

Steel Double strip armour	FF
Non-magnetic (Al.) round wire armour	Wa
Non-magnetic (Al.) strip armour	Fa
PVC outer sheath	Y

Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and armoured cables.

### 3.3 INSPECTION

All cables shall be inspected by the contractor upon receipt at site and checked for any damage during transit.

### 3.4 JOINTS IN CABLES

The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoid cable jointing. This apportioning shall be got approved by the Owner's site representative before the cables are cut to lengths. Where joints are unavoidable heat shrinkable type joints shall be made. The location of such joints shall be got approved from the Owner's site representative and shall be identified through a marker.

### 3.5 JOINTING BOXES FOR CABLES

Cable joint boxes shall be installed with heat shrinkable sleeve and of appropriate size, suitable for XLPE armoured cables of particular voltage rating.

### 3.6 JOINTING OF CABLES

All cable joints shall be made in suitable, approved cable joint boxes and the filling in of compound shall be done in accordance with manufactures' instructions and in an approved manner. All straight through joints shall be done in epoxy mould boxes with epoxy resin.

All cables shall be joined colour to colour and tested for continuity and insulation resistance before jointing commence. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

### 3.7 CABLE END TERMINATIONS

Cable end termination shall be done in cable terminal box using crimping sockets and proper size of glands of double compression type

### 3.8 BONDING OF CABLES

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armour clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on to the cable conductors.

### 3.9 CABLE ACCESSORIES

The termination and straight through jointing kits for use on the systems shall be suitable for the type of cables offered as per this specification.

The accessories shall be supplied in kit form. Each component of the kit shall carry the manufacturer's mark of origin.

The kit shall include all stress grading, insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction sheet shall also be included in each kit.

The contents of the accessories kit including all consumable shall be suitable for storage without deterioration at a temperature of 45° C, with shelf life extending to more than 5 years.

3.9.1 Terminating kits

The terminating kits shall be suitable for termination of the cables to indoor switchgear or to a weatherproof cable box of an outdoor mounted equipment e.g. transformer / motor. For outdoor terminations, weather shields / sealing ends and any other accessories required shall also form part of the kit. The terminating kits shall be from one of the makes / types mentioned in the data sheet.

3.9.2 Jointing kits

The straight through jointing kits shall be suitable for installation on overhead trays, concrete lined trenches, and ducts and for underground burial with uncontrolled backfill and possibility of flooding by water and chemicals. These shall have protection against any mechanical damage and suitably designed to be protected against rodent and termite attack. The inner sheath similar to that provided for cables shall be provided as part of straight through joint. The jointing kits shall be from one of the makes / types mentioned in the data sheet.

3.10 PACKING & DESPATCH

Cables shall be drummed in maximum continuous lengths:

- a) Returnable steel drums for all H.V. cables and L.V. cables of large cross sectional areas or long drum lengths.
- b) Non-returnable wooden drums where the manufacturer can guarantee that such drums are of sufficient strength to protect cable during shipping, handling and outdoor storage for three year period.

Cable ends shall be sealed and fixed to the drum so that both ends are accessible. To protect the cable during shipment, battens shall be fitted around the entire periphery of the drum. Drums shall be suitable for long term outdoor storage at site.

All cable drums shall have the Purchase Order Number, Purchase Order Item Number, Drum Number and Stock Code Number clearly stenciled on the outside of both flanges.

Drum identification labels shall be of non-corrosive, non-hygroscopic material and attached to the outside and inside of the drum flanges. Labels shall be protected by transparent plastic envelopes and give the following information:

- a) Drum identification number and its direction of rotation for cable removal.
- b) Cable voltage grade
- c) Cable construction (e.g. PVC SWA PVC or AYFY)
- d) Number of cores and cross sectional area
- e) Cable quantity (Metres)
- f) Purchase order number and item number
- g) Total weight of cable and drum (kg)
- h) Manufacturer's name

- i) Year of manufacture
- j) Stock code number

The following minimum information shall be furnished.

- a) Standard and maximum drum lengths for all the types of cable offered and the proposed drum lengths for all items.
- b) Inspection test plan.
- c) Cable dimensions (together with tolerances) :
  - i. Diameter of (individual in case of multi stranded) conductor wire
  - ii. Percentage of compaction as per data sheet.
  - iii. Diameter under conductor screen (where applicable)
  - iv. Diameter over conductor screen (where applicable)
  - v. Diameter over individual core insulators
  - vi. Lay of cable in case of multi-core cable
  - vii. Diameter over inner sheath (mm)
  - viii. Diameter over centre sheath (mm)
  - ix. Diameter over lead sheath (mm) ( where applicable )
  - x. Diameter under armour (mm)
  - xi. Diameter over armour (mm)
  - xii. Diameter of armour wires (mm)
  - xiii. Overall diameter (mm)
- d) Cable Physical Properties:
  - i. The filler materials to be used.
  - ii. Cable weight in kg/km
  - iii. Minimum bending radius (x OD)
  - iv. Maximum conductor continuous operating temperature (°C)
  - v. Suitability of outer sheath to resist attack from chemicals.
- e) Cable electrical data :
  - i. Conductor dc resistance per km at 20°C
  - ii. Conductor ac resistance per km at operating temperature and system frequency
  - iii. Conductor inductive reactance per km at system frequency
  - iv. Conductor impedance per km at operating temperature and system frequency
  - v. Conductor capacitance per km
  - vi. Cable armour resistance per km
- f) The current carrying capacity of single and multi-core cables when installed in defined conditions in air, in ducts and direct buried in the soil, together with rating factors for varying ambient temperatures, grouping and installation conditions and methods.
- g) Cable short circuits withstand capacity presented in graphical form or by formulae.
- h) Descriptive literature (catalogues etc.).
- i) Cross sectional view of the physical make up of each cable.
- j) Recommended temperatures below which installation of cable should not be carried out.
- k) Minimum ambient temperature at which cables can be used.
- l) Maximum pulling force for each cable and any special pulling instructions.

- m) Maximum unsupported run of cable both horizontally and vertically.

### 3.11 TEST / INSPECTION

After completion of manufacture of cables and prior to dispatch, the cables shall be subjected to type, routine, acceptance and special tests as detailed below. Consultant's / Owner reserve the right to witness all tests with sufficient advance notice from seller. The test reports for all cables shall be approved from the Engineer before dispatch of the cables.

All routine tests, acceptance tests, type tests and additional type tests for improved fire performance shall be carried out as listed in IS: 1554 and IS: 7098 on PVC and XLPE insulated cables respectively. The test requirements for PVC insulation and sheath of cables, shall be as per latest revision of IS: 5831.

**Test for Resistance to Ultra Violet Radiation:** This test shall be carried out as per ASTM G-53 on outer sheath. Test certificates with respect to this test (not older than one year) from recognized testing laboratory to be furnished for review by Consultant's before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by seller at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided outer sheath remains same.

Acceptance tests as per IS-1554, IS-7098 and the following special tests to be performed on the cables as per sampling plan.

- a) Accelerated water absorption test for insulation as per IS 10810. Test certificates with respect to the test (not older than one year) from recognized testing laboratory to be furnished for review by Consultant's before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by seller at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided type of insulation remains same.
- b) Dielectric Retention Test: The dielectric strength of the cable insulation tested in accordance with NEMA WC - 5 at  $75 \pm 1^\circ \text{C}$  shall not be less than 50 % of the original dielectric strength. (For PVC insulated cables). Test certificates with respect to this test (not older than one year) from recognized testing laboratory to be furnished for review by Consultant's before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by seller at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly and once for each order.
- c) Oxygen Index Test: The test shall be carried out as per IS 10810 or applicable Indian Standard specifications. Sampling to be done for every offered lot/size as per sampling plan.
- d) Flammability Test: The test shall be carried out on finished cable as per IS - 10810. Sampling for these tests is to be done randomly once for each order, provided outer sheath remains same. The acceptance criteria for tests conducted shall be as under:
  - e) The cable meets the requirement if there is no visible damage on the test specimen within 300 mm from its upper end.
  - f) The maximum extent of the charred portion measured on the test sample should not have reached a height exceeding 2.5m above the bottom edge of the burner at the front of the ladder.
  - g) Test for rodent and termite repulsion property: The sellers shall furnish the test details to analyse the property by chemical method. Sampling to be done for every offered lot / size as per sampling plan.

3.12 CABLE INSTALLATION

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks.

Laying of Cables on Cable Trays

The relative position of the cables, laid on the cable tray shall be preserved and the cables shall not cross each other. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius as recommended by the manufacturers. All cables shall be laid with minimum one diameter gap and shall be clamped at every meter to the cable tray. Cables shall be tagged for identification with aluminum tag and clamped properly at every 20M. Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings. All cable shall be identified by embossing on the tag the size of the cable, place of origin and termination.

All cables passing through holes in floor or walls shall be sealed with fire retardant Sealant and shall be painted with fire retardant paint up to one meter on all joints, terminations and both sides of the wall crossings

3.13 CABLES INSIDE BUILDING

Cables inside buildings shall be laid on the cable trays. All cables passing through walls shall run through GI Pipes sleeves of adequate diameter 50 mm apart maintaining the relative position over the entire length.

3.14 CABLE TRAYS

Cable Tray and Cable Ladder systems are intended for the support and accommodation of cables and possibly other Electrical equipment in Electrical/Instrumentation/Communication systems.

**Design and Fabrication of Cable Trays / Ladders:**

The cable trays / ladders shall be fabricated according to the design specified by IEC 61537 and should be tested for Safe Working Load (SWL). The relevant details of SWL and the load chart with respect to SWL, supporting distance and the deflection should be according to the following chart.

Safe Working Load (SWL) with a span length up to 3 meters									
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)						
			1.5m	2m	2.5m	3m			
			Permitted Load (in kg/meter)						
Perforated Cable Tray	35	50 - 300	125	90	50	-			
	60	50 - 600	150	100	50	-			
	85	100 - 600	175	110	50	-			
	110	100 - 550	185	130	75	60			
Safe Working Load (SWL) with a span length up to 10 meters									
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)						
			4m	5m	6m	7m	8m	9m	10m
			Permitted Load (in kg/meter)						
Perforated Cable Tray for long span distance	110	200 - 300	160	110	75	-	20	-	-
		400 - 600	200	150	100	-	40	-	-
	160	200 - 300	230	180	140	100	70	-	-

		400 - 600	250	200	160	130	100	-	-
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Fabrication of Tray and accessories at site and welding is not permitted. In unavoidable circumstances, If any cut or holes are made in the trays/Ladder/ accessories, zinc spray need to be applied over the surface. The metal edge has to be protected by edge protection sleeves to avoid cable damage. Edge of the supports has to be protected with plastic END caps. Screwed connections and internal fixing Devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections.

Cables shall run in cable tray/ladder mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures using mounting accessories.

The cable tray and all accessories shall be fabricated from sheet steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications & should have a Base Perforation Class B according to IEC 61537. The cable trays shall be supplied in standard lengths of 3000mm and the width of the tray shall be as follows.

Width: 50, 100, 150, 200, 300, 400, 500, 600 & 750 mm.

All the cable tray accessories like Bend's, TEES's, Cross over's etc should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be from the same material as of the tray and modular type, it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories etc are shown in the enclosed drawings.

For Cable trays designed, tested and confirming to IEC 61537, thickness of cable tray should be according to the manufacturer's catalogue. For locally fabricated and non-tested tray, thickness should be 2 mm up to span length of 1.5 meter, 2.5 mm for span length between 2 to 3 meter and 3 to 4 mm for span length between 4 and 10 meter

### 3.15 SPECIFICATION FOR HOT DIP GALVANIZING PROCESS

(For Mild Steel Used For Earthing, Cable Trays Or Junction Boxes For Electrical Installation.)

#### General Requirements

a. Quality of Zinc

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

b. Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square metre shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing.

3.16 MOUNTING ACCESSORIES (SUPPORTS AND BRACKETS):

The mounting accessories shall be fabricated from steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications and should be of completely modular type.

All supports and Brackets should be factory made, hot dip galvanized after completing welding, cutting, drilling, other machining operations and tested according to IEC 61537 according to the arrangements in the enclosed drawing. The system shall be designed such that it allows easy assembly at site by using Bolts and Nuts. The main support and brackets shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hard ware etc to form various arrangements required to support the cable trays. Welding of the components at the site shall not be allowed.

**JOINTS**

Joints shall be smooth and without projections or rough edges that may damage the cables.

The Contractor will be required to cover joints with rubber cement or other non-hardening rubberized or plastic compounds if in the opinion of the Department joints may damage cables.

Joints shall as far as possible be arranged to fall on supports. The two cable tray ends shall butt tightly at the centre of the splice and the splice shall be bolted to each cable tray by means of at least 8 round head bolts, nuts and washers. Splices shall have the same finish as the rest of the tray.

3.17 FIXING TO SUPPORTS

Trays shall be bolted to supports by at least two round head bolts per support. Bolts shall be securely tightened against the tray surface to avoid projections which might damage cables during installation.

3.18 FIXING TO THE STRUCTURE

Where installed on concrete or brick, the supports for cable trays and ladders shall be securely fixed by means of at least 2 heavy duty, expansion type anchor bolts. Cantilevered trays shall be supported by a minimum of two expansion bolts per support.

It is the responsibility of the Contractor to ensure that adequate fixing is provided since cable trays and ladders that work loose shall be rectified at his expense. The fixing shall take in to account site conditions that prevail during installation.

Horizontal trays and ladders shall in general be installed below slabs, ceilings, etc. to facilitate access during installation of cables.

Multiple runs shall be spaced at least 300 mm apart unless a different spacing is specified.

**Corrosion Protection:**

The cable tray / ladder/accessories shall be of HOT DIP Galvanized (ISO 1461-1999) for installations in corrosive atmospheres both indoor and outdoor application. Sample tray / ladder / accessories / mounting accessories and supports should be salt spray tested according to ISO 9227 for > 500 hours. (\*550 hours according to class 6 for Hot dip Galvanized surface as per ISO)

3.19 TESTING AND CERTIFICATION IF INSTALLATION :

Cable tray / Ladder, bend, T Bend, cross, and all supports are to be tested for Safe Working Load (SWL), deflections, Impact resistance, Salt Spray & Electrical continuity test according to IEC 61537. The cable tray/ladder should not deflect more than 1/100th of the span length at SWL in Mid span and the transverse deflection of all mounting accessories at SWL shall not exceed 1/20th of the length. The

cable tray / cable ladder should be tested up to 1.7 times SWL at minimum and maximum room temperature. The temperature classification of cable tray system should be - 5 to + 150°C.

3.20 MARKING, DOCUMENTATION, COMPLIANCE AND INSPECTION:

Each system component shall be durably and legibly marked with:

- the manufacturer's or responsible vendor's name or trade mark or identification mark;
- a product identification mark which may be, for example, a catalogue number, a symbol, or the like.

When system components other than cable tray lengths and cable ladder lengths are supplied in a package, the product identification mark may be, as an alternative, marked on the smallest package unit.

Marking shall be applied, by moulding, pressing, engraving, printing, adhesive labels, or water slide transfers. Compliance is checked by inspection and, for marking on the product, by rubbing by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with petroleum spirit. Marking made by moulding pressing, or engraving is not subjected to the rubbing test. After the test, the marking shall be legible.

If a system component is stored and transported at a temperature outside the declared minimum and maximum temperatures, the manufacturer or responsible vendor shall declare the precautions and the alternative temperature limits. Compliance is checked by inspection.

The manufacturer or responsible vendor shall provide in his literature all information necessary for the proper and safe installation and use of the cable tray system and cable ladder system. The SWL and impact resistance is valid for the whole temperature classification declared.

