pipe network to transport air to the detection system, supported by calculations from a computer-based design modelling tool.
- Optional equipment may include intelligent remote displays and/or a high level interface with the building fire alarm system, or a dedicated Xtralis VSM graphics package.
- Performance Requirements
 - Shall be tested and approved to cover up to 800m² (8,000 sq.ft).
 - Shall be approved to provide very early warning smoke detection and provide up to three output levels corresponding to Alert (optional), Pre-Alarm and Fire. These levels shall be programmable and able to be set at sensitivities ranging from 0.005-20% obs/m (0.0015–6% obs/ft). For compliance to UL approval range is 0.0015-4% obs/ft.
 - Shall report any fault on the unit by using configurable fault relay outputs or via VSM.
 - Shall be self monitoring for filter contamination.
 - Shall incorporate a flow sensor in the pipe inlet port and provide staged airflow faults.
- Vesda system must be compatible in all aspects (hardware, software, programming, etc.) with IPR's existing intelligent addressable fire alarm and detection system of NOTIFIRE Make with Model no. NFS2-3030.

PERFORMANCE REQUIREMENTS FOR VESDA SYSTEM

- The detector shall be NRTL listed and approved to cover up to 800m² (8000 sq.ft).

- Shall be approved to provide very early warning smoke detection and provide up to three output levels corresponding to Alert (optional), Pre-Alarm and Fire. These levels shall be programmable and able to be set at sensitivities ranging from 0.005-20% obs/m (0.0015–6% obs/ft). For compliance to UL approval range is 0.0015-4% obs/ft.
- The detector shall provide fault indication on the unit using the Instant Fault Finder function.
- The detector shall be self monitoring for filter contamination.
- The detector shall provide staged airflow faults via the use of an ultrasonic flow sensor in the pipe inlet port.

MATERIALS & EQUIPMENTS

- Both Light Scattering and Particle Counting shall be utilized in the device as follows:
The Laser detection Chamber shall be of the mass Light Scattering type and capable of detecting a wide range of smoke particle types of varying size. A particle counting method shall be employed for the purposes of
 - Preventing large particles from affecting the true smoke reading.
 - Monitoring contamination of the filter (dust & dirt etc.) to notify automatically when maintenance is required.
- The Laser Detection Chamber shall incorporate a separate secondary clean air feed from the filter; providing clean air barriers across critical detector optics to eliminate internal detector contamination.
- The detector shall not use adaptive algorithms to adjust the sensitivity from the set during commissioning. A learning tool shall be provided to ensure the best selection of appropriate alarm thresholds during the commissioning process.

DETECTOR ASSEMBLY

- The Detector, Filter, Aspirator and Relay Outputs shall be housed in a mounting box and shall be arranged in such a way that air is drawn from the fire risk area and a sample passed through the Dual Stage Filter and Detector by the Aspirator.
- The Detector shall be LASER-based type and shall have an obscuration sensitivity range of 0.005-20% obs/m (0.0015–6% obs/ft).
- The Detector shall have up to three independent field programmable smoke alarm thresholds across its sensitivity range with adjustable time delays for each threshold between 0-60 seconds.
- The Detector shall also incorporate the facility to transmit a fault either via VESDAnet or relay.

- The detector shall have a single pipe inlet which must contain a flow sensor. Both Minor and Urgent flow faults for both high and low shall be reported.
- The filter must be a two-stage disposable filter cartridge. The first stage shall be capable of filtering particles in excess of 20 microns from the air sample. The second stage shall be ultra-fine, removing more than 99% of contaminant particles of 0.3microns or larger, to provide a clean air barrier around the detector's optics to prevent contamination and increase service life.
- The aspirator shall be a purpose-designed rotary vane air pump. It shall be capable of allowing for multiple sampling pipe runs up to 80m (260 ft) in total with a transport time per applicable local codes.
- The Assembly must contain relays for alarm and fault conditions. The relays shall be software programmable (latching or non-latching). The relays must be rated at 2 AMP at 30 VDC. Remote relays shall be offered as an option and either configured to replicate those on the detector or programmed differently.
- The assembly shall have built-in event and smoke logging. It shall store smoke levels, alarm conditions, operator actions and faults. The date and time of each even shall be recorded. Each detector (zone) shall be capable of storing up to 12,000 events.

DISPLAYS ON THE DETECTOR ASSEMBLY

- The detector will be provided with LED indicators only.
- Each Detector shall provide the following features at a minimum:
 - Independent high intensity alarm indicators for Pre-Alarm and Fire (Alert indicated by the Pre-Alarm LED flashing) corresponding to the alarm thresholds of the detector.
 - Fault indicator.
 - OK indicator.
 - Isolate indicator.
- A single button supporting the following features:
 - Reset – (a single push of the button) unlatches all latched alarm conditions on the assigned VLC zone.
 - Isolate – (push and hold) Isolates the individual VLC zone (inhibits Alarm relay and initiates the Fault relay to indicate the disabled state).
- A remotely mounted Display may be optionally equipped with 7 configurable relays for signalling alarm and fault conditions.

The remote Display shall be able to identify Faults originating in the particular VLC zone (Zone Fault), those produced by the overall smoke detection system or from those resulting from network wiring errors (Network Fault). LED indicators shall be provided for each fault category.

PROGRAMMERS

- When required, a Programmer module may be located within the detector, a remote mounting box, or in a portable hand-held unit.

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- Each Programmer at a minimum shall support the following features:
 - Programming of any device on the system.
 - Viewing of the status of any device in the system.
 - Adjustment of the alarm thresholds of a nominated detector.
 - Setting of Day/night, weekend and holiday sensitivity threshold settings.
 - Initiation of AutoLearn, to automatically configure the detectors alarms threshold settings to suit the current environment.
 - Multi-level password control.
 - To Program latching or non-latching relay operation.
 - To Program energizing or de-energizing relays.
 - To Program high and low flow settings for airflow supervision.
 - To Program aspirator speed control.
 - To Program maintenance intervals.
 - Facilities for referencing with time dilution compensation.
 - Testing of relays assigned to a specific zone to aid commissioning

NETWORK

- The devices in the smoke detection system shall be capable of communicating with each other via twisted pair RS485 cable. The network shall be able to support up to 318 devices (detectors, displays units and programmers).
- The network shall be capable of being configured in a fault tolerant loop for both short circuit and open circuit. Any communication faults shall be reported unambiguously and shall be clearly attributable to an individual device or wire link in the fault messages.
- PC based configuration tools shall be available to configure and manage the network of detectors.
- Digital Communication Port shall comply with EIA RS485 Protocol.

SYSTEM MANAGER GRAPHIC SOFTWARE FOR COMPLETE MONITORING AND CONTROL OF VERY EARLY WARNING SMOKE DETECTION SYSTEM:

- The software package shall centrally monitor and configure very early warning smoke detection and fire protection systems in multiple local or remote locations.
- The software package shall be compatible with smoke detection and fire protection systems that are approved by global approvals bodies and meet all local codes, standards and regulations.
- The software shall consist of monitoring and configuration components:
 - The configuration component shall allow users to configure all detectors remotely by using a connected PC.
 - The monitoring component shall allow users to monitor individual detectors, multiple detectors connected via a HLI or multiple HLIs.

SYSTEM DESCRIPTION**ACCESS & USABILITY**

- The software shall support local and remote password-based access control
- Three local password-protected levels of software access: designer, user and administrator.
- Multiple user accounts with unique user-ID and password based access control.
- Remote password-management of remote fire networks
- The software shall have a user-friendly graphics user interface.
- The software shall support cut and paste functionality for common tasks.
- The software shall provide support for multiple languages including English
- The software shall support translations of messages from one supported language to another.
- The software shall support disk space monitoring.

MONITORING FUNCTIONALITY

- The software shall have the capacity to monitor multiple connections:
 - The software shall enable one or more workstations to monitor and configure multiple detector systems in multiple buildings and multiple sites.
 - The software shall provide an event list that provides a single integrated view of all events

(faults/troubles and alarms) across multiple sites.