3.21 FIRE RETARDANT CABLE PAINT & FIRE BARRIER

The fire retardant paint / barrier shall be listed by independent test agencies such as UL, FM or OPL and be tested to, and pass the criteria of ASTM E 814 ( UL1479) standard test method for fire test through- penetration fire stops and ASTM E 1996 (UL 2079) standard test method for fire resistive joint system/

3.21.1 Fire retardant cable Paint

The Fire resistant cable coating / painting shall be intumescent / ablative, water based compound, The coating shall expand up to 10 times, supplied in a manufacturer seal container indicating manufacturing and expiry dates. The coating material shall be non-toxic, asbestos free, & halogen free and shall have good mechanical strength. The colour of paint shall be white and density of coating shall be 1.3kg/ltr, coating shall have a snap time of 30 minutes, the expansion shall begin at 230 deg.C and it shall have a oxygen index of 41%.

Coating shall be applied by ordinary paint brush after cleaning the cables of dust and oil deposition. A minimum textured finish of 3 mm wet film thickness shall be achieved by applying the material in 2-3 layers leaving intervals of 2 to 8 hours depending upon the moisture and thickness, moisture and temperature hours between each coat.

3.22 TESTING OF CABLES

Cables shall be tested at works for all routine tests as per IS including the following tests before being dispatched to site by the project team.

- a) Insulation Resistance Test.
- b) Continuity test.
- c) Sheathing continuity test



- d) Earth test.(in armored cables)
- e) Hi Pot Test.

Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Owner's site representative.

- a) Insulation Resistance Test( Sectional and overall)
- b) Continuity test.
- c) Sheathing continuity test
- d) Earth test.

All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labor for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Owner's site representative, results will be noted and signed by all present and record be maintained.

#### **4. FINAL DISTRIBUTION BOARDS (FDB's)**

Final Distribution Boards (FDBs) shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, neutral grounded at transformer. The DB shall be minimum dielectric strength of 2.5 KV / Sec. All Distribution Boards shall be manufactured by a manufacturer listed in Appendix-I.

FDB's shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1993.

##### **4.1 CONSTRUCTION FEATURES**

FDB's shall be made out of 1.6 mm thick ( for residential project FDB shall be of minimum 1.2 mm thick ) high quality CRCA sheet steel and shall be pre-treated and powder coated sheet steel used in the construction of FDB shall be folded and braced as necessary to provide a rigid support for all component. FDB shall be suitable for indoor / outdoor installation, wall mounting free standing type, in double door construction. The Final Distribution Boards shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket, padlocking arrangement. All removable/ hinged doors and covers shall be grounded by 4.0 sq.mm tinned stranded copper connectors. Final Distribution Boards shall be suitable for the climatic conditions. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall conform to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage up to and including 1100 V AC.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self-threading screws shall not be used in the construction of FDBs.

Knockout holes of appropriate size and number shall be provided in the FDB's in conformity with the location of cable/conduit connections. Detachable sheet steel gland plates shall be provided at the top / bottom to make holes for additional cable entry at site if required.

Final Distribution Boards shall comprise of the following:

- 4.1.1.1 A panel for mounting where appropriate incoming supply circuit breaker & other auxiliaries for Control & distribution as required.
- 4.1.1.2 Installations accessories shall be part of the DB for fixing conductor and rails for mounting MCB's and RCCB's etc. Neutral bus bars & earthing bus bars required in the circuit. All bus bars in the FDB shall be insulated type.

- 4.1.1.3 Service cable /interconnection shall be part of the Distribution Boards.
- 4.1.1.4 The board shall be installed at a height such that the operating is within reach of the normal human height i.e. 1.2 to 1.8 meters from finish floor level.
- 4.1.1.5 Degree of protection shall be IP-42 for indoor application, IP-55 for kitchen & laundry and IP-65 for outdoor application.
- 4.1.1.6 All three phase distribution boards shall have 4 rows and single phase distribution boards shall have single rows for housing of MCB's and RCCB's unless noted otherwise.
- 4.1.1.7 Phase segregation to be maintained in all three phase distribution boards.
- 4.1.1.8 Earthing shall be provided in each FDB's.

#### **4.2 MINIATURE CIRCUIT BREAKER (MCB)**

Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B, C, D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the external operating handle.

All MCB's used for protection of resistive and lightly inductive load shall be type "B" characteristic. Inductive (motor) load shall be of type "C" characteristic and discharge lamps and UPS etc. shall be of type D characteristic

#### **4.3 RESIDUAL CURRENT CIRCUIT BREAKER CURRENT OPERATED TYPE (RCCB)**

##### **a. System of Operation**

Residual Current Circuit Breaker shall conform to IEC 61008. RCCB shall work on the principle of core balance transformer. The incoming shall pass through the toroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage current exceeds a predetermined critical value. RCCB shall be current operated independent of the line voltage, current sensitivity shall be of 30 mA at 240/415 volts AC and shall have a minimum of 10,000 electrical operations.

##### **b. Mechanical Operation**

The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing /opening of all the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under tripping conditions.

##### **c. Neutral Advance Feature**

The neutral moving contact shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact first before the phases; and at the time of opening, the neutral shall break last after allowing the phases to open first. This is an important safety feature which is also required by regulations.

d. Testing Provision

A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB / RCCB and the operating handle shall move to the "OFF" position.

4.4 Earthing

Earthing shall be provided as per IS:3043-1987.

All metallic non-current carrying parts of the switchgear shall be bonded together and connected to the switchgear earth busbar.

All doors shall be bonded to the main structure by means of a flexible copper connection arranged so that it cannot be trapped as the door is opened or closed.

Provision shall be made, for earthing cable screen and armouring to the earth busbar, near the gland.

Each earthing point shall be marked with an E.

4.5 Painting

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be of Siemens gray paint shade no. RAL-7032 of IS Code No.5.

4.6 Labels

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

A main label shall be affixed in a prominent position on each switchboard giving the following information:

- a. Manufacturers name and type
- b. Switchboard Tag Number
- c. Each circuit shall be fitted with a ferule giving the following information: -

**Circuit Details**

Labels shall be fitted on front of cubicles.

When the operating sequence of the equipment is not evident, e.g. mechanical / key interlocking features; instruction labels shall be provided and fixed near the point of operation.

Labels shall have black characters on a white background and be made of a non-corrodible material. Warning / Danger labels shall have White lettering on a red background.

Labels shall be affixed by means of screws or rivets. Use of adhesives shall not be accepted.

Each circuit shall be provided with durable one-line synoptic diagram, clearly indicating the specific function of the different compartment when this would not be clear from the general layout.

<b>Description</b>	<b>Requirement</b>
Material	Anodised Aluminium
Engraving	Black engraving on white background
Size of the Label	To suit application / importance
Fixing	With self-tapping screws
Use	Main Panel, feeders and individual devices

#### 4.7 TESTING

Testing of panels shall be as per following codes:

- a. IS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages upto and including 1000 VAC.
- b. IS: 13947 : 1993 Degree of protection

#### 4.8 WIRING

In wiring a distribution panel it shall be insured that total load of various distribution panel and/or consuming devices is divided evenly between the phases and number of ways as per Consultants drawing.

### 5. **EARTHING**

#### 5.1 EARTHING

The system shall be TNS with four wire supply system (R, Y, B, N and. E) brought from the main L T Panel. All the non-current carrying metal parts of electrical installation and all metal conduits trunking, cable sheaths, switchgear, distribution panels, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All metal work such as pipe lines, ducts, cable trays, stair case railing etc shall be bonded to earth.

All earthing shall be in conformity with IS:3043 1987, and the basic system of earthing shall be TNS.

Earthing work shall also conform to CPWD General Specifications for Earthing work and Indian Electricity Rules 1956 amended up to date and in the regulations of the local Electricity Supply Authority.

#### 5.2 EARTHING CONDUCTORS

Earthing conductors shall be of copper for equipment neutral earthing, IT equipment earthing, Server / Hub rack earthing, Isolation transformer neutral earthing etc. as per as mentioned in Schedule of quantities.

Copper \ GI conductor shall be used for general body earthing as mentioned in the Schedule of quantities. Conductor shall be protected against mechanical injury and corrosion.

### 5.3 SIZING OF EARTHING CONDUCTORS

Sizing of earth conductor for receiving station, HV equipment and main LV panels etc. shall be based on actual fault current calculated.

Earthing grid near substation station & earthing grids for other building shall be connected together at ground floor for equipotential bonding & to minimize overall resistance of earthing path.

Earthing grids of electronic \ IT equipment shall be separate & shall not be connected to general earthing grids with prior consent from user. Electronic \ IT equipment earthing grids for various buildings can be interconnected for equipotential bonding & to minimize overall resistance of earthing path

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

### 5.4 CONNECTION OF EARTHING CONDUCTORS

All joints in tapes shall be with four rivets (minimum 2 nos. diagonally opposite in case of smaller width strip) and shall be brazed in case of copper and by welding bolting in case of GI, wires shall be connected with crimping lugs, all bolts shall have spring washers. Sub- mains earthing conductors shall run from the main distribution panel to the sub distribution panel. Final distribution panel earthing conductors shall run from sub-distribution panel.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution panel. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to distribution panel at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc, which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed. The installation shall be complete in all respects for efficient and trouble free service. All work shall be carried out in a first class quality and neat workmanship. Grounding conductors shall be handled carefully to avoid kinking and cutting of the conductors during their installation. All exposed ground conductors run shall be taken in a neat manner horizontal, vertical and parallel to the building walls or columns and shall not be laid haphazardly. All connections to the grounding grid shall be made with **earthing** strip welded to grid and bolted at equipment ends.

### 5.5 PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system. The electrical resistance measured between earth connection at the main L T panel and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate or circuit breakers, and shall not exceed 1 ohm. All switches carrying medium voltage shall be connected with earth by two separate and distinct connections. The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in G I pipe of adequate size. The overlapping in strips at joints where required, shall be minimum 75 mm. The joints shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner. Sweated lugs of adequate capacity and size shall be used for termination of all conductor wires above 6 sq.mm size. Lugs shall be bolted to the equipment body to be earthed after the

metal body is cleaned of paint and other oily substances and properly tinned. Equi-potential bonding of all metallic structures shall be done.

#### 5.6 EARTHING

The following must always be ensured in earthing system.

- All earths must be interconnected at the earth pits. This includes generator neutrals, transformer neutrals, transformer body, lightning protection system earths, UPS earths etc.
- Extraneous conductive parts such as gas pipes, other service pipes and ducting risers and pipes of fire protection equipment and exposed metallic parts of the building structure.

5.7 The Contractor shall get the soil resistivity test done at his own cost of the area where earthing pits are to be located before starting the installation.

#### 5.8 RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 1 ohm.

#### 5.9 SPECIFICATION FOR HOT DIP GALVANIZING PROCESS

##### General Requirements

##### a. Quality of Zinc

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

##### b. Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square meter shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters.

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

#### 5.10 EARTHING ELECTRODE

##### **Copper Earth Electrode**

Earthing electrode shall be 600 x 600 x 3.15 mm thick tinned copper plate electrode, with 2 Nos 50 x 6 mm copper strips from earth plate electrode to inspection chamber, 50 mm dia medium class GI pipe, CI funnel with 20 gauge GI wire mesh, masonry chamber 1000 x 500 mm with concrete base as per IS3043 with C I heavy duty / chequered plate manhole cover with frame painted with bitumastic paint and packing with mixture of charcoal and common salt around plate electrode including digging of pit up to permanent moisture level and as per soil condition but not less than 3 meters and back filling as required.

### **GI Earth Electrode**

Earthing electrode shall be 600 x 600 x 6.3 mm thick GI plate electrode, with 2 nos. 50 X 6 mm GI strips from earth plate electrode to inspection chamber, 50 mm dia medium class GI pipe, CI funnel with 20 gauge GI wire mesh, masonry chamber 1000 X 500 mm with concrete base as per IS3043 with CI manhole cover with frame painted with bitumastic paint and packing with mixture of charcoal and common salt around plate electrode including digging of pit upto permanent moisture level but not less than 3 meters and back filling as required.

### **Pipe Earth Electrode**

Earthing electrode shall consist of a GI pipe (class B of approved make), not less than 80 mm dia. and 3 meters long. GI pipe electrode shall be cut tapered at the bottom and provided with holes of 12 mm dia. drilled at 75 mm interval upto 2.5 meters length from bottom. The electrode shall be buried vertically in the ground as far as practicable below permanent moisture level, but in any case not less than 3 mtr. below ground level. The electrode shall be in one piece and no joints shall be allowed in the electrode. Wherever possible, earth electrodes shall be located close to water tap, water drain or a down take pipe. Earth electrode shall not be located in proximity to a metal fence. It shall be kept clear of the building foundations and in no case; it shall be nearer than 2 meters from the outer face of the wall. The pipe earth electrode shall be kept vertically and surrounded with 150mm thick layer of charcoal dust and salt mixture upto a height of 2.5 meters from the bottom. At the top of the electrode a G.I. threaded cap shall be provided for watering the earth. The main earth conductors shall be connected to the electrode just below the G.I. cap, with proper terminal lugs and check nuts. The G.I. cap over the GI pipe and earth connection shall be housed in a masonry chamber, approximately 300 mm length x 300 mm wide and 300 mm deep. The masonry chamber shall be provided with a cast iron inspection cover resting over a C.I. frame, embedded in masonry.

### **Maintenance free Earthing Electrode System/ Chemical Earthing**

In maintenance free earthing copper bonded earthing rod electrode shall be of 14.35 mm in diameter and 3 meter length. The rod shall be placed in a 150 mm dia an augured hole in the ground and then surrounded by ground enhancement material in either a dry form or pre mixed in a slurry. Once set, ground enhancement material becomes hard and as such holds positively to the rod as well as surrounding ground.

Earth rod offered shall have passed the test required of BS7430/ ANSI/ UL467 and confirm to the adhesion of the copper coating to the steel core (Design feature that prevents the ingress of moisture and subsequently the integrity of the rod.

Minimum 0.25 mm thickness of copper shall be deposited over the steel core as per BS 7430/ UL 465. Average life of the ground rod shall be 30 years in most soil.

Ground enhancement material shall be as per IEEE-80 clause 14.5d with a resistivity of less than 0.12 ohm-meters. The ground enhancement material shall be permanent and not leach any chemicals in to the ground. The pH value of the ground enhancement material shall be 6.9 to 5.2 of 100 gm/ lit @ 20 deg.C.

Minimum 30 Kg of ground enhancement material shall provided for each earth electrode.

Inspection chamber shall be of 400 x 500 mm with concrete base CI manhole cover with frame painted with bitumastic paint. 2 Nos. of 50 x 6 mm cross section & 300 mm long copper strip to be clamped with copper clad rod electrode have sufficient nos ( But not less than 4 Nos.) of 10□ mm GI nuts & bolts for connection to the equipment / interconnection to the other pits to form equi-potential bonding.

#### **5.11 EARTH FOR UPS / LOW VOLT / SERVERS**

Clean earth shall be used for earthing UPS / Low volt / Server systems and shall be separate from safety earthing. Separate earthing electrode shall be provided in the ground and from this electrode, single core copper cable of required size shall be taken as earth conductor to be laid in the vertical

shaft. This cable shall be terminated on each floor in a earth terminal box located in the shaft. The earth terminal box shall have 50x6mm copper busbar mounted on insulators. The busbar shall have facility to terminate the incoming earth cable as well as required number of outgoing earth conductors.

#### 5.12 ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

The resistance of earthing system shall not exceed 1 ohm. Earthing clamps for supporting earth strips shall be of such design so as to avoid bimetallic action between strip and clamps.

After the installation of strips the wall slab or floor etc. should be finished to the satisfaction of the Engineer-In Charge.