- The software shall prioritize all events presented in the event list according to logical precedence rules.
- The software shall allow management of all events from the event list including acknowledgement of events and resetting of devices.
- The software shall allow colors to be assigned to different event types.
- The software shall allow printing of event lists.
- The software shall be able to provide an all-in-one monitoring solution:
 - Using standard RS232 ports (or Ethernet) on existing and future monitoring and control systems, PCs using the software shall connect to and interpret status change data transmitted from the ports and provide graphic annunciation, control, history logging and reporting as specified herein.
 - Network systems that cannot interface to Network systems or systems requiring the use of a “dry contact” or “voltage monitoring” interfaces to connect to Network shall not be accepted.
- The software shall be able to connect to multiple remote sites via IP-based LAN or WAN using virtual serial port emulation.
- The software shall communicate with one or more Network-compliant detectors via a high level interface (HLI) natively using the Network protocol without the necessity for using protocol translation or other communications equipment.
- The software shall be able to monitor up to 318 devices.
- The software shall be compatible with 4 alarm levels:
 - **Alert** (Alarm Level 1) – may be used to activate a visual and audible alarm in the fire risk area.
 - **Action** (Alarm Level 2) – may be used to activate the electrical/electronic equipment shutdown relay and activate visual and audible alarms in the Security Office or other appropriate location.
 - **Fire 1** (Alarm Level 3) – may be used to activate an alarm condition in the Fire Alarm Control Panel to call the Fire Brigade and activate all warning systems.
 - **Fire 2** (Alarm Level 4) – may be used to activate a suppression system and/or other suitable countermeasures (e.g. evacuation action or shutdown of systems).
- The software shall allow importation of .wav files for event notification.
- The software shall have a text-to-speech option to allow natural language annunciation of all faults and alarms:

- The text-to-speech component of the software shall use Nuance's RealSpeak speech engine.
- The text-to-speech functionality shall be available in a number of different languages.
- The software shall support sophisticated floor plan development and management functionality:
 - The software shall enable floor plan drawings to be used in the software to graphically notify users where a smoke event is occurring in their monitored system.
 - The software shall allow development of multiple levels of interconnected floor plans.
 - The software shall allow importation of AutoCAD, jpg, bmp and other common image files
 - The software shall include software to allow designers to create and manipulate CAD images for incorporation in meaningful context-sensitive multi-level floor plans
 - The software shall allow for multiple device smoke trending on a single graph.
 - The software shall support printing on a printer such as a line printer that supports Unicode.
- The software shall support sophisticated event log management functionality:
 - Event logs from all networked detectors shall be able to be retrieved and viewed.
 - Event logs for each monitored site and/or combined event logs for multiple sites.
 - Event logs shall be able to be archived and sorted
 - Total event integration, consolidation and archiving across multiple networks shall be provided. All system, network and device events shall be stored in an ODBC-compliant database.
- A remote notification facility shall enable the use of email (or SMS) to provide immediate and up-to-date information the system's operational status irrespective of location.
- The software shall enable presentation of unique customised corporate response procedures upon occurrence of specific events in defined parts of the facility

CONFIGURATION FUNCTIONALITY

- The software shall allow configuration of all models of detectors:
 - Full remote programming of all detector functions.
 - Saving of detector configurations for safe storage.
 - The software shall allow creation of off-line configurations for all such detectors and allow a merge and compare of off-line configuration with on-line configurations.

PERFORMANCE REQUIREMENTS

- The software shall operate on either Windows 2000 Professional or Windows XP Professional.
- The software shall function on the following minimum PC specifications:
 - **Processor** – Pentium. Minimum configuration: P4 2.8Ghz 1MB cache
 - **RAM** – 2 GB
 - **Hard Disk** – 1 by 80 GB system Disk; 2 by 80 GB if connected to Raid Storage
- Display – Preferred: Dual Monitor AGP Card with 256 MB memory. Minimum: Single Monitor 128 MB memory.
-

SAMPLING PIPE

- The sampling pipe shall be smooth bore with an internal diameter between 15-25 mm. normally; pipe with an outside diameter of 25mm and internal diameter of 21mm should be used.
- The pipe material should be suitable for the environment in which it is installed, or should be the material as required by the specifying body.
- All joints in the sampling pipe must be air tight and made by using solvent cement, except at entry to the detector.
- The pipe shall be identified as Aspirating Smoke Detector Pipe along its entire length at regular intervals not exceeding the manufacturer's recommendation or that of local codes and standards.
- All pipes should be supported at not less than 1.5m centres, or that of the local codes or standards.
- The far end of each trunk or branch pipe shall be fitted an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design.

SAMPLING HOLES

- Sampling holes shall not be separated by more than the maximum distance allowed for conventional point detectors as specified in the local codes and standards. Intervals may vary according to calculations. For AS1670.1 -2004 the maximum allowable distance is 10.2m. For FIA the maximum allowable distance is 10.6m. For NFPA the maximum allowable distance is 30ft.
- Each sampling point port shall be identified in accordance with Codes or Standards.

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- Consideration shall be given to the manufacturer's recommendations and standards in relation to the number of sampling points and the distance of the sampling points from the ceiling or roof structure and forced ventilation systems.
- Sample port size shall be as specified by ASPIRE2 calculations.

INSTALLATION

- The Contractor shall install the system in accordance with the manufacturer's recommendation.
- The contractor shall install the detectors and devices in the loop of the existing fire alarm control panel. (Notifier- Model No. NFS2 3030.
- Where false ceilings are available, the sampling pipe shall be installed above the ceiling, and Capillary Sampling Points shall be installed on the ceiling and connected by means of a capillary tube.
- The minimum internal diameter of the Capillary tube shall be 5mm, the maximum length of the capillary tube shall be 2m unless the manufacturer in consultation with the engineer have specified otherwise.
- The Capillary tube shall terminate at a ceiling Sampling Point specifically approved by the Client. The performance characteristics of the sampling points shall be taken into account during the system design.
- Air Sampling Piping network shall be laid as per the approved pipe layout. Pipe work calculations shall be submitted with the proposed pipe layout design for approval.

TESTING

COMMISSIONING TEST

- Commissioning of the entire installation shall be done in the presence of the owner and/or its representative.
- All necessary instrumentation, equipment, materials and labour shall be provided by the Contractor.
- The Contractor shall record all tests and system calibrations and a copy of these results shall be retained on site in the system Log Book.

FUNCTIONAL TEST

- Introduce Smoke into the Detector Assembly to provide a basic functional test.

- Introduce smoke to the least favourable Sampling Point in each Sampling Pipe. Transport time is not to exceed 90 Sec's.

DELIVERY, STORAGE AND HANDLING

- **CONTRACTOR'S RESPONSIBILITY**

- It shall be the responsibility of the Contractor to ensure delivery of the equipment to the site free of any damages to the latter.
- Any Loading / Unloading Charges or incidental expenses there of shall be by the Contractor for safe transit and storage of the equipment, and no further claim shall be made to the client on this account.
- It shall be the responsibility of the Contractor to inward all material with proper emphasis on documentation and clearance from the Consultant / Client and project managers.
- Any Damaged Equipment supplied to the site shall be immediately replaced under notice to the client's project Supervisor / Manager at site.
- The Contractor shall provide for a safe and secure storage of the Equipment supplied under Lock and Key and shall indemnify the client against any on-site damage or theft of the Equipment, for which the contractor has realised the monies form the Client.

- **PROTECTION**

- The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted.
- The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on-site that is not immediately installed.
- The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

- **CLEANING**

- This contractor shall clean up all debris resulting from his or her activities daily.
- The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed.
- Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dirt and debris, etc.
- At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas.
- Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

GENERAL INSTALLATION PROCEDURES AND REQUIREMENTS.

- Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- All cables, junction boxes, cables supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- Manual Pull Stations shall be suitable for surface mounting or semi flush mounting as shown on the plans, and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor.
- Typical Operational Requirement
 - Actuation of any manual station, smoke detector heat detector or water flow switch shall cause the following operations to occur unless otherwise specified:
 - Activate all programmed speaker circuits. Actuate all strobe units until the panel is reset.
 - Light the associated indicators corresponding to active speaker circuits.
 - Release all magnetic door holders to doors to adjacent zones on the floor from that the alarm was initiated.
 - Return all elevators to the primary or alternate floor of egress.
 - A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.
 - Smoke detectors in the elevator machine room or top of hoist way shall return all elevators in to the primary or alternate floor. Smoke detectors or heat detectors installed to shut down elevator power shall do so in accordance with ANSI A17.1 requirements and be coordinated with the electrical contractor.
 - Correct installation, combined with the use of high quality equipment, components and cabling, ensures that the fire detection and alarm system shall operate as designed and provide many years of trouble-free service.
 - The Fire Alarm contractor shall install the alarm system in accordance with the documented installation instructions.
 - The Fire Alarm contractor shall provide all relevant installation documentation required for each component of the system.
 - Installation of the system shall be in accordance with the recommendations set out in NFPA-72
 - The Fire Alarm contractor shall be responsible for the correct setting of all equipment and components of the system in accordance with previously agreed plans and drawings.
 - All cabling and wiring shall be tested before they are connected to the fire controller and its associated devices.

- **WARNING:** If the tests are carried out after the cables and wires have been connected to the controller and its devices, components within the controller and the devices will be damaged by high voltages used during testing.

MATERIALS

- All cabling and wiring to be used in the system shall be copper Armored with conductor not less than area 1.5mm² in cross section.
- Wiring used for driving devices requiring high currents (e.g. bells, etc.) shall limit the voltage drop to less than 10% of the nominal operating voltage.
- Cables used for the transmission of system data and alarm signals shall be in accordance with the types recommended by the manufacturer of the fire alarm system.
- The ends of all cables shall be sealed by means of proprietary seals and associated glands. No heat shall be applied to any seal or termination. Cable tails shall be insulated by means of blank PVC sleeving anchored and sealed into the seal.
- Where protection of the cable glands is required or terminations are on display, the glands shall be enclosed in red colored shrouds of the appropriate British Standard color.
- All cables to brick/concrete shall be securely fixed by means of copper saddles sheathed with red PVC. These saddles shall be provided near bends and on straight runs at intervals no greater than recommended in the British Standards or by the manufacturer.
- Where multiple cables are to be attached to a wall or soffit, copper saddles shall enclose all cables and shall be secured by means of suitable masonry plugs and two round head plated woodscrews
- Where multiple cables are to be attached to the top of horizontal trays they shall be neatly run and securely fixed at suitable intervals. Copper or plastic cable fixings shall be used.
- At detector and sounder locations, cables shall be terminated in approved galvanized junction boxes. All other devices forming part of the system shall utilize dedicated /custom back boxes.

INSTALLATION OF DETECTORS

- All detectors (and bases) shall be installed in accordance with guidelines set out in NFPA -72 and the installation instructions provided by the manufacturer.
- All detectors shall be installed in the exact locations specified in the design drawings; thus providing the best possible protection.
- The type of detector installed in each particular location shall be the type specified in the design drawings.

- All detector bases shall be securely fixed to approved boxes and allow for easy fitting and removal of detectors.
- Cable and wire entries to detector bases shall be fitted with grommets to prevent possible damage to the insulation.
- Cable and wire strain relief clamps shall be provided at all entries to detector bases.
- Cable entries of detector bases used in environments with abnormal atmospheric or operating conditions shall be appropriately sealed to prevent ingress of dust, water, moisture or other such contaminants.

INSTALLATION OF CONTROL DEVICES

- All control devices (e.g. Call points, sounders, interface modules, etc.) Shall be installed in accordance with the guidelines set out in NFPA-72 and the installation instructions provided by the manufacturer.
- All control devices and associated modules shall be installed in the exact locations specified in the design drawings.
- The type of control device installed in each particular location shall be the type specified in the design drawings.
- All control devices and associated modules shall be securely fixed, and if required, marked with appropriate notices, warnings, signs as applicable.
- Cable and wire entries to all control devices and associated modules shall be fitted with grommets or glands so as to prevent possible damage to the insulation.
- Cable and wire strain relief clamps shall be provided at entries to control devices and associated modules as required.
- Cable entries of control devices and associated modules used in environments with abnormal atmospheric or operating conditions shall be appropriately sealed to prevent ingress of dust, water, moisture or other such contaminants.

INSTALLATION OF FIRE CONTROLLER EQUIPMENT

- The fire controller equipment shall be installed in accordance with the guidelines set out in NFPA-72 and the installation instructions provided by the manufacturer.
- The fire controller and its associated component parts shall be installed in the location specified in the design drawings.

- The type of fire controller and its associated component parts installed shall be the type specified in the design drawings.
- The fire controller equipment shall be securely fixed, and if required, marked with appropriate notices, warnings, signs as applicable.
- Cable and wire entries to the fire controller and associated devices shall be fitted with grommets or glands to prevent possible damage to the insulation.
- Cable and wire strain relief clamps shall be provided at entries to fire controller and associated devices as required.
- The fire alarm system mains power connections to the fire controller equipment shall be accordance with the guidelines set out in the relevant British Standards and the installation instructions provided by the manufacturer.
- The fire alarm system mains power isolating switch shall be colored red and clearly labelled 'FIRE ALARM: DO NOT SWITCH OFF'.
- Each circuit of the system shall be connected to the fire controller via associated fuse or circuit breaker devices located within the fire controller unit.
- All cables from the fire controller equipment to the detection and alarm devices shall be clearly labelled.

COMMISSIONING

- Pre Commissioning: At final commissioning of each system, the Contractor shall confirm that:
 - All detection devices, including point detectors, beam smoke detectors, flame detectors, and aspirating smoke detectors and inputs are tested and operate correctly.
 - All manual controls, whether manual call points or centrally located controls, operate correctly.
 - The correct indications are given at the control and indicating equipment, including the repeater panels, mimic panels and graphics PC central control and display terminal.
 - All outputs operate, in the required manner, including alarm sounders or voice alarm system loudspeakers, visual indicators and connections to ancillary services and other systems. In particular, the Contractor shall check that audibility levels of sounders and/or audibility and intelligibility of voice alarm broadcasts are correct.
 - The fire detection and fire alarm system complies with the operational sequence detailed in Section 5 of this Specification.
 - The standby batteries are adequately sized. (Measurements of the quiescent and alarm loads shall be taken and compared to calculated values used at the design stage.) Calculations and measurements shall be submitted to the Engineer.
 - Commissioning shall be fully documented and the documentation submitted to the Engineer.
 - The Contractor shall demonstrate each fire detection and fire alarm system to the satisfaction of the Engineer by conducting a series of witnessed acceptance tests as directed by the Engineer. This shall take place after the above final commissioning and following receipt of the commissioning

documentation by the Engineer. Acceptance testing shall include the actuation of all devices in the system, simulation of various faults and operation of all manual controls.

- Following commissioning, a system soak period of not less than one week shall follow, unless the system incorporates fewer than 50 automatic fire detectors, in which case no soak test is necessary.
- Both the installation and the commissioning activities shall be undertaken as a single continuous operation.
- Upon completion of the installation activity, the Fire Alarm contractor shall Test, Start-up, Commission and Handover the system to the customer.
- The Fire Alarm contractor shall make use of the following documents to record test results and details of commissioning tests:
 - Cable Test Sheets
 - Installation Check Report
 - System Layout Drawing(s)
 - System Schematic Diagram(s)
- The Fire Alarm contractor shall be responsible for inspecting and testing the complete system, including:
 1. Detectors
 2. Call Points
 3. Sounders
 4. Ancillary Devices
 5. Fire Controller Equipment and Associated Devices
 6. Auxiliary Equipment (e.g. Plant Interface Module, etc.)
 7. Operating and Control Software.
- The fire controller and associated devices and modules shall be tested in accordance with the guidelines set out in NFPA-72 and the testing instructions provided by the manufacturer.
- The Fire Alarm contractor shall start up and operate the system for a trial period to ensure that it operates correctly.
- The Fire Alarm contractor shall test all functions of the system, including the software, to ensure that it operates in accordance with the requirements of the design specification and relevant standards.
- The Fire Alarm contractor shall undertake audibility tests during which the sounders may be operated continuously over a period of two hours. (Should the customer require these tests to be carried out at a separate visit, or out of normal working hours, this can be arranged at additional cost.)
- Commissioning of the system shall constitute practical completion following the satisfactory completion of installation, testing and start up; the Fire Alarm contractor shall demonstrate to the customer that the system successfully performs all of the functions set out in the design specification.
- The Fire Alarm contractor shall provide the customer with an agreed quantity of spare parts testing equipment and consumables which are to be used during routine maintenance and testing of the system.
- The Fire Alarm contractor shall provide a customer appointed fire system supervisor with on-site training in the use, operation and maintenance of the system and explain the procedures to be followed in the event of fire and false alarms. The system supervisor shall also be shown how to carry out routine maintenance and testing procedures, and how to keep the Log Book. (Also see Section 9).

- The Fire Alarm contractor shall prepare a report detailing all tests performed during installation and commissioning of the system. The report shall include the results of the tests and details of any specific settings or adjustments made. Any outstanding tasks or activities which are to be completed at another time shall also be included in the report.
- The Fire Alarm contractor shall present an Acceptance Certificate for signature by the customer.