### 6. **CABLING FOR VOICE SYSTEM**

#### 6.1 **Scope**

This document defines the cabling system and subsystem components to include cable, termination hardware, supporting hardware, and miscellany required to supply, and to install a complete cabling infrastructure supporting voice and video. The intent of this section is to provide pertinent information to allow the vendor to bid the labor, supervision, tooling, materials, and miscellaneous installation hardware and consumables to install a complete system. However, it is the responsibility of the vendor to propose any, and, all items required for a complete system whether or not it is identified in the specification, drawings and bill of materials attached to this specification.

#### 6.2 **Applicable Documents**

The cabling system described in this specification is derived in part from the recommendations made in industry standard documents. The list of documents below (or the latest revisions) has bearing on the desired cabling infrastructure are incorporated into this specification by reference:

- i. This Technical Specification and Associated Drawings
- ii. ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard – March 20010.
- iii. ANSI/EIA/TIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces - February, 1998
- iv. ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings - February, 1993
- v. ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications - August, 1994

#### 6.3 **Backbone Wiring**

##### **General**

The function of the backbone wiring shall be to provide interconnections between telecommunications closets, equipment rooms and entrance facilities in the telecommunications wiring system. The backbone wiring shall consist of the transmission media, intermediate and main cross connects, and mechanical



terminations for interconnection of telecommunications closets, equipment rooms and entrance facilities. The backbone wiring shall include transmission media in the building.

The backbone wiring shall use the star topology wherein each telecommunications closet shall be wired to a main cross connect / patch panel or an intermediate cross connect then to a main cross-connects / patch panel. There shall be no more than two hierarchical levels of cross connects / patch panel in the backbone wiring. Interconnections between any two telecommunications closet shall pass through three or fewer cross-connects / patch panel.

Bridged taps shall not be permitted as part of the backbone wiring.

One of the following types of cables shall be used for backbone wiring as defined in schedule of quantities.

1. 100-ohm UTP multiplier backbone cable.
2. 62.5 / 13.5 um optical fiber cable.

The contractor has to assure that cross talk coupling between individual, unshielded twisted-pairs shall not affect the transmission performance of multi-pair cables.

#### **6.4 Horizontal Wiring**

##### **General**

The horizontal wiring shall be the portion of the tele communications wiring system that will extend from the work area telecommunications outlet to the telecommunications closet. The horizontal wiring shall include the telecommunications outlet in the work area, mechanical termination for the horizontal cables, and cross-connections located in the telecommunications closet.

The horizontal wiring shall be capable of handling the following minimum services.

1. Voice telecommunications.
2. Premises switching equipment.

The horizontal wiring shall be a star topology with each work area telecommunications outlet connected to a telecommunications closet. Horizontal wiring shall preferably contain no more than one transition point between different forms of the same cable type.

Bridged taps shall not be permitted as part of the horizontal wiring.

The maximum horizontal distance shall be limited to 90 meters (295 ft) independent of media type i.e. the cable length from the mechanical terminating of the media in the telecommunications closet to the telecommunications outlet in the work area shall be limited to this distance. This horizontal distance includes cabling required from the telecommunications outlet to the work station. Horizontal cable shall be limited to one of the following types as listed out in the schedule of quantities.

1. Four-pair 100-ohm unshielded twisted pair (UP) cables.
2. 62.5/125 um optical fiber cable.

##### **Grounding Considerations**

Grounding system shall be an integral part of the telecommunications wiring system. In addition to helping protect personnel and equipment from hazardous voltages, the grounding system shall reduce the effect of electromagnetic interference ((EMI) to and from the telecommunications wiring system.

Grounding shall meet the NEC requirements and practices or local authorities or codes whichever impose a more stringent requirement.

The following shall be considered for the grounding system.

Installation conforms with proper practices and requirements.

Each telecommunications closet shall have an appropriate grounding access.

Grounding shall be available for cross-connect frames, patch panel racks, telephone and data equipment and equipment required for maintenance and testing.

## **6.5 Backbone Wiring Distances**

### **Telecommunications Closet to Main Cross-Connect**

The maximum backbone distance between the main cross-connect patch panel and the mechanical termination in the telecommunications closet shall be as follows:

For 62.5 / 125 ohms optical Fiber cable the distance between Telecommunication closet and main cross connect / patch panel shall not exceed 2000 mts.

For 100 ohm UTP cable, maximum distance between telecommunication closet and main cross connect / panel shall be 800 mts.

Telecommunications equipment which connect directly to main or intermediate cross-connects / patch panel shall done via cables of 30 m or less.

## **6.6 Telecommunications Closet**

A telecommunications closet shall be defined as an area within the building set aside for the exclusive purpose of housing equipment associated with the telecommunications wiring system. There shall be no upper limit on the number of telecommunications closets which may be provided within the building. The telecommunication closet shall have following three possible configurations.

### **Horizontal Backbone Connection**

The telecommunications closet shall contain the mechanical terminations for a portion of the horizontal wiring system and a portion for the backbone wiring system. In such a case the telecom closet shall provide facilities (space, power, grounding etc.) for the passive (cross-connect) / patch panel or active devices or both used to interconnect the two system.

### **Backbone Wiring System Interconnection**

The telecommunications closet may contain the intermediate cross-connect / patch panel or main cross connect / patch panel for different portions of the backbone wiring system. In this usage, the telecommunications closet shall provide facilities for the passive or active devices or both used to interconnect two or more portions or the backbone wiring system.

### **Entrance Facilities**

A telecommunications closet may be used to contain the demarcation point or an underbuilding entrance facility. In this usage, the telecommunications closet shall provide facilities for the active and / or passive devised required interconnecting the demarcation point or underbuilding entrance facility or both to the telecommunication wiring system.

The design of the telecommunications closet shall be as per the requirements of EIA/TIA-569.

## **6.7 Equipment Room**

The equipment room shall be defined as an area within the building where telecommunications systems shall be housed along with the mechanical termination of one or more portions of the telecommunications wiring system. Equipment room shall be considered to be distinct from telecommunications closets because of the nature or complexity of the equipment they contain. Any or all of the functions of a telecommunications closet shall be alternatively provided by an equipment room.

## **6.8 Cable Specifications**

### **6.8.1 UTP Cabling System**

#### **6.8.1.1 Unshielded twisted pair cabling system, TIA / EIA 568-B.1 addendum Category 6 Cabling system**

- |    |   |   |
|----|---|---|
| a. | Networks Supported  | 10 / 100 Ethernet, 155 Mbps ATM, 1000 Mbps IEEE 802.3ab Ethernet, and proposed Cat 6 Gigabit Ethernet.                          |
| b. | Warranty  | 25-year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs |
| c. | Performance characteristics to be provided along with bid | Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel                 |

#### **6.8.1.2 Unshielded Twisted Pair, 0.5mm copper cable , TIA / EIA 568-B.2**

- |    |   |   |
|----|---|---|
| a. | Material:   |   |
| b. | Conductors  | 0.5mm solid bare copper or better   |
| c. | Insulation  | Polyethylene  |
| d. | Jacket  | Flame Retardant PVC   |
| e. | Pair Separator  | Cross-member fluted Spline.   |
| f. | Approvals   | UL Listed<br>ETL verified to TIA / EIA Cat 6  |
| g. | Operating temperature                                     | -20 Deg. C to +60 Deg. C  |
| h. | Frequency tested up to                                    | Minimum 600 MHz   |
| i. | Packing   | Box of 305 meters   |
| j. | Delay Skew  | 45ns MAX.   |
| k. | Impedance   | 100 Ohms + / - 15 ohms, 1 to 600 MHz  |
| l. | Performance characteristics to be provided along with bid | Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR |

## **6.9 0.5mm Riser Cable**

This cable shall consist of solid copper conductors insulated with expanded polyethylene covered by a PVC sheet. The core shall be covered with a layer of plastic tape and overlaid with a corrugated PVC plastic. it shall be suitable to be used without conduit. The cable shall meet. EIA/TIA -568, C S A T -529,

IEEE 802.3 & 10 B A S E -T. The pair sizes shall be as per the schedule of quantities. The cable shall meet the following specifications.

- |    |                                   |                      |
|----|-----------------------------------|----------------------|
| a. | Maximum DC Resistance             | 26.5 ohm per 100 ft. |
| b. | Maximum D C Unbalanced Resistance | 17%                  |
| c. | Mutual Capacitance at 1 kHz       | 16 nF per 1000 ft.   |

#### **6.10 Warranty**

Owner seeks warranty for the installed cable plant from the OEM equipment supplier. Bidder shall ensure that the OEM norms for supply, installation, testing and documentation as specified by the OEM supplier shall be adhered to, provided those are in line with TIA / EIA standards and Owner requirement specifications. The warranty shall be provided by the OEM vendor to Owner and shall be administered in India. The duration of the warranty shall be for a minimum of 25 years and shall cover the system performance, application assurance and the costs of the supply of components and installation.

### **7. CABLING FOR DATA SYSTEM**

#### **7.1 Scope**

This document defines the cabling system and subsystem components to include cable, termination hardware, supporting hardware, and miscellany required to supply, and to install a complete cabling infrastructure supporting data and video. The intent of this section is to provide pertinent information to allow the vendor to bid the labor, supervision, tooling, materials, and miscellaneous mounting hardware and consumables to install a complete system. However, it is the responsibility of the vendor to propose any, and, all items required for a complete system whether or not it is identified in the specification, drawings and bill of materials attached to this specification.

#### **7.2 Applicable Documents**

The cabling system described in this specification is derived in part from the recommendations made in industry standard documents. The list of documents below (or the latest revisions) has bearing on the desired cabling infrastructure are incorporated into this specification by reference:

- a. This Technical Specification and Associated Drawings
- b. ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard – March 2010.
- c. ANSI/EIA/TIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces - February, 1998
- d. ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings - February, 1993
- e. ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications - August, 1994

#### **7.3 Cabling System and Component Specifications**

##### **7.3.1 UTP Cabling System**

##### **7.3.1.1 Unshielded twisted pair cabling system, TIA / EIA 568-B.1 addendum Category 6 Cabling system**

Networks Supported	10 / 100 Ethernet, 155 Mbps ATM, 1000 Mbps IEEE 802.3ab Ethernet, and proposed Cat 6 Gigabit Ethernet
Warranty	25-year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs
Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel

7.3.1.2 Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2

Material:

Conductors	23 AWG solid bare copper or better
Insulation	Polyethylene
Jacket	Flame Retardant PVC
Pair Separator Approvals	Cross-member fluted Spline. UL Listed ETL verified to TIA / EIA Cat 6
Operating temperature	-20 Deg. C to +60 Deg. C
Frequency tested up to	Minimum 600 MHz
Packing	Box of 305 meters
Delay Skew	45ns MAX.
Impedance	100 Ohms + / - 15 ohms, 1 to 600 MHz.
Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR

**7.4 UTP Jacks**

Type	PCB based, Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2
Durability	
Modular Jack	750 mating cycles
Wire terminal	200 termination cycles
Accessories	Strain relief and bend-limiting boot for cable Integrated hinged dust cover
Materials	
Housing	Polyphenylene oxide, 94V-0 rated
Wiring blocks	Polycarbonate, 94V-0 rated

Jack contacts	Phosphorous bronze, plated with 10.27micro-meter thick gold
Approvals	UL listed
Performance Characteristics to be provided with bid	Attenuation, NEXT, PS NEXT, FEXT and Return Loss

**7.5 UTP Jacks panel**

Type	24-port, PCB based, Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2
Ports	24
Port arrangement	Modules of 6-ports each, arranged 1port x 6.
Category	Category 6
Circuit Identification Scheme	Icons on each of 24-ports
Port Identification	9mm or 12mm Labels on each of 24-ports (to be included in supply)
Height	1 U (10.75 inches)
Durability	
Modular Jack	750 mating cycles
Wire terminal (110 block)	200 termination cycles
Accessories	Strain relief and bend limiting boot for cable
Materials	
Housing	Polyphenylene oxide, 94V-0 rated
Wiring blocks	Polycarbonate, 94V-0 rated
Jack contacts	Phosphorous bronze, plated with 10.27micro-meter thick gold
Panel	Black, powder coated steel
Approvals	UL listed
Termination Pattern	TIA / EIA 568 A and B;
Performance Characteristics to be provided along with bid	Attenuation, NEXT, PS NEXT, FEXT and Return Loss

**7.6 Faceplates**

<b><u>Type</u></b>	<b><u>1-port, White surface box</u></b>
Material	ABS / UL 94 V-0

**7.7 Workstation / Equipment Cords**

Type	Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2
Conductor	23 AWG 7 / 32, stranded copper
Length	7-feet
Plug Protection	Matching colored snag-less, elastomer polyolefin boot
Warranty	25-year component warranty
Category	Category 5
Plug	
Housing	Clear polycarbonate
Terminals	Phosphor Bronze, 50 micron gold plating over selected area and gold flash over remainder, over 100 micron nickel underplate
Load bar	PBT polyester
Jacket	PVC
Insulation	Flame Retardant Polyethylene

**7.8 Warranty**

Owner seeks warranty for the installed cable plant from the OEM equipment supplier. Bidder shall ensure that the OEM norms for supply, installation, testing and documentation as specified by the OEM supplier shall be adhered to, provided those are in line with TIA / EIA standards and Owner requirement specifications. The warranty shall be provided by the OEM vendor to Owner and shall be administered in India. The duration of the warranty shall be for a minimum of 25 years and shall cover the system performance, application assurance and the costs of the supply of components and installation.

**8. TESTING**

**8.1 GENERAL**

At the completion of the work, the entire installation shall be subject to the following tests in the presence of the Engineer-in-charge.

- Insulation resistance test.
- Earth continuity test.
- Earth resistivity test.
- Test as per Appendix 'E' of IS: 732 -1989

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the Contractor at his own cost.

8.2 INSULATION RESISTANCE TEST

The insulation resistance shall be measured between earth and the whole system of conductors, or any section thereof, with all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 660 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 divided by the number of points provided on the circuit, the whole installation shall have an insulation resistance greater than one mega ohms. The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant standard specification or where there is no such specification, shall not be less than one a mega ohms. All equipment's, cables shall be inspected at works by the Architect as per relevant IS and testing commissioning of installation as per Appendix 'E' of IS: 732-1989 shall be done and all record to be maintained.

8.3 TESTING OF EARTH CONTINUITY PATH

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

8.4 TESTING OF POLARITY OF NON-LINKED SINGLE POLE SWITCH

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



## **FIRE DETECTION & ALARM SYSTEM WITH VOICE EVACUATION SYSTEM AND PUBLIC ANNOUNCEMENT**

### **1. GENERAL DESCRIPTION**

- The Fire Alarm System supplier shall furnish and install a fully integrated Fire Detection cum Voice Evacuation system.
- It is proposed to have a single, unified and integrated Fire Alarm cum Voice Evacuation system to meet the Life Safety Standards defined in NFPA standards and NBC standards.
- The Fire Alarm System shall consist of Smoke detectors, Heat Detectors, and combination detectors selected as per specific requirements of the area to be installed in, as well as various input / output modules.
- It is proposed to have Fire Detection Panels distributed at various floors, in the LV shafts.
- Distributed on the floors are also the Voice and Fire Fighter's Telephone Command Centers, in direct peer-to-peer network with the Fire Alarm Panels.
- Every Staircase shall be provided with a Fire Fighter's telephone station comprising of a Firefighters telephone and jack, and a cabinet to house the same securely.
- Voice evacuation speakers to meet the sound pressure levels as decreed by NFPA 72, NFPA 101 shall be deployed in the entire complex. Exit sounders, which shall emit a distinct temporal sound signature to help occupant evacuate the floor shall be deployed at the Fire Exit Staircases.
- Digital Voice amplifiers shall be deployed on floor levels as per the attached schematics.
- Touch Screen Panels, which shall enable the Fire Fighters to have immediate first-hand information of any fire scenario, along with the facility to display auxiliary information which shall be programmed to facilitate firefighting, shall be deployed at the entrances to the individual sections of the building, as depicted in the Schematic.
- In Conclusion, a Truly Peer to Peer network of intelligent nodes shall be deployed to ensure life safety of the occupant of the building, and shall be programmed to ensure the fastest detection and safe evacuation of the occupants.
- The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
- The system shall be an active/interrogative type system where each addressable device is repetitively scanned, causing a signal to be transmitted to the main fire alarm control panel (FACP) indicating that the device and its associated circuit wiring is functional. Loss of this signal at the main FACP shall result in a trouble indication as specified hereinafter for the particular input.
- The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.