TRAINING OF OPERATING PERSONNEL

- All training shall be by the Building Controls Contractor and shall utilize specified manuals, as-built documentation, and the on-line help utility.
- Operator training shall include four initial eight-hour sessions.
- Hands on demonstration of the system shall be provided to safety, security and other concerned group members
- The initial operator training program shall be to establish a basic understanding of Windows based software, functions, commands ETC.
- Special Emphasis shall be laid by the Trainer on imparting knowledge to the participants on extracting the maximum mileage out of the Head-end application to achieve energy monitoring and efficiency.
- Participants should be trained in the concept of maximum demand load management.
- User manual and sequence of operation shall submit in hard as well as soft copy to the client
- The training shall encompass as a minimum:
 1. Troubleshooting of input devices, i.e., bad sensors.
 2. Sequence of operation review.
 3. Sign on - sign off.
 4. Selection of all displays and reports.
 5. Use of all dialogue boxes and menus.
 6. System initialization.
 7. GUI Software.
 8. Network Management Software.

E-13 ACCESS CONTROL SYSTEM**1.1 SYSTEM DESCRIPTION**

The Access Control System automates the process of tracking employees and visitors as they check in and out for work and provide accurate time and leave data for each employee. This helps to increase efficiency and productivity of the organization. Access control secures valuable assets of the organization that depends on having right answers to who, what, where and when. Defining, controlling monitoring entries and exits in each area is necessary for putting right people in right time.

1.2 ACCESS CONTROL PANEL

	ACCESS CONTROL PANEL
	DATABASE:
	Cardholder capacity: 50,000
	• Transaction storage: 45,000
	• Flash programming for firmware revision updates
	• Access level: 128
	• Holidays: 255
	• Time zone: 127
	• Card reader formats: 128 Wiegand format support
	• Credential facility codes: 8
	• Dedicated tamper alarm
	• Dedicated power fail alarm
	• Real time clock:
	Geographic time zone support
	Leap year support
	Communication:
	• Ethernet port connected to TCP/IP network as master panel
	• RS485 multi-drop connection for downstream panels
	Onboard I/O:
	• 2 Readers, expandable to 62 readers
	8 Supervised inputs
	• 4 Relay outputs
	Operational Functionality:
	• Duress detection
	• Operational modes:

	Card only
	PIN only
	Card or PIN
	Card and PIN
	• Maximum site codes: 8 digit
	• Anti-Passback support: Local Global Forgiveness
	• Interlocks: 256
	Environment:
	• Temperature: 0 to 50° C operational;
	-55 to 85° C storage
	• Humidity: 0 to 85% RHNC

1.3 FINGER PRINT CARD READER

	FINGER PRINT CARD READER:	Smallest proximity reader for door mullions
	Memory	8MB flash + 8MB RAM
	Fingerprint Sensor	500 dpi optical sensor
	Identification Speed	2,000 match in 1 second
	Fingerprint Capacity	10,000 templates (5,000 users, 2 finger prints per user)
	Log Capacity	50,000 events
	RF Card, iCLASS	Proximity (125kHz EM, HID Prox), Mifare (13.56MHz)
	Operation Mode	Fingerprint, RF Card, RF card + Fingerprint
	Wiegand	Configurable up to 64 bits
	TTL I/O	2 inputs for exit switch and door sensor
	Display	Multi-color LED

1.3 ACCESS CONTROL MANAGEMENT SOFTWARE

	ACCESS CONTROL MANAGEMENT SOFTWARE:
	Integrate access control, digital video and intrusion integration
	using Honeywell's Rapid Eye™ Multi-Media Series and Fusion
	Series DVRs, and VISTA-128FBP and VISTA-250FBP
	controllers
	– Arm or disarm with a card read
	– Record and playback access or intrusion events and alarms
	– Multiple camera control, including PTZ
	– Programmable camera presets
	– Synchronized video playback
	– Alarm video popup and user verification
	– Synchronized video playback with access or
	intrusion alarms or events
	• Manage cardholders through multiple locations
	• Available as single or five concurrent operator workstations
	• Quick start setup and configuration wizards
	• Real-time alarm/event monitoring
	– 99 priority levels
	– Control and response, including acknowledge, clear,
	annotate, live video, recorded video
	– Manual override, lock and unlock doors,
	shunt/unshunt zones and input points
	– Manual override of system functions
	Lock and Unlock doors
	Arm/disarm partitions and zone
	Bypass/Un-Bypass Zones
	Generate predefined or customized reports
	using easy templates
	– Schedule e-mail or printed reports

	• CCTV control interface to most popular matrix switchers
	• Schedule guard tours
	• Enhance elevator control
	• Global anti-passback processing
	• Content-sensitive help screens
	• Dynamic floor plans
	– Control devices
	– Floor plan linking
	– Acknowledge/clear alarms
	– Visual feedback
	• Operating systems supported: Windows® Vista Enterprise,
	Windows® Vista Business, Windows® XP Professional SP2
	and Windows® 2003 Server*
	*SQL Server™ 2005 or SQL Server™ 2005 Express Edition must be loaded
	on the computer before WIN-PAK SE is installed.

SPECIAL CONDITION FOR TESTING
(CONTRACTOR TO READ THIS CAREFULLY)

1.0 SCOPE :

Contractor should have to take all necessary testing/ random testing of equipments and component prior to supply as per the guidelines / rules / sampling method etc. of IS at manufacturing works or other standard lab in presence of Client's representative & consultant as witness testing. Any deviation in parameters which is not as per IS is not accepted and client reserve the rights to reject the same at any stage of the project.

MODE OF PAYMENT

The following payment will be made after deducting retention money.

Payment for various items shall be made as follows:

1.	Light, Fan, Plug, Bell, Telephone, TV, Computer point Etc.(Part payment of plug on Board will not be considered)	20 % when conduits are laid in slab & Boxes are fixed
		40 % when wires are drawn in above conduits.
		10 % when switches are fitted and testing is done.
		10 % after completion of the job.
2.	HT Equipment, Transformer, MV switchgear, Distribution Boards Cable Trench,Cables,Bus Duct, Server, EPABX	70 % for erection. .
		30 % after testing and commissioning
3.	Earthing	70 % after earthing is complete. 30 % after testing and commissioning.
4.	Light fixture and Fans	70 % for erection.
		30 % after testing and commissioning.

Special Notes:

NO PAYMENT SHALL BE MADE AGAINST THE MATERIAL, WHICH IS NOT GOING TO CONSUME IN NEXT 2 MONTHS.

THE FINAL CERTIFICATE SHALL BE GIVEN ONLY AFTER THE CONTRACTOR SUBMITES FOUR SETS OF AS BUILT DRAWING BOTH HARD COPY AS WELL AS SOFT COPY DULY APPROVED BY CLIENTS ENGINEER AND CONSULTANT.

Sign & Seal of
Contractor

APPLICABLE STANDARDS

Sr. No.	IS No.	Description
1	IS: 10118-1982	Installation of Switch gears.
2	IS: 3156-1992	Voltage Transformer
3	IS: 2705-1992	CT for measuring and protection
4	IS: 8623-Part II 1993	Bus-bar arrangement and marking
5	Bus-bar arrangement and	Bushing
6	IS: 5621-1980	Large Hollow Porcelains Insulator
7	IS: 2544-1973	Insulators greater than 1000V
8	IS: 2629-1985 IS: 2633-1986	Hot Dip Galvanizing
9	IS: 1248-2003	Meters (measuring).
10	IS: 11353-1985	Marking and arrangement of switch gear bus bars main connectors and auxiliary wiring
11	IS: 692-1994	HV Cable Paper Insulated Lead Sheathed Cables for Rated Voltage up to and Including 33 kV – Specification
12	IS: 3043-1987	Code of practice for earthing.
13	IS: 13947-Part I-1993	General requirements for switchgear and control gear for voltage not exceeding 1000 Volts.
14	IS:8623-1993	Factory built assemblies of switch gears and control gears for voltage up to and including 1000 Volts A.C. and 1200 Volts D.C
15	IS: 13947 PART-1	Cubical Boards.
16	IS: 2675-1983	Enclosed distribution fuses boards and cutouts for Voltage not exceeding 1000 Volts.
17	IS: 8828-1995	Miniature Circuit Breaker
18	IS: 1554-Part I-1988	PVC insulated electric cables heavy duty.
19	IS: 3961-Part II & IV-1967	Recommended current rating for cables.
20	IS: 8130-1984	Copper conductor in insulated cables and cores
21	IS: 8130-1984	Conductor for insulated electric cables and flexible cords.
22	IS: 3975-1999	Low Carbon Galvanized Steel Wires, Formed Wires and Tapes for Armouring of Cables - Specification
23	IS: 5831-1984	PVC insulation and sheath of electric cables.
24	IS: 8130-1984	Aluminum conductor for insulated cables.
25	IS: 11955-1987	Recommended current rating for Cable.
26	IS: 732-1989	Code of practice for electrical wiring installation system Voltage not exceeding 650 Volts.
27	IS: 1646-1997	Code of practice for fire safety of Buildings (general) electrical installation.
28	IS: 694-1990	PVC insulated cables (wires).

EW

29	IS: 9537-Part III-1983	Installation of Rigid non-metallic conduits for electrical wiring
30	IS: 6946-1973	Flexible (playable) nonmetallic conduits for electrical installation.
31	IS: 1293-2005	Plugs and sockets upto 250V.
32	IS: 8130-1984	Conductors for insulated electrical cables and flexible codes.
33	IS: 9537-1980	Specification for conduit for electrical installation.
34	IS: 3419-1988	Accessories for non-metallic conduits for electrical wiring.
35	IS: 3854-1997	Switches.
36	IS: 6538-1971	Plugs.
37	IS: 1913-1978	General and safety requirement for lighting fittings.
38	IS: 1944-1981	Code of practice for lighting public thorough fares.
39	IS: 3528-1966	Waterproof electric lighting fittings
40	IS: 2312-1967	Exhaust Fan
41	IS: 374-1979	Class I Ceiling Fan
42	IS: 7098 (Part I, II, III-1988	XLPE armoured Cables upto 1000V.

NOTE:

All codes and standards means the latest where not specified otherwise the installation shall generally follow the Indian Standard codes of practice or relevant British Standard Codes of Practice in the absence of corresponding Indian Standards.

PLEASE FOLLOW:

- a. Indian Electricity Act of 1910 and rules issued there under revised up to date.
- b. Regulations for electrical equipment in building issued by The Bombay Regional Council of insurance Association of India.

LIST OF APPROVED MAKE / MANUFACTURER FOR ELECTRICAL WORK MATERIALS

1) Rigid PVC Conduit	:	ISI & FIA approved & manufactured from virgin material. Precision, NIHIR, PPI, Vraj.
2) Accessories for conduit	:	Same make as of pipe.
3) Flexible Copper Wires	:	FRLS type : R.R. Kable, Havell's, Finolex, Polycab, Avocab, Jainson, KEI.
4) Switches	:	Legrand (Myrius), MK (Logic), Schnieder(Opale), Salzer (Elite).
5) Light Fixture	:	Phillips, Wipro, GE, (As suggested by architect - Sample to be approved)
6) FTL/CFL/Lamps or any kind of light source	:	Osram, Philips, Crompton, GE.
7) PVC tape	:	Steel grip, Anchor
8) Distribution boards	:	Legrand (lexic), Schneider MG, L&T, Hager. Factory fabricated. Double door type
9) MCCB/MCB/ELMCB	:	Legrand (lexic), Schneider MG, L&T, Hager.
10) LT Cables	:	Finolex, Havells, Polycab, Avocab, Jainson, KEI.
15) Panel Fabricators	:	CPRI Approved panel builders only
16) Load Manager	:	Conserve, Secure, Elmeasure, Rushabh.
17) Meters	:	Conserve, Secure, Elmeasure, Rushabh.
20) Relay	:	Areva, Siemens, L&T, ABB, CSPC, Schnieder
25) HRC Fuses & Fuse-Base	:	Schneider MG, Siemens, L&T,
11) Connectors	:	ELMEX, Wago, Telemecanique Connectwell.
12) Glands	:	Compression type, Heavy duty and deep threading with rubber-ring and double washers. (Sample to be approved) HMI, Comet
13) Cable Lugs	:	Dowell's, 3-D (long neck)
14) Metal Clad Plug-socket	:	Legrand, Indoasain, RR PCE, BCH, Schnieder
15) Button holder, Angle holder, ceiling rose	:	Anchor, CPL
31) Cable Tray	:	OBO, Legrand, Gewiss
33) TV Cable	:	Finolex, RR Cable, Havell's, Jainson, KEI
35) Current Transformer	:	AE, Virat, Narmada
36) Indication Lamp	:	LED Type : Schneider, L&T, RASS, Salzer
37) Voltage Selector S/w	:	L&T, Salzer
38) Ammeter Selector S/w	:	L&T, Salzer
40) Fire Stoppers	:	Hilti, 3M
16) Raceway	:	OBO, MK (Ega), Legrand
17) Anchor Fastener	:	Hilti, 3M
18) Chemical Earthing	:	OBO, LPI
19) Whether protected junction boxes	:	Spelsberg, Hensel
20) DB Surge protector	:	Legrand, Schneider, L&T, Hager
21) Telephone TAG block	:	Krone
22) Telephone Cable	:	Finolex, Polycab

23) CAT 6A Data Cable	:	Dlink
24) Telephone Socket	:	As same as make of switch
25) Data Socket	:	As same as make of switch
26) Fire Alarm & Detection	:	Honetwell Nitifier, Bosch
27) Access Control System	:	Honetwell, Bosch, HID
28) Laser detector	:	VESDA/ICAM
Air Terminal nozzle	:	VESDA/ICAM
Remote display		
Monitor software		
Graphic software		
(for Aspiration system)		

Special Notes :

- The successful tenderer will have to supply the makes from above in consultation with the Engineer-in-Charge/Architect/Consultant without any extra cost.
- However, the final decision for accepting make specified by tenderer would be of client/Architect/Consultants.
- As far as possible, the successful tenderer will have to place order directly to the manufacturer OR it's authorized dealer.
- The Engineer-in-charge/Architect/Consultants have right to check the challans of supplier.
- The MCB and MCB DBs must be of same make.
- Make of components required to be used by contractor to complete the installation, if not mentioned anywhere, shall be required to GOT IT APPROVED by Engineer-in-charge/Architect/Consultant before installation in writing manner.
- Within a week of work order, the contractor shall submit the sample of each item / component of above mentioned approved make for the approval of the Engineer-in-charge/Architect/Consultant.

ELECTRICAL ITEM SPECIFICATION**SUMMARY PAGE****I. Electrical Works**

A. Material Specification

Section - 1	E-1	LT Switchgear & POWER PANEL
Section - 2	E-2	LT Distribution Board
Section - 3	E-4,5	LT Cabling and Termination
Section - 4	E-7	Internal Wiring
Section - 5	E-8	Light Fixtures and Fans
Section - 6	E-9	Earthing
Section – 7	E-11	Telephone and Data Distribution

ELECTRICAL ITEM SPECIFICATIONS**E-1 LT SWITCH GEAR & POWER PANELS**

1.1 Supplying, unloading at site, shifting to site, assembling, leveling, grouting, erecting, Testing, & Commissioning of L.T. panel board, fabricated from CRCA sheet & folded channel totally enclosed cubical type compartmentalized as per drawings. All energy meter are Post paid- Dual Source type as per specification.

1) Material

MV switch gear & power panel shall confirm E-5

2) Workmanship :

- 1) Main busbar should be electrolytic tinned copper type.
- 2) All internal wiring and all connection shall be with copper wires and strips as required. Use copper flexible wire for below 100 Amps and copper strips for 100 Amps and above ratings.
- 3) All component, frame etc shall be earthed. A common internal earth bar with two separate earthing leads to be provided.
- 4) Painting or powder coating to be done on all sheet metal works as required.
- 5) Panel should have MS base frame for floor mounting unless otherwise specified.
- 6) The board should be front operated and extensible type.
- 7) Compression type brass glands and crimping lugs for incomer and outgoing ends.
- 8) All ammeters to be provided with C.T.'s and selector switch and voltmeter with selector switch and control fuses.
- 9) Panel components shall be as specified
- 10) The design and location of all panels to be approved by the architect/consultant before fabrication and Installment.
- 11) All panels should be dust and vermin proof.
- 12) All panels should be fabricated out of 14 gauge sheet The door should be made from 14 gauge (2 mm) and the other parts should be made from 14 gauge sheet metal.
- 13) All meters should be digital type with communication port only unless and otherwise specified.
- 14) The metering on main panels shall be LOAD MANAGER with communication port unless and otherwise specified.
- 15) All the Switches used should be capable of withstanding the AC23 duty for motor operation. The Switches should have quick make quick break. The contacts should be silver plated double break type.
- 16) Main LT Panel, Bus coupler and APFCR panel should be fabricated in the approximate length of 1 meter and depth of 1 meter compartment.
- 17) The board should withstand the system prospective fault current
- 18) Engraved plastic labels shall be provided indicating the feeder details, capacity, cable size and load in KW and danger signs.
- 19) The entire panel board should be with adequate height width & depth as per relevant prevailing I.S. code and Installation include foundation bolts of suitable size as per requirement.
- 20) All compartment doors should be concealed hinged type & handles of feeders to be interlocked mechanically with the doors such that door cannot be opened when the switch is in 'ON' position & switch cannot be 'ON' when the door is in open position.
- 21) Provide suitable size CT shorting terminal for all CT's.