- The system shall be support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.
- Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.
- The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

## 2. SCOPE OF WORK

- 2.1 Intelligent reporting, microprocessor controlled fire detection cum Voice Evacuation system shall be installed in accordance with the specifications and drawings.

The basic system comprises of Main Addressable Intelligent fire alarm panels, Voice and Fire Fighters Telephone Command Systems, Network Repeaters, Touch Screen Displays, networked on a peer to peer network as the headend of the System.

The Low side of the System shall comprise of the initiating devices such as the smoke / Heat / Combination Sensors, Manual Pull Stations etc.

Notification Appliances shall include Hooter cum Strobes, Speakers and Speaker cum Strobes, Flashers, Alarm Bells etc.

All the above components shall be connected by interconnecting flexible copper cables, FRLS, PVC grade, laid in GI conduits, or Armoured Cable for physical protection.

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.

- 2.2 The system shall be designed such that each signaling line circuit (SLC) is limited to only 80% of its total capacity at initial installation.
- a. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
  - b. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
  - c. 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.
  - d. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.
  - e. Notification Appliance Circuits (NAC) speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone whichever is greater.
  - f. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.

- g. Notification Appliance Circuits (NAC) speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.
- h. Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.
- i. Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.
- j. Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.
- k. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B (Style Y), or two Class A (Style Z) circuits.
- l. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:
  - i. The digital amplifier shall automatically broadcast the stored audio message.
  - ii. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.
  - iii. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.
  - iv. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to seven (7) remote Fire Fighter's Telephone locations simultaneously on a telephone riser.
  - v. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.
  - vi. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of at least 16 or 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.

### 2.3 Basic System Functional Operation

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

- a. The System Alarm LED shall flash.
- b. A local piezo electric signal in the control panel shall sound.
- c. The 640-character 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.

- d. Printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
- e. 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.
- f. The audio portion of the system shall sound the proper audio signal (consisting of tone, voice, or tone and voice) to the appropriate zones.

### 3. CODES AND STANDARDS

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

A. Underwriters Laboratories Inc. (UL) - USA:

- No. 50 Cabinets and Boxes
- No. 268 Smoke Detectors for Fire Protective Signaling Systems
- No. 864 Control Units for Fire Protective Signaling Systems
- No. 268A Smoke Detectors for Duct Applications.
- No. 521 Heat Detectors for Fire Protective
- No. 228 Door Closers-Holders for Fire Protective Signaling Systems.
- No. 464 Audible Signaling Appliances.
- No. 38 Manually Actuated Signaling Boxes.
- No. 346 Water flow Indicators for Fire Protective Signaling Systems.
- No. 1481 Power supplies for Fire Protective Signaling Systems.
- No. 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems.
- No. 1971 Visual Notification Appliances.

NFPA CODE 70 (NEC)

NFPA 72 Fire Alarm Code

NFPA 101 Life Safety Code

B. National Building Code of India, 2005.

C. All requirements of the Authority Having Jurisdiction (AHJ).

### 3.1 APPROVALS

- 3.1.1 The system shall have proper listing and/or approval from the following nationally recognized agencies:

**UL Underwriters Laboratories Inc. / FM Factory Mutual**

- 3.1.2 The Fire Alarm Control Panel and all transponders shall meet the modular listing requirements of Underwriters Laboratories, Inc.
- 3.1.3 Each sub-assembly, including all printed circuits, shall include the appropriate UL modular label.
- 3.1.4 This includes all printed circuit board assemblies, power supplies, and enclosure parts. Systems that do not include modular labels may require return to the factory for system upgrades, and are not acceptable.

**4. PRODUCT / MATERIAL SPECIFICATIONS**

**4.1 General**

This section of the specification includes the furnishing, installation, and connection of a microprocessor controlled, analog addressable, intelligent fire alarm equipment required to form a complete coordinated system ready for operation.

It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings and specified herein.

The panel shall further extend fire and fault outputs, and on line data of status of all components, to the BMS for critical alarm monitoring, and it shall be possible to connect a interface card for open Protocol based (Commonly Bacnet Over IP, Modbus or eqv.) output to enable a software level integration with the BMS System.

The Panel shall be with integral voice evacuation cum Fire Fighters telephone system to relay evacuation messages in case of a fire emergency.

Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Central Monitoring Stations (Fire Command Center Room) and designated personnel, and if required, in other buildings at the site via a multiplex communication network.

The system shall also support independent gas release circuits for activation of various Fire Suppression systems, as required.

The system shall include hardware, modules to facilitate cross zoning of specific sensors, abort release functions, time delay and inputs for pressure switch and 24V output for Output operations.

The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

The main panel is to be located in the BMS Room on the Lower Basement Floor. All the other panels shall be distributed throughout the building complex, and shall be of multiple loops to accommodate all the sensors and devices with the spare loop capacity of 20% on every loop.

All the sensors and devices are connected to floor panels and all output circuits are activated from the same.

The Hooters cum Strobes / Speaker Strobes (Refer layout plans) are located at strategic locations to ensure audible alarm and voice messages reach every corner of the floor.

The panel shall be capable to zone all the sensors and devices and shall be able to activate outputs against activation of zone.

Wherever Applicable, The sensors located in Server Room shall be programmed in 2 separate zones per room to facilitate cross zoning, time delay and output to Gas Release system Panel in these rooms.

The panels shall be supplied with UPS power 230V AC and shall have its in-built battery backup and battery charger for 24 hours of standby operation, and the system shall be able to function for 30 minutes in full Alarm Condition, even during a Power Failure.

#### **4.2 Basic Performance:**

- Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 6 (Class A) Signaling Line Circuits (SLC).
- Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
- Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
- On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
- 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.

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.

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.

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.

The audio portion of the system shall sound the proper signal (tone or voice) to the appropriate zones.

The fire alarm system shall detect all changes in status of monitored points and shall initiate appropriate acts to alert/evacuate occupants, provide event annunciation and activate auxiliary controls as specified herein.

The system shall accept process and evaluate the following types of input signals:

- Automatic Fire Detectors
- Manual Alarms
- Supervisory (Tamper ) Condition
- Trouble

The system shall store a record of alarm, supervisory and trouble events in non-volatile history file. This file shall contain the most recent 1000 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 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, Multi criteria, Beam detectors 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 silenceble 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) tonight (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, signaling 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.

#### **4.3 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%



#### **4.4 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 10,000m<sup>2</sup>.

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-circuits 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 2,000m<sup>2</sup>, 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.

#### **4.5 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.

#### **4.6 SYSTEM COMPONENTS**

##### **4.6.1 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.

#### **4.6.2 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 signaling (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.

#### **4.6.3 CABLING**

All fire alarm system wiring must be as specified here in.

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 signaling line circuits, for notification appliance circuits.

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

FRLS armoured cable with Copper conductor having cross-linkable halogen free Ethylene Propylene Rubber (EPR) insulation and LSZH inner & outer sheath. Basic design as per BS 7846, IEC-502, IEC-61034. Fire performance tests as per BS 8491:2008 Cat.3 (120 mins) for above 20 mm overall dia & for below 20 mm overall dia as per BS 6387 C.W.Z. & BS EN 50200 PH-120 + Annex-E. BRE GLOBAL / LPCB certified.

#### **4.6.4 FIRE ALARM CONTROL PANEL OR NETWORK NODE**

The main FACP Central Console shall be a suitable to accommodate required number of devices having 1 Loop as spare for detectors & devices as well. It shall contain a microprocessor based Central Processing Unit (CPU).

The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, panel modules including initiating circuits, control circuits, and notification appliance circuits, local and remote operator terminals, printers, annunciators, and other system controlled devices.

In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:

- Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

- Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
- Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.
- Visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.

When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

- The system alarm LED shall flash.
- A local piezo-electric audible device in the control panel shall sound a distinctive signal.
- The backlit 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.
- Printing and history storage equipment shall log and print the event information along with a time and date stamp.
- All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

When a trouble condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

The system trouble LED shall flash.

- A local piezo-electric audible device in the control panel shall sound a distinctive signal.
- The LCD display shall indicate all information associated with the trouble condition, including the type of trouble point and its location within the protected premises.
- Printing and history storage equipment shall log and print the event information along with a time and date stamp.
- All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (trouble notification appliances and/or relays) shall be activated.

When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

- The system trouble LED shall flash.
- A local piezo-electric audible device in the control panel shall sound a distinctive signal.
- The LCD display shall indicate all information associated with the supervisory condition, including the type of trouble point and its location within the protected premises.

- Printing and history storage equipment shall log and print the event information along with a time and date stamp.
- All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

When a security alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

- The system security LED shall flash.
- A local piezo-electric audible device in the control panel shall sound a distinctive signal.
- The backlit 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.
- Printing and history storage equipment shall log and print the event information along with a time and date stamp.
- All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

When a pre-alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

- The system pre-alarm LED shall flash.
- A local piezo-electric audible device in the control panel shall sound a distinctive signal.
- The backlit 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.
- Printing and history storage equipment shall log and print the event information along with a time and date stamp.
- All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

#### **4.6.5 Operator Control**

##### **4.6.5.1 Acknowledge Switch:**

- a) 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.
- b) Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
- c) 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.

#### **4.6.5.2 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.

#### **4.6.5.3 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.

#### **4.6.5.4 Lamp Test**

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.

#### **4.6.5.5 Scroll Display 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.

#### **4.5.5.6 Print Screen**

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

### **4.6 System Capacity and General Operation**

- 4.6.1 The control panel shall be capable of expansion via up to 10 SLC modules. Each module shall support a maximum of 318 analog/addressable devices for a maximum system capacity of 3180 points. The system shall be capable of 3072 annunciation points per system regardless of the number of addressable devices and shall support up to 96 panel circuits which may consist of either inputs or outputs.
- 4.6.2 The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit liquid crystal display, individual, color coded system status LEDs, and a QWERTY style alphanumeric keypad for the field programming and control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either the owner or installing company.
- 4.6.3 All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.
- 4.6.4 The FACP shall be able to provide the following software and hardware features:
- a) Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If

the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.

- b) Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.
- c) Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.
- d) Action: If programmed for action, and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on alarm level.
- e) The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
- f) Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.
- g) NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the requirements of NFPA 72.
- h) Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.
- i) On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop.
- j) History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.
- k) Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.
- l) The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.
- m) Drill: The system shall support means to activate all silenceable fire output circuits in the event of a practice evacuation or "drill". If enabled for local control, the front panel switch shall be held for a minimum of 2 seconds prior to activating the drill function
- n) Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.
- o) Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions

- p) Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.
- q) Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.
- r) Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.
- s) Print Functions: The system shall provide means to obtain a variety of reports listing all event, alarm, trouble, supervisory, or security history. Additional reports shall be available for point activation for the last Walk Test performed, detector maintenance report containing the detector maintenance status of each installed addressable detector, all network parameters, all panel settings including broad cast time, event ordering, and block acknowledge, panel timer values for Auto Silence, Silence Inhibit, AC Fail Delay time and if enabled, Proprietary Reminder, and Remote Reminder timers, supervision settings for power supply and printers, all programmed logic equations, all custom action messages, all non-fire and output activations (if pre-programmed for logging) all active points filtered by alarms only, troubles only, supervisory alarms, pre alarms, disabled points and activated points, all installed points filtered by SLC points, panel circuits, logic zones, annunciators, releasing zones, spal zones, and trouble zones.
- t) Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.
- u) Resound based on type for security or supervisory: The system shall indicate a Security alarm when a monitor module point programmed with a security Type Code activates. If silenced alarms exist, a Security alarm will resound the panel sounder. The system shall indicate a Supervisory alarm when a monitor module point programmed with a supervisory Type Code activates. If there are silenced alarms, a Supervisory alarm will resound the panel sounder.
- v) Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.
- w) Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.
- x) Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector to up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result or product of all cooperating detectors chamber readings.
- y) Tracking/Latching Duct (ion and photo): The system shall support both tracking and latching duct detectors either ion or photo types.
- z) ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer

and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.

- aa) NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.
- bb) Security Monitor Points: The system shall provide means to monitor any point as a type security.
- cc) One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.
- dd) Control by Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.
- ee) Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.
- ff) 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.
- gg) 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.
- hh) 10 trouble equations per device: The system shall provide support for up to 10 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.
- ii) Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.
- jj) Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zones with four abort options to satisfy any local jurisdiction requirements.
- kk) Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector or indicating panel module input. The timer function shall delay an alarm signal for a user-specified time period and the



control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. It shall also be possible to set a maximum verification count between 0 and 20 with the "0" setting producing no alarm verification. When the counter exceeds the threshold value entered, a trouble shall be generated to the panel.

#### **4.6.5 Central Processing Unit**

- a. The Central Processing Unit shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the Central Processing Unit.
- b. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.
- c. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.
- d. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
- e. Consistent with UL864 standards, the CPU and associated equipment are to be protected so that voltage surges or line transients will not affect them.
- f. Each peripheral device connected to the CPU shall be continuously scanned for proper operation. Data transmissions between the CPU and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques.
- g. The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
- h. The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.
- i. The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.
- j. The CPU shall provide one high-speed serial connection for support of network communication modules.
- k. The CPU shall provide double pole relays for FIRE ALARM, SYSTEM TROUBLE, SUPERVISORY, and SECURITY. The SUPERVISORY and SECURITY relays shall provide selection for additional FIRE ALARM contacts.

#### **4.6.6 Display**

- a. The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.
- b. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
- c. The system display shall provide a backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide ten Light-Emitting-Diodes (LEDs) that indicate the status of the following system

parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, and CPU FAILURE.

- d. The system display shall provide a QWERTY style keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.
- e. The system display shall include the following operator control switches: ACKNOWLEDGE, SIGNAL SILENCE, RESET, DRILL, and LAMP TEST. Additionally, the display interface shall allow scrolling of events by event type including, FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and OTHER EVENTS. A PRINT SCREEN button shall be provided for printing the event currently displayed on the 2 X 40-character LCD.

#### **4.6.7 Loop (Signaling Line Circuit) Control Module**

- a. The Loop Control Module shall monitor and control a minimum of 318 intelligent addressable devices. This includes 159 intelligent detectors (Ionization, Photoelectric, or Thermal) and 159 monitor or control modules.
- b. 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.
- c. 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.
- d. 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.
- e. 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.

#### **4.6.8 Enclosures**

- a. 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.
- b. The back box and door shall be constructed of 0.060 steel with provisions for electrical cables connections into the sides and top.
- c. 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.
- d. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

#### **4.6.9 Digital Voice Command Center**

4.6.9.1 The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.

4.6.9.2 Function: The Voice Command Center equipment shall perform the following functions:

- a. Operate as a supervised multi-channel emergency voice communication system.
- b. Operate as a two-way emergency telephone system control center.
- c. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
- d. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
- e. Provide all-call Emergency Paging activities through activation of a single control switch.
- f. As required, provide vectored paging control to specific audio zones via dedicated control switches.
- g. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
- h. Provide a software utility capable of off-line programming for the VCC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the VCC shall not inhibit the emergency operation of other nodes on the fire alarm network.
- i. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SCL controlled switching.
- j. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
- k. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

#### **4.6.10 Power Supply:**

- a. The Addressable Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.
- b. The Addressable Main Power Supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.
- c. The Addressable Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 25-200 amp-hours within a 48-hour period.
- d. The Addressable Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.

- e. The Addressable Main Power Supply shall be power-limited per UL864 requirements.

#### **4.6.11 Auxiliary Field Power Supply - Addressable**

- a. 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.
- b. 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 powers 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.
- c. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as two Classes "A" and two Class "B" or four Class "B" only circuits. All circuits shall be power-limited per UL 864 requirements.
- d. 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.
- e. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.
- f. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling 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.
- g. 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.
- h. 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.
- i. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be Dip-switch selectable.
- j. The addressable power supply mounts in either the FACP back box or its own dedicated surface mounted back box with cover.
- k. 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.
- l. 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.

- m. When selected for Notification Appliance Circuits, the output circuits shall be individually DIP-switch selectable for Steady, March Time, Dual Stage or Temporal.
- n. 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.
- o. 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.
- p. 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.

#### **4.6.12 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.

- a. 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.
- b. 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.
- c. The FCPS shall include an attractive surface mount back box.
- d. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.
- e. The FCPS include power limited circuitry, per 1995 UL standards.

#### **4.6.13 System Circuit Supervision**

- a. 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.
- b. Transponders that lose communication with the CPU shall sound an audible trouble and light an LED indicating loss of communications.
- c. Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall be supervised for off-normal position.
- d. 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).

#### **4.6.14 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

#### 4.6.15 Audio Amplifiers

1. The Audio Amplifiers will provide Audio Power (@25 Volts RMS) for distribution to speaker circuits.
2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:
  - Earth Fault on DAP A (Digital Audio Port A)
  - Earth Fault on DAP B (Digital Audio Port B)
  - Audio Amplifier Failure Detected Trouble
  - Active Alarm Bus input
  - Audio Detected on Aux Input A
  - Audio Detected on Aux Input B
  - Audio Detected on Firefighter's Telephone Riser
  - Receiving Audio from digital audio riser
  - Short circuit on speaker circuit 1
  - Short circuit on speaker circuit 2
  - Short circuit on speaker circuit 3
  - Short circuit on speaker circuit 4
  - Data Transmitted on DAP A
  - Data Received on DAP A
  - Data Transmitted on DAP B
  - Data Received on DAP B
  - Board failure
  - Active fiber optic media connection on port A (fiber optic media applications)
  - Active fiber optic media connection on port B (fiber optic media applications)
  - Power supply Earth Fault
  - Power supply 5V present
  - Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble

The audio amplifier shall provide the following built-in controls:

- Amplifier Address Selection Switches
  - Signal Silence of communication loss annunciation Reset
  - Level adjustment for background music
  - Enable/Disable for Earth Fault detection on DAP A
  - Enable/Disable for Earth Fault detection on DAP A
  - Switch for 2-wire/4-wire FFT riser
5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
  6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
  7. System shall be capable of backing up digital amplifiers.

#### **4.6.16 240W/250W Analogue Amplifier**

- Related output power – 240W/250W
- Main Power supply Voltage -- AC 220V -15% ~ +10% 50~60Hz
- Backup Power Supply Voltage – AC 220V -15% ~ +10% 50~60Hz
- Main Power supply fuse T10AL 250V
- Loudspeaker Output – 100V/70V
- Frequency Response – 70 ~ 15 KHz (+1dB~ -3dB)
- SNR 90Db

#### **4.6.17 6W Ceiling/Wall Mounted Speaker**

- 6W ceiling speaker with Max SPL1M/1W 96dB. Frequency response of 80Hz-20KHz with dispersion angle of 160deg. The speaker should have tappings at 6W/3W/1.5W
- Max Power 9W
- Rated Power 6 W
- Power taps @ 100V – 6W/3W/1.5W
- Sound pressure level at 6W/1W (4KHz, 1m) – 96dB /88dB
- Frequency Range -80Hz -20 KHz 10dB
- Dispersion angle (1KHz /-6dB) - 160°
- Related Input Voltage – 100 V /70V
- Rated impedance Connection 1.7K $\Omega$  / 3.3 k $\Omega$

- Dimensions ( $\Phi$  x H) -  $\Phi$ 180 mm x 55 mm
- Hole cut-out size 150mm
- Size of speaker – 5”
- Colour – White (RAL 9010 )
- Weight of Magnet – 117g

**4.6.18 Armored 2 Core Cable**

- Continuous length of 2 Core ,
- 1.5 sq. mm dia strip
- Armoured, PVC insulated ,
- PVC Sheathed Cable

**4.6.19 Laying of 2 Core Armored Cable**

- It is proposed to lay the 2 core Armoured cable in order to commission the Public Address System.
- The approximate length of the 2 Core Armored cable which is supplied by the contractor to be laid in metres as per BOQ.

**4.6.20 Audio Message Generator (Prerecorded Voice)/Speaker Control:**

- a. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
- b. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.
- c. A built-in microphone shall be provided to allow paging through speaker circuits.
- d. System paging from emergency telephone circuits shall be supported.
- e. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:

LED Indicators:

- Lamp Test
- Trouble
- Off-Line Trouble
- Microphone Trouble
- Phone Trouble



- Busy/Wait
- Page Inhibited
- Pre/Post Announcement Tone

**4.6.21 Controls with associated LED Indicators:**

- a. Speaker Switches/Indicators
  - i. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
  - ii. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.
- b. Emergency Two-Way Telephone Control Switches/Indicators
  - i. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
  - ii. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

**4.6.22 Remote Transmissions:**

- s. Provide local energy or polarity reversal or trip circuits as required.
- b. 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.
- c. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.
- d. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

**4.6.23 System Expansion**

Design the main FACP and transponders so that the system can be expanded in the future (to include the addition of twenty percent more circuits or zones) without disruption or replacement of the existing control panel. This shall include hardware capacity, software capacity and cabinet space.

**4.6.24 Field Programming**

- a. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
- b. It shall be possible to program through the standard FACP keyboard all system functions.
- c. All field defined programs shall be stored in non-volatile memory.
- d. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level shall be used for status level changes such as point/zone disable or manual on/off commands (Building Manager). A second (higher-level) shall be used for actual change of the life safety

program (installer). These passwords shall be five (5) digits at a minimum. Upon entry of an invalid password for the third time within a one minute time period an encrypted number shall be displayed. This number can be used as a reference for determining a forgotten password.

- e. The system programming shall be "backed" up on a 3.5" floppy diskette utilizing an upload/download program. This system back-up disk shall be completed and given in duplicate to the building owner and/or operator upon completion of the final inspection. The program that performs this function shall be "non-proprietary", in that, it shall be possible to forward it to the building owner/operator upon his or her request.

The installer's field programming and hardware shall be functionally tested on a computer against known parameters/norms which are established by the FACP manufacturer. A software program shall test Input-to-Output correlations, device Type ID associations, point associations, time equations, etc. This test shall be performed on an IBM-compatible PC with a verification software package. A report shall be generated of the test results and two copies turned in to the engineer(s) on record.

#### 4.6.25 Specific System Operations

- 1) 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.
- 2) 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 any time 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.
- 3) 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.

- 4) System output points shall be capable of being turned on or off from the system keypad or the video terminal.
- 5) 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 personal when a detector is at 80% of its alarm threshold in a 60 second period.

### **Addressable Devices**

- 1) Addressable devices shall provide an address-setting means using rotary decimal switches / Soft Programming.
- 2) Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type address switches.
- 3) Detectors shall be analog and Addressable, and shall connect to the fire alarm control panel's Signaling Line Circuits.
- 4) 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.
- 5) 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.
- 6) 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.
- 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).

#### **Manual Call Points**

- The Manual call points(MCP) used in the building shall confine to the relevant standard shaving the following features
- Manual call points shall be of Double action - break glass type with Push Button.
- The mounted arrangement shall be such that it can be either surface mounted or flush mounted
- Each addressable MCP will comprise of an electronic circuit built in to it to provide addressing capability.
- The MCPs shall be provided with inbuilt fault isolator. (The bidder shall consider an external isolator if not inbuilt)
- The MCP shall have a LED to indicate Alarms
- The MCP shall be UL&FM approved list

#### **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 Self Acclimatizing Multi Sensor Detector**

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 it's 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 smoldering 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 signaling line circuit.

#### **Intelligent Duct Smoke Detector**

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

#### **Addressable Dry Contact Monitor Module**

- 1) 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.
- 2) The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.
- 3) 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.
- 4) 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**

- 1) 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 contract relay.
- 2) 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.
- 3) 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.
- 4) 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.
- 5) 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 backbox. 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.

#### **LCD Alphanumeric Display Annunciator:**

The alphanumeric display annunciator shall be a supervised, back-lit LCD display containing a minimum of 160 characters for alarm annunciation in clear English text.

The LCD annunciator shall display all alarm and trouble conditions in the system.

Up to 32 LCD annunciators may be connected to an EIA 485 interface. LCD annunciators shall not reduce the annunciation or point capacity of the system. Each LCD shall include vital system wide functions such as, System Acknowledge, Silence and Reset.

LCD display annunciators shall mimic the main control panel displays and shall not require special programming.

The LCD annunciator shall have switches which may be programmed for System control such as, Global Acknowledge, Global Signal Silence and Global System Reset. These switch inputs shall be capable of being disabled permanently or by a key lockout function on the front plate.

#### **Beam Detector**

The System Sensor beam detectors are four wires conventional reflected beam smoke detectors. It shall be used with UL Listed compatible fire alarm control panels only. Installation of the single-ended reflective design is much quicker than a dual ended projected beam detector. Alignment is easily accomplished with an optical sight and a two-digit signal strength meter incorporated into the beam detector. Listed for operation from -22°F to 131°F. The beam detectors are a transmitter/receiver unit and a reflector. When smoke enters the area between the unit and the reflector, it causes a reduction in the signal strength. When the smoke level (signal strength) reaches the predetermined threshold, an alarm is activated. The detectors have four standard sensitivity selections as well as two Acclimate® settings. When either Acclimate® setting is selected, the detector will automatically adjust its sensitivity using advanced software algorithms to select the optimum sensitivity for the specific environment. The beam detector has an integral sensitivity test feature of a filter attached to a servomotor inside the detector optics.

#### **Features**

- Transmitter/receiver built into same unit.
- Six user-selectable sensitivity levels.
- 16' to 328' protection range.
- Removable plug-in terminal blocks.
- Digital display for easy alignment.

- Built-in automatic gain control compensates for signal deterioration from dust buildup.
- Paintable cover.
- Optional remote test station.
- Optional long-range kit for applications in excess of 230' (70 m).
- Optional multi-mount kit providing ceiling or wall mounts capability with increased angular adjustment.
- Optional heater kits for prevention of condensation Optional heavy-duty mounting bracket

#### **Serially Connected Annunciator Requirements**

1. The annunciator shall communicate to the fire alarm control panel via an EIA 485 (multi-drop) two-wire communications loop. The system shall support two 6,000 ft. EIA-485 wire runs. Up to 32 annunciators, each configured up to 96 points, may be connected to the connection, for a system capacity of 3,072 points of annunciation.
2. An EIA-485 repeater shall be available to extend the EIA-485 wire distance in 3,000 ft. increments. An optional version shall allow the EIA-485 circuit to be transmitted over Fiber optics. The repeater shall be UL864 approved.
3. Each annunciator shall provide up to 96 alarm and 97 trouble indications using a long-life programmable color LED's. Up to 96 control switches shall also be available for the control of Fire Alarm Control Panel functions. The annunciator will also have an "ON-LINE" LED, local piezo sounder, local acknowledge and lamp test switch, and custom zone/function identification labels.
4. The annunciator may be field configured to operate as a "Fan Control Annunciator". When configured as "Fan Control," the annunciator may be used to manually control fan or damper operation and can be set to override automatic commands to all fans/dampers programmed to the annunciator.
5. Annunciator switches may be programmed for System control such as, Global Acknowledge, Global Signal Silence, Global System Reset, and on/off control of any control point in the system.
6. An optional module shall be available to utilize annunciator points to drive EIA-485 driven relays. This shall extend the system point capacity by 3,072 remote contacts.
7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above

#### **Battery**

- 1) Shall be 12 volt, Lead Acid Maintenance free type.
- 2) Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 30 minutes of alarm upon a normal AC power failure.
- 3) The batteries are to be completely maintenance free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.

**Battery Charger**

- 1) Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 240-volt 50/60 hertz source.
- 2) Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
- 3) Shall have protection to prevent discharge through the charger.
- 4) Shall have protection for overloads and short circuits on both AC and DC sides.

**Speakers:**

1. All speakers shall operate on 25 VRMS or with field selectable output taps from 0.5 to 2.0 Watts.
2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).
3. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
4. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.

**Audible/Visual Combination Devices:**

1. Shall meet the applicable requirements of Section A listed above for audibility.
2. Shall meet the requirements of Section B listed above for visibility.

**Addressable Relay Module:**

Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0Amps inductive. 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.

**Sounder (Hooter) Cum Strobe:**

- The Sounder used in this Building shall confine to the relevant standards having the following features
- The Sounder shall be a Addressable sounder.(Bidder shall consider external power supply, cable, conduits, modules required for activating externally powered sounder and include the costing as part of the item –Sounders)
- The Sounder shall have inbuilt fault isolator module.(bidder shall consider external isolators if not inbuilt)
- The Sounder shall either be addressed by Dip switch or by the Panel.
- The Sounder shall be placed in the detection loop only and a separate loop or cables or sounders shall not be used
- The sounder shall have a sound pressure level of 90dB and the volume shall be adjusted from the Fire Alarm Panel



- The sounder shall be tested and maintained with ease from the FACP
- The Volume levels for Testing and Drill shall be programmed as per site conditions.
- The Sounder shall be capable of either accommodating a Flasher or a Detector and shall work as Sounder cum strobe or Sounder cum detector base.
- The Sounder shall have a feature of synchronizing with other sounder in the loop.
- The Strobe used in this Building shall confine to the relevant standards having the following features
- The Strobe shall have are d flash light and shall flash at minimum of 1Hz
- The Strobe shall also be part of Testing and Drill and shall be programmed as persite conditions.
- The Strobe shall consume a minimal current of 10mA and thus allowing connecting at least 10 strobes in the same loop.
- The Strobe shall be capable of either fixing it in a Sounder and shall work as Sounder cum strobe as per site conditions.
- The Sounder cum strobe shall be UL&FM approved list

**Strobe lights:-**

Shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.

**Alphanumeric LCD Type Annunciator:**

1. 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.
2. The LCD annunciator shall display all alarm and trouble conditions in the system.
3. An audible indication of alarm shall be integral to the alphanumeric display.
4. The display shall be UL listed for fire alarm application.
5. 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.
6. 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.
7. 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.

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

**Fixed Emergency Telephone Handset**

1. The telephone cabinet shall be painted red and clearly labeled as "Emergency Telephone." The cabinets shall be located where shown on drawings.
2. The handset cradle shall have a switch connection so that lifting the handset off of the cradle shall send a signal to the fire command center, which shall audibly and visually indicate its on-line (off-hook) condition.
3. On activating the remote phone, the phone earpiece shall sound a telephone ring signal until the master handset is lifted.
4. The two-way emergency telephone system shall support a minimum of seven (7) handsets on line without degradation of the signal.

**Interactive Touch Screen Display:**

This specification includes the furnishing, installation, connection, and testing of an interactive firefighters' display; including Underwriters Laboratories (UL) listed application software and hardware complete and ready for operation. The basic system shall be Underwriters Laboratories (UL) listed for :No. 864 Control Units or Fire Protective Signaling Systems (Ancillary listing)

An interactive firefighters' display shall be installed in accordance to the project specifications and drawings. The interactive firefighters' display system shall include, but not be limited to, a touch screen interface, network communications media, power supplies, and wire / fiber optic media as shown on the drawings and specified herein.

The interactive firefighters' display shall support fire alarm, supervisory, and security events from the fire alarm control panel(s). The interface shall display building floor plans with respective active fire alarm devices, water supplies, evacuation routes, access routes, gas, power and HVAC shutoffs, chemical hazards, and structural hazards in the building.