- 22) Provide suitable size Exhaust Fan for APFCR / RTPFC Panel.
- 23) All MCCB should be with breaking capacity of $I_{cs}=100\% I_{cu}$

3) Mode of measurement:

The rate shall be for one unit of panel.

E-2 LT DISTRIBUTION BOARD

2.0 Supplying, assembling, grouting, levelling, installation, Connecting & testing D.B of specified make but without MCB / ELMCB/MCCB/ SPD etc. with all internal bus bar as per requirement and as specified in BOQ.

2.1 VTPN Distribution Board**1) Material**

As per item no 2.1.1, 2.1.2 and 2.1.3 of BoQ.

2) Workmanship

As per item no 2.1.1 above.

3) Mode of measurement

As per item no 2.1.1 above.

2.2 TPN Distribution Board:**1) Material**

Distribution board shall confirm to item no 2.2.1 and 2.2.2 of BoQ.

2) Workmanship:

- 1) All the D.B. should have separate neutral link per phase with main neutral link i.e. four neutral link of appropriate nos. of way.
- 2) The D.B. should be provided with 2 separate insulated earth links.
- 3) The D.B. should be concealed type having sheet metal enclosure with double door unless or otherwise specified.
- 4) The D.B. should be Powder coated.
- 5) The D.B. shall have top and bottom plates open able.
- 6) The D.B. shall be provided with necessary cable junction box

3) Mode of measurement

The rate shall be for one unit of D.B.

2.3 SPN Distribution Board**1) Material**

As per item no 2.3.1 and 2.3.2 of BoQ.

2) Workmanship

As per item no 2.1.1 above.

3) Mode of measurement

As per item no 2.1.1 above.

2.4 MCB, ELMCB and its Accessories

Supplying, Assembling, leveling, connecting & testing MCBs/ELCBs/ELMCBs/Isolators of various rating in boards as specified in 2.0 of BoQ.

1) Material

M.C.B. shall confirm to item no 2.4 of BoQ.

2) Workmanship

Should mount all the MCBs/ELCBs/ELMCBs/Isolators and other accessories in the D.B. as per the MCB chart furnished by consultant and also do the necessary connections. Should check for any faulty connections and reconnect the same. Also check for the loading once complete installation of fixtures and other equipments is completed.

3) Mode of measurement

The rate shall be for one unit..

2.5 MCCB

Supplying, Assembling, leveling, connecting & testing following MCCB etc in boards as specified in item no. 2.5 of BoQ.

1) Material

M.C.C.B. shall confirm to item no. 2.5.1 and 2.5.2 of BoQ.

2) Workmanship

Should mount all the MCCBs and other accessories in the D.B. as per the chart furnished by consultant and also do the necessary connections. Should check for any faulty connections and reconnect the same. Also check for the loading once complete installation of fixtures and other equipments is completed.

3) Mode of measurement

As per item 2.4 but for MCCB.

2.6 Caution Board:

Providing and erecting metallic vitrified danger notice board for MEDIUM

VOLTAGE installation to be erected as per IS and as specified in item no. 2.6 of BoQ.

1) Material

Should confirm to item no 2.6.1 of BoQ.

2) Workmanship

The plates shall be mounted on the D.B. as per the instructions from consultant.

3) Mode of measurement

Rate shall be considered for 1 no of plates.

2.7 Voltage Surge Protector

Supplying, Assembling, leveling, connecting & testing VSP of various rating in boards as specified in item no. 2.7 of BoQ.

1) Material

VSP shall confirm to item no. 2.7.1 and 2.7.2 of BoQ.

2) Workmanship

Should mount all the VSP and other accessories in the D.B. as per the DB Details furnished by consultant and also do the necessary connections. Should check for any faulty connections and reconnect the same. Also check for the loading once complete installation of fixtures and other equipments is completed.

3) Mode of measurement

Rate shall be considered for per no.

E-3 CABLE TRENCH

3.1 Excavation and back filling of cable trenches required for laying the cables directly buried in the ground. This includes supplying and providing cable markers at an interval of 10 meters. The depth shall be app. 0.9mtr and the width shall be as per requirement.

1) Material:

All the tools and tackles required for the excavation shall be provided by the contractor. Cable marker shall be provided.

2) Workmanship

Excavation shall be done as per the route specified in the plan of the consultant. Also the depth as specified in the item shall be strictly maintained. Cable markers shall be installed at length specified in the item.

3) Mode of measurement:

The item shall be paid in cubic Mtr. And the measurement shall be certified by the engineer in charge from the Clients side. Depth of the excavation shall be measured from average ground level given in drawing

3.2 Supplying and spreading fine sand for a thickness of 100 mm. and providing and laying bricks for protection on cable on all the three sides.

1) Material:

All the tools and tackles required for the spreading fine sand and back filling shall be provided by the contractor. Bricks of 2nd class or higher quality shall be used.

2) Workmanship

Bricks shall be laid on all the three sides of the cable as per the drawing of the consultant. Proper thickness for the fine sand as specified in the item shall be strictly maintained. After back filling proper leveling shall be done and lumps of soil should not be visible. The trench should give a leveled look.

3) Mode of measurement:

The item shall be paid in running Mtr. and the measurement shall be certified by the engineer in charge from the Clients side.

E-4 LT CABLING

- 4.1 Supply, testing and Laying XLPE steel/GI wire/flat armoured cable of 1100 V grade of Aluminum / Copper Conductor of following sizes in readymade trench or mounted on wall with necessary clamping arrangement or in pre-laid RCC /DWC hume pipe with necessary cable identification mark to be provided at distance of 25 mt. The vertical cable on wall shall be drawn in pre laid conduit for vertical mechanical support.**

1) Material

Shall be confirm to Item no. 4.1 of BoQ

2) Workmanship

Installation

A) Cables shall be laid in the routes marked in the drawings. Where the route is not marked, the contractor shall mark it out on the drawings and also on the site and obtain the approval of the Architect/Consultant before laying the cable. Procurement of cables shall be on the basis of actual site measurements and the quantities shown in the schedule of work shall be regarded as a guide only.

B) Cables, running indoors shall be laid on walls, ceiling, inside shafts or trenches. Single cables laid shall be laid in GI/PVC pipe and not to fix on wall slab directly or drawn through GI / PVC pipes fixed on wall or ceiling and supported at not more than 500 mm. Where number of cables is run, necessary perforated cable trays shall be provided wherever shown. Perforated trays shall be mild steel or Aluminum as specified in the schedule of work and supported on mild steel frame work as shown on drawings or as approved. Cables laid in built-up trenches shall be on steel supports. Plastic / Aluminum identification tags shall be provided at every 30 m. All cables laid shall be properly dressed and at least 50 mm space shall be kept between the cables.

C) Cables shall be bent to a radius not less than 12 (twelve) times the overall diameter of the cable or in accordance with the manufacturer's recommendations whichever is higher.

D) In the case of cables buried directly in ground, the cable route shall be parallel or perpendicular to roadways, walls etc. Cables shall be laid on an excavated, graded trench, over a sand or soft earth cushion to provide protection against abrasion. Cables shall be protected with brick or cement tiles on all the three sides as shown on drawings. Width of excavated trenches shall be as per drawings. Back fill over buried cables shall be with a minimum earth cover of 750 mm to 1000 mm. The cables shall be provided with cables markers at every 20 meters and at all loop points.

E) The general arrangement of cable laying is shown on drawings. All cables shall be full runs from panel to panel without any joints or splices. Cables shall be identified at end termination indicating the feeder number and the Panel/Distribution board from where it is being laid. cable termination for conductors upto 4 sq.mm. may be insertion type and all higher sizes shall have tinned copper compression lugs. Cable termination shall have necessary brass glands. The end termination shall be insulated with a minimum of six half-lapped layers of PVC tape. Cable armoring shall be earthed at both ends.

F) In case of cables entering the buildings. It would be done duly only through pipes. The pipes shall be laid in slant position. So, that no rain water may enter the building. After the cables are tested. The pipes shall be sealed with M. seal & then tarpaulin, shall be wrapped around the cable for making the entry of water light.

G) cables shall be provided with stainless steel/Aluminum cable identification tags at a maximum distance of 10m.

H) All cables to be laid should be properly dressed and at least 50 mm space should be kept between the cables.

Testing:

A) MV cables shall be tested upon installation with a 500 V Meggar and the following readings established:

- 1) Continuity on all phases.
- 2) Insulation Resistance.

(a) Between conductors.

(b) All conductors and ground.

All test readings shall be recorded and shall form part of the completion documentation.

3) Mode of measurement

The cable shall be measured in per mt. Basis and the rates shall include;

- Cables and clamps and Tags
- Installation, Commissioning and testing.
- Cable length shall be certified by engineer in charge from Clients side.

E-5 CABLE TERMINATION

5.1 Supplying & fixing double compression type Brass glands (single compression for indoor application and double compression for outdoor applications) & making joint with necessary bi metallic crimping socket of long neck type connecting the same to various equipment/panel/DB etc. for the following sizes:

1) Material

Should conform to item no 5.1 of BoQ.,

2) Workmanship

Cable joints shall be done as per regular practice and check shall be carried out for loose connections and leakages. Insulation cutting shall be done properly taking care that no area of the conductor remains exposed. Crimping shall be done with the help of hydraulic tool.

3) Mode of measurement

Rate shall be considered for 1 no of joint.

E-6 CABLE TRAY**6.1 Supplying and fixing following sizes of HOT DIP GI cable trays including couplers, fittings and other accessories as required, and duly suspended from the ceiling with suspenders/fixed on ceiling/walls on fastners etc as per specifications complete as required.****1) Material**

Should conform to item no 6.0 of BoQ.,

2) Workmanship

As directed by engineer in charge.

3) Mode of measurement

Rate shall be considered for 1 mtr cable tray including all accessories.

6.2 Supplying , fabricating and installation of various sizes clamps for cable tray supports using available M.S. sections & rod as per drawings or instructions of engineer in charge or consultant including applying zinc chromate yellow oxide and two to three coats of required enamel paints with anchor fasteners etc..**1) Material**

Should conform to item no 6.3 of BoQ.,

2) Workmanship

As directed by engineer in charge.

3) Mode of measurement

Rate shall be considered per KG including all accessories.

EW**E-7 INTERNAL WIRING****7.1 Point wiring****1) Material**

Shall confirm to item no 7.0 of BoQ.

2) Workmanship**Installation**

- A) 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. diameters unless otherwise indicated or approved. Size of wires shall not be less than 1.5 sq.mm. Copper.

Nominal Cross sec. Area (mm²)	<u>20 mm</u>		<u>25 mm</u>		<u>32 mm</u>		<u>38 mm</u>	
	S	B	S	B	S	B	S	B
1.50	4	3	10	8	15	9	--	--
2.50	4	2	9	6	10	8	--	--
4.00	2	2	6	4	9	6	--	--
6.00	1	--	5	4	9	6	--	--
10.00	1	--	3	3	7	5	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°.

- B) Conduits shall be kept at a minimum distance of 100 mm. from the pipes of other non-electrical services. And maintain minimum 300 mm distance between telephone, TV & Computer piping.

C) Separate conduits/raceways shall be used for :

1. Normal lights and 5 A 3 pin sockets on lighting circuit.
2. Separate conduit shall be laid from D.B. to switch board or point.
3. Power outlets - 15 A 3 pin 20 A/30 A, 2 pin scraping earth metal clad sockets.
4. Emergency lighting.
5. Telephones.
6. Fire alarm system.
7. Public address system & Music system.
8. For all other voltages higher or lower than 230 V.
9. Computer Wiring

- D) Call bell wiring layout of conduits shall be generally as indicated on drawings and the layout shall be supplemented and complemented by contractor on site with the approval of the Engineer.
- E) 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.
- F) Conduits run on surfaces shall be supported on GI 12 mm. thick pressure saddles which in turn are properly screwed to the wall or ceiling. Saddles shall be at intervals of not more than 500 mm. 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 uncton/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.
- G) 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 final finish will be done by the building contractor.
- H) Conduits buried in concrete structure shall be put in position and securely fastened to the reinforcement and got approved by the Engineer, 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.
- I) 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 Perspex / Acrylic plate truly cut and fixed with cadmium plated brass screws. These junction boxes with cover plate shall form part of point wiring or conduit wiring as the case may be including the cost of removing the Perspex / Acrylic cover for painting and re-fixing. No separate charges shall be allowed except where specially mentioned.
- J) 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.
- K) An insulated earth wire of copper rated capacity shall be run in each conduit.

2) Lighting & Power Wiring:

- A) All final branch circuits for lighting and appliances shall be flexible copper wire of appropriate size run inside conduits. The conduit shall be properly connected or jointed into sockets, bends, junction boxes.

- B) Branch circuit conductor sizes shall be as shown in the schedule of quantities and or drawings.
- C) All circuits shall preferably be kept in a separate conduit upto 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, of the same phase.
- D) 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 Engineer's approval.
- E) 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.
- F) 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.
- G) 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.
- H) Every conductor shall be provided with identification ferrules at both ends (At DB & Switch Board end) matching the drawings.
- I) Switch board module shall be as per consultant / architect detail. Dummy plate for switch board shall be part of point wiring rate.
- J) 3 core flexible wires for point to Light fixture shall be considered in point rate.

3) Testing

The entire installation shall be tested for:

- a) Insulation resistance.
- b) Earth continuity.
- c) 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) when laid in ground / floor the PVC pipe will be Heavy gauge & with 1100v grade PVC insulated flexible copper conductor wire. The switches should be modular with molded 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 inclusive of 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 switch board and outlet points. The size of the wire shall be as per the specification. Colour code shall be strictly followed. Heavy gauge PVC pipe shall be laid for ground / floor.

The size of wires shall as follow:

10 Amps. Metal clad points:

Phase / Neutral 2.5 mm²

Earth 1.5 mm²

6 Amps. Out let points:

Phase / Neutral 2.5 mm²

Earth 1.5 mm²

Two nos. of 16 Amps. socket out let connected in parallel from DB to first outlet

Phase / Neutral 4.0 mm²

Earth 2.5 mm²

Two nos. of 16 Amp. socket out let connected in parallel from first outlet to second outlet.

Phase / Neutral 2.5 mm²

Earth 1.5 mm²

Light, fans, exhaust fan, 5 Amp. plug point, two way light point, bell point etc.

Phase / Neutral 2.5 mm²

Earth 1.5 mm²

6/16 Amp. Socket outlet for appliances / AC (Single Phase/Three Phase) / Geyser

Phase / Neutral 4.0 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.

Mode of measurement

The unit rate shall include:

- 1) Making zari in the wall & semi finishing the surface.
- 2) Ball and socket joints where ever required
- 3) Earthing of fittings, Electrical connection to the fixtures from the outlet point/ ceiling rose
- 4) Supply and Installation and interconnection of electronic regulators for ceiling fan
- 5) Circuit Mains shall not be paid extra. Rate for the point shall consist of wiring from the out let point to the switch board as required with a connector/ plate/ ceiling rose fan box with hook socket with switch. The point rate shall include in addition to phase and neutral wire a PVC insulated earth continuity wire from switch to outlet. The unit rate for the point shall consist of the circuit wiring form LDB / ELDB to outlet point through switch and/or socket, switch board as required and including the outlet points with connector, fan hook box or sockets. Separate phase, neutral and earth wire from LDB / ELDB to the final termination at outlet points (Primary points) and from primary point to secondary point. No extra rate shall be paid for circuit mains for looping switch board to switch board.
- 6) There may be few Emergency light points and SB for the same. For Emergency light points no Circuit Mains shall not be paid extra. Rate for the point shall consist of wiring from the out let point to the switch board as required with a connector/ plate/ ceiling rose fan box with hook socket with switch as mentioned above.

7.2 MAINS:

1) Material:

As per item no 7.2 of BoQ.

2) Workmanship

As per item no 7.1 above

3) Mode of measurement

The mains shall be paid on per mtr basis which shall include cost of wires, pipe, bends and junction and accessories for mounting and jarri work. The length shall be certified by the engineer in charge.

7.3 RACEWAYS:

7.3.1 Supply and installation of PVC race way with all accessories.

1) Material

As specified in itme no 7.3 of BoQ

2) Workmanship

As directed by engineer in charge

3) Mode of measurement

The rate shall be for 1 mtr of raceway with cover.