The system shall include an easy one-touch method of viewing building, emergency contacts, the facility site plan, and active event information. A supervised interface to fire alarm control panels and network shall be made available. The system shall be electrically supervised and monitor the integrity of all conductors.

**Fire Fighter's Display: Performance requirements**

- A. The network will interface and report the individually monitored system's alarm status via a user-friendly Graphical User Interface (GUI) based software.
- B. The software shall operate under Microsoft® Windows® XP Embedded platform as manufactured by Microsoft Corporation.
- C. The GUI based software must be capable of graphically representing the facility being monitored with floor plans and icons depicting the actual locations of the fire alarm device locations.
- D. The software shall use a 1280 pixel x 1024 pixel GUI display capable of showing a large primary floor plan display, a site plan representative of an aerial view of the facility, the first active fire alarm on the system.
- E. The software shall permit automatic navigation to the screen containing an icon that represents the first fire alarm device in alarm in the event of an off-normal condition.

- F. The fire alarm device icon shall be visible only when it is in an alarm (or active) condition.
- G. The software shall display the activated smoke detectors in a time sequence to track smoke progression.
- H. The software shall allow the importation of externally developed floor plans in Windows Metafile (WMF), JPEG (JPG), Graphics Interchange Format (GIF) and Bitmap (BMP) format.
- I. The software shall provide a intuitive and easy way to navigate to different screens representing floors and areas within a facility.
- J. The system shall provide for continuous monitoring of all fire alarm conditions regardless of the current activity displayed on the screen.
- K. The software shall display "YOU ARE HERE" along with icons representing standard building objects (stairs, elevators, etc.) to be shown on the floor plan.
- L. The software shall allow icons that represent hazardous materials stored in a facility.
- M. The software shall provide a screen that displays preprogrammed building contact information.
- N. The software shall provide a screen the displays building occupancy and other general building information.
- O. The software shall allow a site plan to be imported that shows an aerial view of the facility.
- P. The software shall display all active fire, supervisory, and security events within an event list.
- Q. The system shall operate on an UL listed Embedded platform operating at no less than 700 MHz on the Microsoft® Windows® XP Embedded platform.
- R. The Embedded platform shall have: no less than 256 megabytes of RAM, a flash drive with no less than 1 Gigabytes of storage space, 100 Base-T Ethernet NIC card, and USB ports.
- S. The Embedded platform shall have a minimum 19" touchscreen display.
- T. The Embedded platform shall come equipped with all necessary gateway modules to allow connection to the network it monitors as standard equipment.
- U. A UL listed Ethernet Hub shall be provided for connection of multiple interactive displays and/or gateways.

#### **MONITORING NETWORK**

- A. The monitoring network shall consist of a network based on proven ARCNET® technology.
- B. The network shall have the ability to use fiber optic cable (single-mode and multi-mode), wire (twisted pair copper media in a style 4 or style 7 configuration), or combination wire/fiber communications with support of up to 103 nodes.
  - 1. Wire networks shall support 12 AWG, 1 Pair Shielded to 24 AWG, 4 Pair Unshielded following the manufacturer's guidelines.
  - 2. Fiber optic networks shall support 62.5/125µm cable 8dB limit (50/125µm cable 4.2dB limit)
  - 3. Wire to fiber conversions using repeaters

- C. High-speed data communications (312,500 BPS).
- D. True peer-to-peer communications between fire alarm control panels.

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- C. High-speed data communications (312,500 BPS)
- D. True peer-to-peer communications.

#### **INTEGRATION NETWORK**

- A. The integration network shall be capable of monitoring a minimum of 100 nodes (Network Input/output Nodes and routers) on an integration gateway consisting of, but not limited to:
  - 1. Intelligent or conventional fire alarm control panels.
  - 2. Competitor's intelligent or conventional fire alarm control panels.
- B. Up to 99 gateways shall be connected via Ethernet for a total local area combination of up to 12672 (99x128) nodes.
- C. Local area networks shall consist of a free topology network using twisted pair copper media in a bus, star, T-tap, or ring style 7 configurations at 78 Kilo baud.

Transmit/receive twin fiber (multi-mode 62.5/125 µm) strand FT-10 point-to-point topology and bi-directional FO-10 networks shall also be available. Wide area networks shall be supported by the use of network expansion routers.

- 1. Free topology (FT-10 style) wire network run allows multiple T-taps within a 1,500-foot (457.2 m) radius; 8,000 foot (2438.4 m) point-to-point using twisted pair; or 6,000-foot (1828.8 m) bus topology.
  - 2. Free topology (FT-10 style) fiber network can also use fiber-optic cabling. Operates at 78.5 Kbaud.
  - 3. Fiber optic (FO-10 style) network allows bus or ring topology using only fiber-optic cabling; node-to-node distance of over 10,000 feet (3048 m) with message regeneration. FO-10 style operates at 1250 Kbaud and utilizes multi-mode bi-directional fiber media (single fiber strand) in a bus or loop configuration.
- D. Provide routers, repeaters or bridges where required to increase distance, alter network configuration or change media or to extend to remote facilities over alternate communications media including UL listed dial-up PSTN telephone, leased line, multimode fiber or Ethernet connectivity.
  - 1. Dial-up units shall dial a local number and stay connected. Upon loss of carrier, a

- supervisory alarm shall be indicated at the workstation and the units shall automatically redial to connect.
2. Network expansion routers shall support public switched telephone circuits, two-wire or four-wire leased lines, and CAT5 Ethernet networks.
- E. Network interface software shall be by the same manufacturer as the hardware portion of this specification.
- F. The integration network shall utilize Network Input / Output Nodes to interface between the individual buildings' systems to be monitored by the integration network. The Network Input/output Nodes shall act as a translator from the building system's specific panel communications protocol to the integration network protocol as well as serve as a transceiver from the building system panel to the integration network.
1. Network Input/Output Nodes shall be available in configurations that will allow transparent communications via RS 232 serial data ports with intelligent fire alarm control panels, security systems, and CCTV systems.
  2. Network Input/Output Nodes shall be available in configurations that will allow monitoring of dry contacts, switched voltages, conventional security devices, access control panels and conventional fire alarm control panels using scheduled, automated and manual control.
  3. Network Input/ Output Nodes shall be UL listed to Standard 864 and 1076 and be provided with their own enclosure or be available in chassis mount configurations.
  4. Network Input/output Nodes shall operate at 24 VDC and obtain their power from the monitored control panel or a UL listed battery backed auxiliary power supply. All terminals shall be transient protected to 2400V and LEDs shall be provided for status, service and diagnostics.
- G. Digital Alarm Communicator Receiver Network
1. The system shall provide a digital alarm communicator receiver (DACR) gateway with a RS 232 interface to the following digital alarm communicator receivers for wide area event reporting: Ademco 685, Silent Knight 9500 and 9800, Radionics 6600.
  2. Each gateway shall support up to 10 digital alarm communicator receivers for alarm and trouble information from reporting devices.
- H. Workstation Network:
1. Computers shall be networked using Ethernet supporting the use of TCP/IP protocol for local area systems.
  2. The network shall be capable of supporting multiple clients (e.g., workstations, configuration applications, automated response applications) and up to ninety-nine (99) gateways.
  3. A UL listed Ethernet Hub shall be provided for connection of multiple workstations, gateways, clients, and/or network printers.
  4. System shall be UL listed to communicate between clients and gateways over a business computer network (shared IP).

**PC Graphical Station: System Setup & Configuration :**

- A. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes.
- B. The factory trained technician shall install initial data and artwork at each workstation including:
- C. Distribution of monitoring, control and security profiles as requested by owner.
- D. Area diagrams, floor plans, key maps and screen titles.
- E. Auto-navigation criteria.
- F. Guidance text as provided by owner.

**SUBMITTALS AND DOCUMENTATION**

Pre Commissioning

Prior to handover, the Contractor shall furnish with 'as fitted' drawings / wiring diagrams.

'As fitted' drawings shall indicate the layout of all equipment, layout of aspirating smoke detector pipework, cable routes and cable sizes/types used. Wiring schematics, including cable termination details, shall also be provided by the Contractor.

'As fitted' CAD drawings shall be prepared using a software package capable of providing dwg format and two electronic copies shall be made available in that format. Also, four sets of A0 prints shall be provided to the Engineer.

Prior to handover, the Contractor shall also furnish GSI with O&M manuals. In addition to the manufacturer's technical data sheets on all components of the system and standard operating and maintenance instructions, the O&M manuals shall include specially written sections covering the specific operation of the system and any special maintenance requirements.

Three printed copies of the O&M manuals shall be supplied along with a copy in electronic form in a format that is computer readable, e.g. the Microsoft Office™ range of software i.e. Word™, Excel™, etc.

The following documentation shall also be provided at handover:

- The site-specific software as loaded into each control panel, to be supplied in both electronic format and printed listing for secure storage on site by GSI.
- Alarm audibility and/or intelligibility information. (This can be recorded on the 'as fitted' drawings.)
- Test results for all system wiring.
- Commissioning testing results/listings.
- Standby battery calculations.

#### Contract Documentation

The Fire Alarm contractor shall provide a complete set of documents describing the system and its design concepts, installation, final testing, commissioning, and required operating and maintenance procedures.

As a minimum, the following documentation shall be provided for the system:

1. System description.
2. Checklist of equipment and components.
3. Installation instructions.
4. Equipment connection diagrams showing wiring detail of Addressable Device positions with addresses.
5. Standby battery calculations showing system power requirements and formulas used to calculate specified power.
6. Final testing instructions.
7. Commissioning instructions.
8. Certification documents.
9. Log book.
10. System operating instructions.
11. Routine maintenance instructions and schedules.
12. Remote monitoring link description and operating instructions (if this option is being provided).

As a minimum, the following drawings shall be provided for the system:

1. System schematic diagram.
2. Cabling and wiring diagram.
3. Detailed equipment connection diagrams.
4. Building plan showing zoning and location of fire controller, detectors, call points, sounders and ancillary devices.

The Fire Alarm contractor shall provide a complete set of system operating and service manuals for the following:

1. Fire controller
2. Detectors
3. Call points
4. Sounders
5. Ancillary devices
6. Remote monitoring link (if this option is being provided).

The date for submission of all documentation shall be in accordance with the schedule provided by the Fire Alarm contractor and as agreed with the customer.

## **5. AS-BUILT DRAWINGS & OPERATING MANUALS**

5.1 The Contractor shall submit As-Built drawings that have been reviewed and deemed satisfactory by the Engineer. Final submission shall include four (4) sets of A1 size, one set of A3 size and two sets of electronic copy (AutoCAD files) on CD-ROM disc.

5.2 The Contractor shall submit three (3) copies of an operating manual that have been reviewed and deemed satisfactory by the Engineer

The manual should include:

- General description of equipment and system.
- Operating instruction for all equipment and system.
- Schedule of equipment clearly stating the type, make, model, serial number, quantity, capacity, location and date of installation.
- Manufacturer's literature including catalogues, wiring diagrams, technical description, etc.
- Recommended frequency and detailed task list for routine maintenance for each system and equipment
- Final factory and site testing results for each equipment and each system with signatures of witnesses.
- Emergency contact lists for 24-hour, 365-days including duty and backup personnel.

5.3 Closes-Out Documents

- a. Submit final copies of the shop drawings outlined as above. These final submittals shall reflect all field modifications and change orders required to complete the installation. Submit the following quantities of record submittal drawings immediately following receipt of notification of substantial completion. Auto CAD drawing or VISIO files of all shop drawings on or CD ROM disks.
- b. Three complete sets of documents located in a Spiral Bound notebook and organized by subject with divider tabs.

## **6. CLOSEOUT MINIMUM REQUIREMENTS**

The Life Safety Contractor shall ensure the following are completed at hand-over:

- a. Any snagging to be documented and agreed date determined for clearance.
- b. All passwords/PIN numbers, levels and operators recorded.
- c. Disk copies of all system and data files supplied.
- d. Proprietary software manuals & disks.
- e. Consumables, printer ribbons, printer paper at agreed levels.
- f. All equipment access keys handed over.



g. Complete sets of O&M manuals left with system, any agreed amendments/additions required to be documented and a target date for completion agreed.

h. Training of engineers and operators to be checked complete or program for completion agreed.

**7. FINAL INSPECTION:**

At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

**8. INSTRUCTION:**

Provide instruction as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

**9. QUALITY ASSURANCE**

**General**

a. The Life Safety System shall be furnished, engineered, and installed by Trained Engineers of the Contractor.

b. The contractor shall have extensive knowledge in the System Network Integration or shall be a factory trained and certified Integrator.

c. The contractor shall employ technicians who have completed the factory authorized training. The contractor shall employ technicians to provide instruction, routine maintenance, and emergency service within 24 hours upon receipt of request.

**10. 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 Armoured with conductor not less than area 1.5mm<sup>2</sup> 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 coloured shrouds of the appropriate British Standard colour.

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 coloured red and clearly labeled '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 labeled as part of the fire detection and alarm system.

## 11. TESTING AND COMMISSIONING, TRAINING

Initial testing can be carried out as per following but not limiting to :-

Sr. No.	Description	Visual	Test Readings	Documentation
1	All cables are tested for continuity, insulation, resistance etc.			√
2	Carry out visual checks on all panels, cables, interphase modules etc.to ensure they are clean and free from any mechanical damage	√		
3	Check for proper termination & feruling	√		
4	Check input A/C supply voltage		√	
5	Check location/spacing of Detectors as per standards	√		
6	All device are addressed as per drawing		√	

7	Check Distribution of Detector / Loops / Zones as per Drawing.		√	
8	Check all Modules / Detectors, for healthy blinking status.	√		
9	Apply Smoke / Aerosol to random detectors & check output of the same in panel, shall display proper address/Loop/zone. Check for activation of appropriate speaker circuits with message.		√	
10	Check distribution of Amplification Zones as per approved shop drawings		√	
11	Check tripping of AHU / Fan / Access doors etc. on activation of detectors.		√	
12	Activation of Hooter circuits as programme ,PA evacuation message/alert message/emergency message		√	
13	All the manual call point are working properly		√	
14	Hooter / Strobe are working as programmed		√	
15	If power fails, whether panel working on battery supply		√	
16	Panel display and all key working properly		√	
17	Check for seamless integration with BMS		√	

1. Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.
2. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
3. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
4. Verify activation of all flow switches.
5. Open initiating device circuits and verify that the trouble signal actuates.
6. Open signaling line circuits and verify that the trouble signal actuates.
7. Open and short notification appliance circuits and verify that trouble signal actuates.
8. Ground initiating device circuits and verify response of trouble signals.
9. Ground signaling line circuits and verify response of trouble signals.
10. Ground notification appliance circuits and verify response of trouble signals.
11. Check presence and audibility of tone at all alarm notification devices.
12. Check installation, supervision, and operation of all intelligent smoke detectors during a walk test.
13. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

14. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

**12. 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.

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.

### **13. 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.
- 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 and the process logic applied by the IBMS system to achieve the same.
- 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.

#### **14. INTERFACING WITH OTHER SERVICES.**

- Interfacing with Third Party Service providers and Equipment Providers is an integral and most important part of the scope of works of the IBMS vendor.
- It shall be the Contractor's responsibility to study and include the Design Logics of various Utilities being provided by third parties
- It is expected and assumed for granted that the Contractor shall study of third party drawings to locate equipment / locate Marshalling boxes to pick up signals relevant to Control and Monitoring of Life Safety
- The Contractor shall also prepare and share data related to software level integrations to the IBMS contractor on .net / xml / or conventional integration on MODBUS / LONWORKS / BACNET over IP Platforms, made available either on Serial interface or on a IP Platform.
- The Contractor shall be responsible to ensure that all information relevant to Interfacing with Other Services and Other Systems is collated and put to use to ensure a fully operational Life Safety System as per technical requirements put forth in the Tender, and to the description of the Architect / Client / Consultant as Directed from Time to Time.
- During Execution, it shall be Contractor's responsibility to follow Co-ordinated drawings and interface with other Services and contractors for proper laying and installation of equipment such that there is no fouling of services in any manner.