E-8 LIGHT FIXTURES & FANS

8.0 Supplying, erecting, connecting, testing and commissioning of Following type Light Fixture with all necessary Hardware, Internal Wiring with Lamp, Ballast etc. all required accessories Complete in all respect. Cost includes wiring from outlet point to light fixtures and also wiring from first light fixtures to second light fixtures wherever provided on back to back (touching each other) arrangements.

1) Material

Shall confirm to item no 8.0 of BoQ.

2) Workmanship

The fixture shall be installed on wall / ceiling as directed and as per manufacturer's instruction, with necessary accessories for surface, concealed, suspended from ceiling, bracket mounting etc. The job also includes connection of fixture with respective outlet point with heat resistant wires through heat resistance sleeve and PVC connector. The exhaust fan shall be installed complete with M.S. angle iron mounting frame/ ring, G.I. louvers, wire mesh and plug at the end of the cord including wiring & earthing etc. Proper earthing shall be provided to the fixtures

3) Mode of measurement

The unit rate shall be considered for Supplying and fixing one fixture. The rate shall include following

- a) All fixing accessories, mounting bracket, ballast condensers and control gear wherever applicable.
- b) Supplying and fixing Ball and socket joints wherever required.
- c) Earthing of fittings.
- d) Electrical connections to fittings/fans from the junction box/ceiling rose.
- e) Installation and interconnection of Electronic regulators for ceiling fans.

E-9 EARTHING**9.1 Providing earthing stations for equipment earthing as shown and specified in drawing for equipment complete with:****1) Material**

Shall be as per item no 9.1 of BoQ.

2) Workmanship

- A) The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.
- B) Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.
- C) The earth conductors (Strips / Wires copper/ Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Mild Steel Zinc Passivated screws \ bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level.
- D) The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.
- E) Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.
- F) The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.
- G) The connection between strip and plate shall be through stainless steel bolts and washers.
Following tests shall be carried out:

- A) The following earth resistance values shall be measured with an approved earth meager and recorded.
 - 1) Each earthing station
 - 2) Earthing system as a whole
 - 3) Earth continuity conductor
- B) Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 3 Ohm in each case.
- C) Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.
- D) All tests shall be carried out in presence of the Site Engineer & the test results shall be submitted in duplicate to the consultants & client with the signatures of the authorities present at the time of testing.

3) Mode of measurement

Rate shall be considered for one unit of pit complete.

9.2 Earth wire/strips:

Supply and laying cu. earthing required size strips for interconnecting the earthing stations, panels, DB's etc. in built up trenches, on walls/ceiling, buried in ground generally as specified and shown on drawings complete with :

a) Fixing accessories.

b) Corrosion protection of buried conductors with bituminous coating and covered with PVC tapes.

1) Material

Shall be as per item no 9.2 of BoQ. Copper strips of sizes specified in the BOQ. The strips shall not be corroded.

2) Workmanship

Copper strips shall be laid along with the cables and mains as instructed by the consultant and along the path of the cable. The strips shall be terminated at both the ends properly via brazing SS nut and bolts with double washer screws and nuts as instructed by the consultant. Strips shall not be bend to and extent that they go brittle.

3) Mode of measurement

The rate shall be considered on per Mtr. basis

9.3 Earth Link:

Earth Link : 40mm x 6 mm 1ft Long Cu. earth link fixed by necessary screws on wall.

1) Material

Should conform to item no 9.2.3 of BoQ.

2) Workmanship

The links shall be done properly so that after the installation is complete they do not get detached. Proper screwing shall be done so as to avoid gaps and maximum area overlap is available.

3) Mode of measurement

The rate shall be for one unit of earth link complete with required screws / nut-bolts & washers.

E-10 MISCELLANEOUS**10.1 Supply & laying of 20 / 32 / 40 mm dia. Heavy guage PVC conduit for Telephone/Data Cable in ground.****1) Material**

As specified in BOQ

2) Workmanship

As specified in BOQ

3) Mode of measurement

The rate shall be for 1 mtr of pipe.

10.2 Supply & laying of 50 / 150 mm dia. Double wall corrugated(DWC) pre lubricated conduit for Fibre/Data Cable in ground but excluding cost of excavation and back filling**1) Material**

As specified in BOQ

2) Workmanship

As specified in BOQ

3) Mode of measurement

The rate shall be for 1 mtr of DWC pipe

10.3 Supply, Installation, Testing & Commissioning of fire resistant, cement based mortar including its various components as given in the BOQ complete in all respect with all required accessories etc.**1.) Material**

Should confirm as per item no. 10.3.1 of BoQ.

2.) Workmanship

As per IS & instruction in BOQ / engineer in-charge / consultant. Proper finishing shall be done so as to avoid gaps and maximum area overlap is available.

3.) Mode of measurement

The rate shall be as specified in BOQ complete.

E-11 Telephone and Data Distribution**11.1 Supply & laying of 30 pair 0.5 mm dia PVC insulated armoured telephone cable in existing hume pipe as specified in BoQ.****1) Material**

As specified in BOQ

2) Workmanship

As per instruction of Engineer-in-Charge.

3) Mode of measurement

The rate shall be for 1 mtr of cable.

11.2 Supply and Installation of 30 pair MDF unit with Krone modules.**1) Material**

As specified in BOQ

2) Workmanship

As per instruction of Engineer-in-Charge.

3) Mode of measurement

The rate shall be per no.

11.3.1 Supply, Installation, Testing and commissioning of telephone point.**1) Material**

As specified in BOQ

2) Workmanship

As specified in BOQ

3) Mode of measurement

The rate shall be per no.

11.3.2 Supply, Installation, Testing and commissioning of Data ad CCTV point.**1) Material**

As specified in BOQ

2) Workmanship

As specified in BOQ

3) Mode of measurement

The rate shall be per no.

11.4 Supply, Installation, Testing and commissioning of Television point.

1) Material

As specified in BOQ

2) Workmanship

As specified in BOQ

3) Mode of measurement

The rate shall be per no.

E-12 Access Control Systems**12.1 SITC of Microcontroller/Microprocessor base Door Controller for Access Control with all interfaces for computer/server connectivity for card base access control. (Access Control)**

- **Material**

Shall conform to 12.1

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

12.2 SITC of finger print card reader, Exit switch, EMI lock with door sensor

- **Material**

Shall conform to 12.2, 12.3, 12.4

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

12.3 SITC of 8C and 4C 0.75mmCu. Shielded flexible cable

- **Material**

Shall conform to 12.5, 12.6

- **Mode of measurement**

The rate shall be per MTR.

12.4 SITC of Web based Software Application for System Configuration, Management & Diagnostics, Time Attendance and Leave Management Application.

- **Material**

Shall conform to 12.7

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

E-13 FIRE ALARM AND DETECTION SYSTEM

Supply, Installation, Testing and Commissioning of UL listed Microprocessor based networkable addressable Main Fire Alarm Control System having minimum 2 loop capacity, each loop having capacity of 159 addressable detectors and 159 addressable devices.

The Panel as well as detectors and devices shall be UL 9th edition Approved/Listed and in conformance with international standards such as NFPA 72 2010 edition National Fire Alarm and Signalling Code for Human Life Safety.

13.1 SITC of Addressable Multi Sensor Smoke Detector.

- **Material**

Shall conform to 13.1

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

13.2 SITC of Rate of Heat Detector.

- **Material**

Shall conform to 13.2

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

13.3 SITC of Addressable Manual Call Point

- **Material**

Shall conform to 13.3

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

13.4 SITC of Remote Exit Directional Sounder

- **Material**

Shall conform to 13.4

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

13.5 SITC of Remote Strobe

- **Material**

Shall conform to 13.5

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

13.6 SITC of Remote Fault Isolator Module

- **Material**

Shall conform to 13.6

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

13.7 SITC of Response Indicator

- **Material**

Shall conform to 13.7

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

13.8 SITC of 2 core 1.5 sq mm Armoured multi-stranded FRLS copper conductor cable with all required accessories.

- **Material**

Shall conform to 13.8

- **Mode of measurement**

The rate shall be for 1 meter of cable.

13.9 SITC of Aspiration System

- **Material**

Shall conform to 13.10

- **Mode of measurement**

The rate shall be for 1 no. of Each Equipment.

13.10 SITC of 2 core 1.5 sq mm Unarmoured multi-stranded FRLS copper conductor cable with all required accessories.

- **Material**

Shall conform to 13.13

- **Mode of measurement**

The rate shall be for 1 meter of cable.