## **CCTV (IP VIDEO SURVEILLANCE) SYSTEM**

### **1. SCOPE:**

The specification of Video Surveillance System covers technical specification and requirement of IP Video Surveillance Systems consisting of Indoor IP dome cameras, Indoor IP PTZ cameras, outdoor IP P/T/Z dome cameras, Video Management Software, Recording servers, switches, colour monitor etc. for surveillance of the facility from a centralized location.

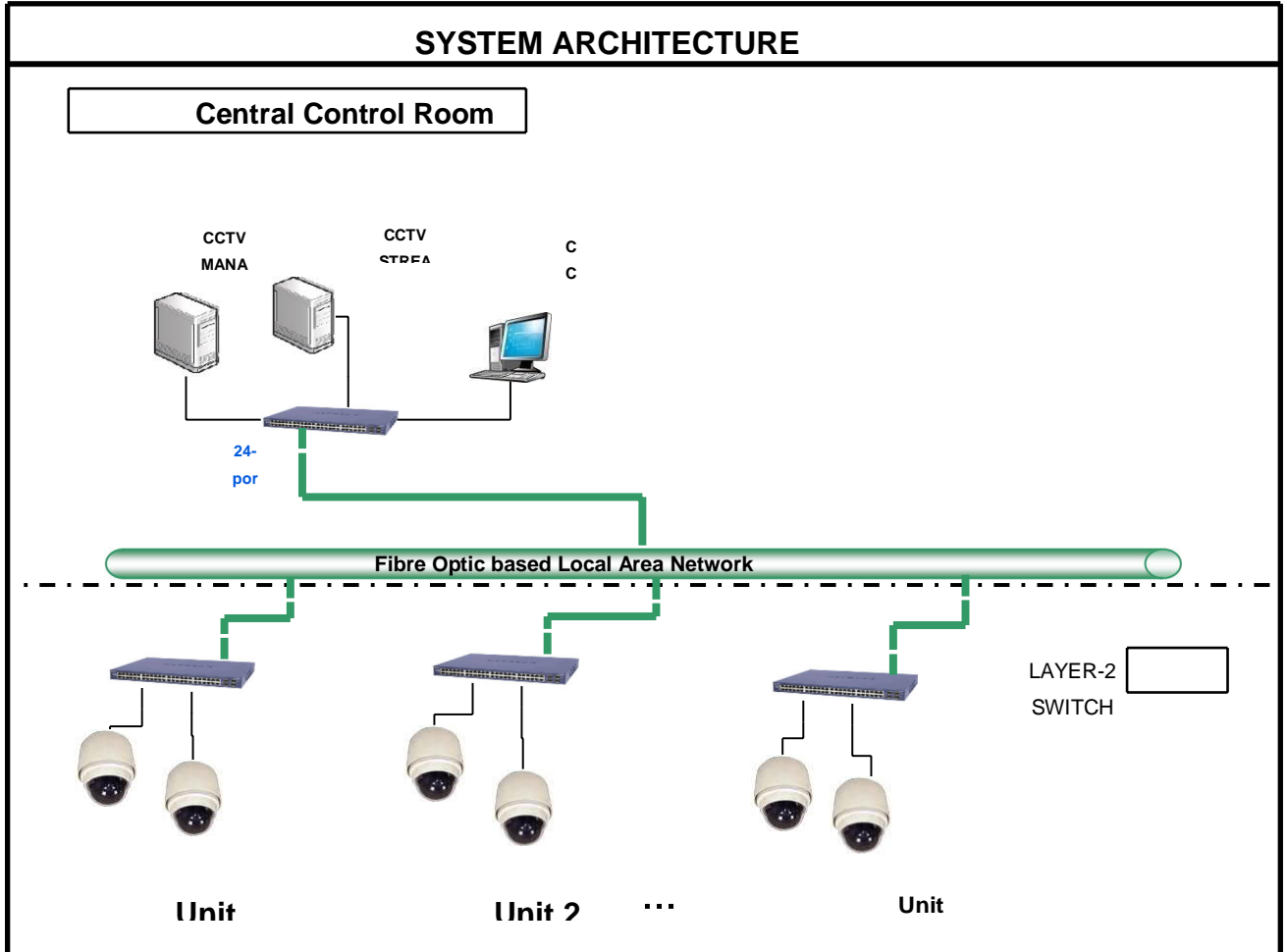
Video Surveillance System shall be an IP enabled system. The recording of the video shall be on an open architecture, non-embedded based recorder server from reputed manufacturers like IBM/HP/Dell. The system shall be able to work on a fibre optic backbone network. The entire system shall be based on nonproprietary open architecture where the Video Management software can work and integrate with any make of standard cameras and encoders, and IT hardware.

### **2. SYSTEM DESCRIPTION**

- a. The Video Management Software should be a fully digital IP-based video surveillance system.
- b. The VMS should work with the latest compression technologies viz MPEG-4 and H.264 and should be capable to interface with IP cameras streaming both compressions.
- c. It should be a fully scalable enterprise-class media management system. This advanced network-based system architecture should enable simultaneous live monitoring from multiple stations and be easily configurable for storage both on and off site. The software should be configured to store and to view images captured by one camera or thousands of cameras and monitor connections across an unlimited number of servers.
- d. Video Surveillance System shall consist of outdoor IP PTZ Dome cameras, recording Servers and PC's and associated Ethernet cable, fiber cable, video cable, power cable, twisted pair cable etc. Bidder should consider all necessary network equipment and accessories to provide a LAN / WAN infrastructure dedicated for video surveillance on a fibre optic backbone network which should be not less than 1 Gbps speed.
- e. The software should provide a single GUI that monitors, records, and offers analysis functionality to deliver the timely, accurate information required for effectively responding to any challenge.
- f. The VMS shall have client station software. The client should offer multi-monitor options, and have drag and drop options and the ability to switch any particular camera onto any monitor through drag operation.
- g. It should be possible to set up a video wall from the software.
- h. The VMS should have the future capability to integrate video analytics for all the cameras. It should presently support motion detection feature and detect on the basis of size of object and direction of movement etc. and generate various types of alarms.
- i. Each camera shall have a video at 4CIF and 25 frames for viewing the videos during live as well as for recording purpose. The storage shall be on a recording server which will be a standard IBM/HP/Dell/ make PC server. The recording shall be stored for at least 30 days at 4CIF and 25 frames per second.

3. **SYSTEM ARCHITECTURE**

The following diagram explains the relationship of various system and integration components:



**4. GENERAL REQUIREMENTS:**

- i. Manufactured products shall have quality system compliance and shall be either UL or CE (EN) or FCC certified.
- ii. The Video Management software and the Cameras should be of the same make.
- iii. All software and firmware upgrades shall be free of cost. All the IP cameras shall be freely accessible and programmable from the control room.
- iv. Every control room of surveillance system shall be capable of getting connected to the optical or other communication backbone.
- v. The power supply available shall be 220 V / 50 Hz AC +/- 10%. All modules of the surveillance system should work using this power supply only with requisite converters, if required.
- v. All the cameras and other modules of Video Surveillance System shall be modular in construction. In case of up gradation of such modules in future, it shall be possible to upgrade them without replacing the entire modules.

**5. TECHNICAL REQUIREMENTS:**

The Video Surveillance System shall consist of:

**5.1 Indoor Fixed IP Dome with Color (Day/ Night) Camera**

The following cameras will be provided with Appropriate Lens, housing and support to work indoor in industrial environment. The camera should meet the following minimum requirement.

Image sensor	:	The camera shall use a 1/4" Progressive Scan RGB CMOS
Lens	:	Varifocal 2.8 - 10 mm, F1.7, fixed iris
Angle of view, horizontal:		22° - 80°
Minimum illumination:		0.9 - 100000 lux, F1.7
Camera angle adjustment:		Pan 360°, tilt 170°, rotation 340°
Video compression:		H.264, Motion JPEG
Resolutions	:	160x90 to 1280x800
Frame rate	:	30fps in all resolutions (H.264 & Motion JPEG)
Video Streaming:		Multiple, individually configurable streams in H.264 and Motion JPEG Controllable frame rate and bandwidth VBR/CBR H.264
Intelligent video:		Video motion detection, active tampering alarm
Security :		Password protection, IP address filtering, HTTPS encryption, digest authentication, user access log
Supported protocols:		IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3(MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS

Approvals:	EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 55024, FCC Part 15 Subpart B Class B, ICES-003 Class B, VCCI Class B, C-tick AS/NZS CISPR 22, EN 60950-1, KCC Class B
Network:	IPv4/v6, QoS
Power over Ethernet (IEEE 802.3af):	Class 2 (max.4.2W)
Serial Connectors:	RS-45 10BASE-T/100BASE-TX PoE

## 5.2 Fixed Color (day/ night) Camera with IP 66 Housing

The following cameras will be provided with Appropriate Lens, housing and support to work in industrial environment. Housing will be provided in all the cameras with IP66 rating with heater and blower. The camera should meet the following minimum requirement.

Image sensor:	The camera shall use a 1/3'' Progressive scan CMOS 2
Lens:	Camera should support both CS-mount & DC-iris lenses; Varifocal 4-10 and 5-50 mm: F1.8, P-Iris; horizontal: 29° - 61°
Angle of view, horizontal:	Horizontal: 29° - 61
Minimum illumination:	Color: 0.6 lux, B/W: 0.08 lux, F1.8
Shutter time:	1/35500 s to 1/6 s
Video compression:	H.264, Motion JPEG
Resolutions:	160 x 90 to 2038 x 1536
Frame rate:	2 MP 4:3 (1600 x 13200) mode and 1080 (1920 x 1080) mode: 30 fps in all resolution; 3 MP mode: 20 fps in all resolution
Video streaming:	Multiple, individually configurable stream in H.264 and Motion JPEG. Controlable frame rate and bandwidth VBR/CBR H.264. Up to 8 individually cropped out view areas. When streaming 5 view areas in VGA resolution, the rate is 20 fps per stream in H.264/Motion JPEG (3 MP capture mode)
Image setting:	Compression, color, brightness, sharpness, contrast, white balance, exposure control, exposure zones, backlight compensation, wide dynamic range, dynamic contrast, fine tuning of behavior at low light
Security:	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control, digest authentication, user access log
Supported protocols:	IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3(MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
Approvals:	EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 55024, FCC Part 15 Subpart B Class B, ICES-003 Class B, VCCI Class B, C-tick AS/NZS CISPR 22, EN 60950-1, E: 3.IP66, IK10

Power: 9.6W PoE Class 3, IEEE 802.3af Power over Ethernet

### 5.3 FIXED COLOR (Day/ Night) CAMERA WITH IP-66 HOUSING

20 The following cameras will be provided with Appropriate Lens, housing and support to work in industrial environment. Housing will be provided in all the cameras with IP66 rating with heater and blower. The camera should meet the following minimum requirement.

Image sensor:	The camera shall use a 1/3" Progressive scan CMOS 2 Megapixel
Lens:	f 5.1 - 51 mm, F1.8 - 2.1, Auto day/night IR filter, autofocus Near focus limit 10mm (wide) or 800mm (tele)
Angle of view, horizontal:	horizontal: 5.4° - 50°, M37x0.75 mounting thread for optional lens adaptor
Minimum illumination:	Color: 2 lux at 30IRE, F1.8, B/W: 0.2 lux at 30IRE, F1.8
Zoom:	10x optical and 12x digital, total 120 xs
Video compression:	H.264, Motion JPEG
Resolutions:	HDTV 1080i 1920x1080, HDTV 720p 1280x720
Frame rate:	30/25 fps in all resolutions (H.264 & Motion JPEG)
Intelligent video:	Video motion detection, active tampering alarm
Security:	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control, digest authentication, user access log
Supported protocols:	IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3(MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
Approvals:	EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 55024, EN 61000-6-1, EN 61000-6-2, EN 60950-1, FCC Part 15, Subpart B, Class B, VCCI, Class B ITE, C-tick AS/NZS CISPR 22, ICES-003, Class B
Network:	IPv4/v6, QoS
Power:	8 – 20 VDC max 11,2 W, 20 - 24 V AC max 17,4 VA, Power over Ethernet IEEE 802.3af Class 3
Serial Connectors:	RS-45 10BASE-T/100BASE-TX PoE

### 5.4 PTZ Network Camera (day and night) with Housing

It shall be for indoor or outdoor purpose type with minimum of following details to work properly in industrial and hilly environment. Housing will be provided in all the cameras with IP66 rating with heater and blower. The camera should meet the following minimum requirement.

Image Sensor:	The camera shall use a 1/4" interlaced CCD
Day night:	Autofocus

Lens:	3.8 – 46 mm, F1.6 – F2.7, automatic,
Minimum illumination/	
Light Sensitivity (LUX):	Color: 1 lux at 30 IRE, F1.6; B/W: 0.3 lux at 30 IRE, F1.6
Shutter time:	NTSC: 1/50000 s to 4/3 s; PAL: 1/50000 s to 8/5 s
PAN/Tilt/Zoom:	20 preset positions; Auto-flip, E-flip; $\pm 170^\circ$ ( $360^\circ$ via Auto-flip) pan; range, $180^\circ$ /s pan speed; $180^\circ$ tilt range, $140^\circ$ /s tilt speed; 12x optical, 4x digital zoom; Control queue, image freeze, sequence mode
	Support Windows compatible joysticks
Video compression:	MPEG-4 Part 2 (ISO/IEC 14496-2); Motion JPEG
Max Video Resolutions:	NTSC: 704x480 to 176x120; PAL: 704x576 to 176x144
Frame per second	
(NTSC/PAL):	Up to 30/25 (NTSC/PAL) in 2CIF/CIF/QCIF; Up to 26/22 (NTSC/PAL) in 4CIF/2CIFexp
Security:	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control
Supported protocols:	IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
Casing:	IP66-rated, rugged aluminum casing with clear dome bubble
Processor & memory:	ETRAX FS, ARTPEC-2, 32 MB RAM, 8 MB Flash
Operating condition:	-20 °C to 40 °C (-4 °F to 104 °F); 2 built-in heaters, 3 built-in fans
Approvals:	EN 55022 Class B, EN 55024, EN 61000-3-2, EN 61000-3-3, EN 60950-1, FCC Part 15 Subpart B Class B, ICES-003 Class B, C-tick AS/NZS 3548
Power supply:	UL, CSA, CE

### 5.5 PTZ Network Camera (day and night) with Housing

It shall be for indoor or outdoor purpose type with minimum of following details to work properly in industrial and hilly environment. Housing will be provided in all the cameras with IP66 rating with heater and blower. The camera should meet the following minimum requirement.

Image Sensor:	The camera shall use a 1/4" ExView HAD Progressive Scan CCD
Day night:	Autofocus, automatic day/night
Lens:	3.4 – 119 mm, F1.4 – 4.2, horizontal angle of view: $1.73^\circ$ - $55.8^\circ$
Minimum illumination/	

Light Sensitivity (LUX):	Color: 0.5 lux at 30 IRE; B/W: 0.008 lux at 30 IRE
Shutter time:	NTSC:1/30 000 s – 0.5 s; PAL: 1/30 000 s – 1.5 s
PAN/Tilt/Zoom:	E-flip; 100 preset positions; Pan: 360° endless, 0.05 – 450°/s; Tilt: 180°, 0.05 – 450°/s; 35x optical zoom and 12x digital zoom, total 420x zoom; Guard Tour; Control queue
Video compression:	H.264 (MPEG-4 Part 10/AVC); Motion JPEG
Resolutions:	NTSC: 704x480 - 176x120; PAL: 704x576 - 176x144
Frame per second (NTSC/PAL):	Up to 30/25fps in all resolutions
Security:	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control, digest authentication, user access log
Supported protocols:	IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ,FTP, SMTP,Bonjour, UPnP, SNMPv1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
Casing:	IP66-rated, metal casing (aluminum, acrylic (PMMA) clear dome cover pre-mounted to casing, sunshield (polycarbonate)
Processor & memory:	ARTPEC-3, 128MB RAM, 128MB Flash
Power:	Camera: High power over ethernet, max.50W Midspan, High Power over Ethernet Midspan 1-port 100-240V AC, Max.60W
Operating condition:	-40 - 50 °C (-40 - 122 °F) Arctic Temperature Control enables camera start-up at temperatures as low as -40C; Humidity 20 – 80% RH (non-condensing)
Approvals:	EN 55022 Class B, EN 55024, EN 61000-3-2, EN 61000-3-3, EN 61000-6-1, EN 61000-6-2, FCC Part 15 Subpart B Class B, VCCI Class B, C-tick AS/NZS CISPR22, ICES-003 Class B, EN 60950-1; Midspan: EN 60950-1, GS, UL, cUL, CE,

## 6. DIGITAL KEYBOARD

Professional joystick for accurate control over network of PTZ (pan/tilt/zoom) and dome network cameras. Connects to PC workstation over USB.

**7. TECHNICAL SPECIFICATION FOR 24 PORT POE 10/100/1000 MBPS LAYER 3 SWITCH**

Sr No	Desired Specification/Qualitative Requirement
1.0	<b><u>Core / Distribution Switches (Layer 3)</u></b>
1.1	<b><u>Architecture</u></b>
(a)	Modular switch with 24 Manageable Gigabit Ethernet ports, 4 RJ 45 ports with option of fibre port of Min 1000 mbps & 03 No's of 10Gigabit Slots for uplink to Switch or Servers for Stacking.
(b)	Switch should provide option of Redundant power supply
1.2	<b><u>Network Media</u></b>
(a)	SFP's 1000BaseSX,1000BaseLX,1000BaseTX,1000Base Lx WDM
1.3	<b><u>Performance</u></b>
(a)	The Switch shall have Non-blocking wire speed switch fabric
(b)	The Switch shall have Min. 100 Gbps Back plane
(c)	The Switch shall have Min.80 million pps
(d)	The Switch shall support Min. 16K Mac address
(e)	The Switch shall support Min. 3000 VLANs
(f)	The Switch shall support IPv4/IPv6 Routing
(g)	The Switch shall have 40 Gigabit Stacking Backplane
(h)	The Switch shall be able to do Physical Stack up to 10 units per stack or more
(i)	The Switch shall be able to do IP Stacking up to 30 units per IP
(j)	The Switch Should support Jumbo Frame (up to 9216 Bytes)
1.4	<b><u>Layer 3 Features</u></b>
(a)	The Switch should have RIPv1(RFC1058)/RIPv2(RFC2453),RIPng,OSPFv2
(b)	The Switch should have Policy Based Routing ,BGP 4 & VRRP
(c)	The Switch should have DVMRP v3, PIM-DM/SM/SDM for IPv4
(d)	The Switch should have IPv6 Tunneling
(e)	The Switch should have Up to 56 IP Interfaces & 10K route entries
(f)	The Switch should have Multi Path Routing support for Equal cost & Weighted Cost
(g)	The Switch should have Per port Limit IP Multicast Address Range for Control Packet
1.5	<b><u>Layer 2 Features</u></b>
(a)	The Switch should have IGMP Snooping v1,v2,v3 & MLD Snooping
(b)	The Switch should have Spanning tree 802.1d,802.1w,802.1s
(c)	The Switch should have 802.3ad Link Aggregation Up to 30 groups per device
(d)	The Switch should have Port Mirroring One to one/Many to One & RSPAN
(e)	The Switch shall have the intelligence to detect the loop occurring from the unmanaged network segment
(f)	The Switch shall have the capability to build the trunk across stack



Sr No	Desired Specification/Qualitative Requirement
(g)	The Switch shall have ITU-T G.8032
(h)	It shall support LLDP and LLDP-MED including client location information. It shall exchange link and device information in multi-vendor networks
1.6	<b><u>VLAN</u></b>
(a)	The LAN switch shall have IEEE 802.1Q VLAN encapsulation. Up to 255 VLANs per switch and up to 4000 VLAN IDs.
(b)	It shall have Automatic Negotiation of Trunking Protocol, to help minimize the configuration & errors.
(c)	It shall have centralized VLAN Management. VLANs created on the Core Switches shall be propagated to all the others switches automatically, thus reducing the overhead of creating/modifying/deleting VLANs in all the switches in turn eliminating the configuration errors & troubleshooting.
(d)	It shall have support for Detection of Unidirectional links and to disable them to avoid problems such as spanning tree loops
(e)	It shall support 802.1v & Q-in-Q Vlan
1.7	<b><u>Quality of Service</u></b>
(a)	It shall support 802.1p Priority Queues (8 Queues)
(b)	Queue Handling mode: WRR & Strict Mode
(c)	Granular Rate Limiting functions on per port & flow based to guarantee bandwidth in increments shall be as low as 64 Kilobits per Second.
(d)	Class of shall be based on Switch port, DSCP, Vlan ID, TCP/UDP port, Protocol type, 802.1p queues, IPv4/v6 address, IPv6 flow label & User defined packet content
(e)	The Switch shall be MEF 9 & 14 Certified to ensure the Service Level Agreements for Voice, video & Data converged applications
1.8	<b><u>Access Control List</u></b>
(a)	The Lan Switch shall have the capability to apply access list control based on IPv4/v6 address, Protocol type, IPv6 flow label, Time based ACL, Vlan-ID, MAC-ID, DSCP, IPv6 traffic class, TCP/UDP Port, Switch port & user defined packet content
(b)	The Switch shall support up to 1600 Access Control Entries minimum
1.9	<b><u>Network Security</u></b>
(a)	The LAN switch shall support IEEE 802.1x to allow dynamic, port-based security, providing user authentication.
(b)	The LAN switch shall support for Admission Control features to improve the network's ability to automatically identify, prevent and respond to security threats and also to enable the switches to collaborate with third-party such as Microsoft for security-policy compliance and enforcement before a host is permitted to access the network
(c)	It shall support for SSHv2, SNMPv3 to provide network security by encrypting administrator traffic during Telnet and SNMP sessions.
(d)	It shall support RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration.
(e)	It shall support DHCP snooping to allow administrators to ensure consistent mapping of IP to MAC addresses. This can be used to prevent attacks that attempt to poison the DHCP binding database, and to rate limit the amount of DHCP traffic that enters a switch port.

Sr No	Desired Specification/Qualitative Requirement
(f)	It shall support DHCP Interface Tracker (Option 82) to augment a host IP address request with the switch port ID.
(g)	It shall support that each end node can be isolated from each other and they should be able to connect to shared ports such as Internet and servers
(h)	It shall support port security to secure the access to an access or trunk port based on MAC address. After a specific timeframe, the aging feature should remove the MAC address from the switch to allow another device to connect to the same port.(up to 14 MAC-ID per port)
(i)	It shall have IP-MAC-Port binding up to 475 Entries per device
(j)	It shall have Web & MAC Based Access Control
1.10	<b><u>Management</u></b>
(a)	The LAN switch shall have CLI support to provide a common user interface and command set with all routers and switches of the same vendor.
(b)	It shall have Remote Monitoring (RMON) software agent to support four RMON groups (history, statistics, alarms and events) for enhanced traffic management, monitoring and analysis.
(c)	It shall support Trivial File Transfer Protocol (TFTP) to reduce the cost of administering software upgrades by downloading from a centralized location.
(d)	It shall support Network Timing Protocol (NTP/SNTP) to provide an accurate and consistent timestamp to all intranet switches.
(e)	It shall support SNMPv1, SNMPv2c, and SNMPv3 and Telnet interface to deliver comprehensive in-band management, and a CLI-based management console to provide detailed out-of-band management
(f)	It shall provide management functions for network segments (access links and individual circuits), monitors individual links.
(g)	It shall have traffic monitoring for all network ports effective at gigabit speed or higher, shall not impact the network performance while providing the real time & historical data of all devices from Layer 2 to Layer 7.
(h)	It shall support configuration rollback to replace current configuration with any saved configuration file.

**8. TECHNICAL SPECIFICATION FOR 24 POE PORT 10/100/1000 MBPS LAYER 2 SWITCH**

Sr No	Desired Specification/Qualitative Requirement
1.0	<b><u>Edge Switch (Layer 2)</u></b>
1.1	<b><u>Architecture</u></b>
(a)	Modular switch with 20 POE Manageable Gigabit Ethernet ports, 4 RJ 45 ports with option of fibreport of Min 1000 mbps.
(b)	
1.2	<b><u>Network Media</u></b>
(a)	SFP's 1000BaseSX,1000BaseLX,1000BaseTX
1.3	<b><u>Performance</u></b>
(a)	The Switch shall have Non-blocking wire speed switch fabric

<b>Sr No</b>	<b>Desired Specification/Qualitative Requirement</b>
(b)	The Switch shall have Min. 48 Gbps Back plane or higher
(c)	The Switch shall have Min.35 million pps or higher
(d)	The Switch shall support Min. 8K Mac address
(e)	The Switch shall support Min. 256 VLANs
(f)	The L2 Switch should have MTBF for 173,467 hours.
(g)	The Switch Should support Jumbo Frame (up to 10240 Bytes)
1.4	<b><u>Layer 2 Features</u></b>
(a)	The Switch should have IGMP Snooping v1,v2
(b)	The Switch should have Spanning tree 802.1d
(c)	The Switch should have 802.3ad Link Aggregation Up to 6 groups per device
(d)	The Switch should have Port Mirroring One to one/Many to One
(e)	The L2 Switch shall have power saving feature which can automatically powers down ports that have no link or link partner.
(f)	The L2 Switch shall not consume more than 250.3 Watts of Power.

1.5	<b><u>VLAN</u></b>
(a)	The LAN switch shall have IEEE 802.1Q VLAN encapsulation. Up to 255 VLANs per switch.
(b)	It shall have Management Vlan
(c)	It shall have AsymmetricVlan
1.6	<b><u>Quality of Service</u></b>
(a)	It shall support 802.1p Priority Queues (4 Queues)
(b)	Queue Handling mode: WRR & Strict Mode
(c)	Class of service shall be based on DSCP,802.1p queues
1.7	<b><u>Network Security</u></b>
(a)	The LAN switch shall support IEEE 802.1x to allow dynamic, port-based security, providing user authentication.
(b)	It shall support RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration.
(c)	It shall have built in mechanism to protect the switch against traffic flooding caused by virus attack
1.8	<b><u>Management</u></b>
(a)	It shall support Firmware upgrade through Web Management or through software must come along with Switch to reduce the cost of administering software upgrades by downloading from a centralized location.
(b)	It shall support Network Timing Protocol (NTP/SNTP) to provide an accurate and consistent timestamp to all intranet switches.
(c)	It shall support SNMPv1 to deliver comprehensive in-band management
(d)	It shall support configuration rollback to replace current configuration with any saved

	configuration file.
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**9. SERVER HARDWARE SPECIFICATIONS:**

- A. Network Digital Video Management Server (NVMS)-Hardware
- (i) The NVMS Server shall be of the most recent computer technology and shall cover the NVMS minimum requirements from reputed makes like HP, IBM, Dell
- a) As a minimum the NVMS server shall be:
- I. Quad Core Xeon 3.2 GHz or better
  - II. GB of RAM or Better
  - III. Dual/redundant power supply
  - IV. Dual/redundant 10/100/1000 network interface card (NIC)
  - V. To provide an advanced and reliable system the following server must be provided for the recording system
    - 1) Dual mirrored 40G Hard drive for Windows 2003 Server based Operating system and NVMS server software
    - 2) Video storage on Direct Attached Storage (DAS) system which as minimum configured as RAID5
  - VI. If storage requires external attached RAID system a Fiber Channel Interface Card shall be used to interface the external RAID to the NVMS Server.
  - VII. To provide an advanced and reliable system the operating system shall be Windows 2000- Server or 2003- Server level (Win 2000 Pro or XP pro will not be considered as approved equal)

**10. STORAGE HARDWARE**

- I. Two redundant, hot-pluggable active/active RAID controller modules with 2 iSCSI host port per controller
- II. Redundant, hot-pluggable power supply/fan modules
- III. 512 MB of mirrored cache on each RAID controller module
- IV. Battery backup in each RAID controller module that protects against cache data loss for up to 72 hours
- V. Online firmware updates for the RAID controller modules, NVSRAM, and physical disks
- VI. Multi-path failover for redundant configurations, which automatically reroutes I/O activity from a failed, offline, or removed RAID controller module to its alternate RAID controller module (or from a failed iSCSI NIC to its peer)
- VII. Support for RAID levels 0, 1, 5, and 10
- VIII. Support for 255 virtual disks with a maximum capacity of 2 TB each
- IX. Expandability of Minimum 45 drives either SAS or SATA.

**11. CABLING SYSTEM AND COMPONENT SPECIFICATIONS**

**11.1 UTP Cabling System**

S. No.	Details	Specification	Compliance	Deviation
1	Type	Unshielded twisted pair cabling system, TIA / EIA 568-B.1 or B.2-1 addendum Category 6 Cabling system	Yes / No	
2	Networks Supported	10 / 100/1000 Ethernet, 155 Mbps ATM, 1000 Mbps IEEE 802.3ab Ethernet, and proposed Cat 6 Gigabit Ethernet	Yes / No	
3	TIA / EIA 568-B.1 or B.2.1	ETL Verified / UL Listed	Yes / No	
4	Warranty	25 year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs	Yes / No	
5	Performance characteristics to be provided along with bid	(a) Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel	Yes / No	
		(b) Should perform to CAT6 with short channel	Yes / No	
		(c) Should support 6 Connection Channel and exceed CAT6 Specs	Yes / No	
		(d)Should have a PSNEXT margin of 7.5 dB over CAT6	Yes / No	

**11.2 UTP Cable**

S.No.	Details	Specification	Compliance	Deviation
1	Type	Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2-1	Yes / No	
2	Conductors	23 AWG solid bare copper	Yes / No	
3	Insulation	Polyethylene	Yes / No	
4	Jacket	Flame Retardant PVC	Yes / No	
	Pair Separator	Cross-member (+) fluted Spline.		
5	Approvals	(a) UL Listed / UL Verified	Yes / No	
		(b) ETL verified to TIA / EIA Cat 6	Yes / No	
6	Operating temperature	-20 Deg. C to +60 Deg. C	Yes / No	
	Storage Temperature	-20 Deg. C to +80 Deg. C		
7	Frequency tested up to	Minimum 600 MHz	Yes / No	

S.No.	Details	Specification	Compliance	Deviation
8	Packing	Box of 305 meters	Yes / No	
9	Cable Outer Diameter	.23 inches	Yes / No	
10	Delay Skew	45ns MAX.	Yes / No	
11	Bend Radius	4 * Cable Diameter	Yes / No	
12	Impedance	100 Ohms + / - 15 ohms, 1 to 600 MHz.	Yes / No	
13	UL/NEC Ratings	CMR Rated	Yes / No	
14	Mutual Capacitance	5.6 NF MAX /100 Mtr.	Yes / No	
15	Conductor Resistance	66.58 Ohms Max / KM	Yes / No	
16	Propagation Delay	536 ns/100 Mtrs. MAX @ 250 Mhz	Yes / No	
17	Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEEXT and PSELFEXT, Return Loss, ACR and PS ACR	Yes / No	
18	ROHS	ROHS/ELV Compliant	Yes / No	

### 11.3 UTP Jacks

S No.	Detail	Specification	Compliance	Deviation
1	Type	PCB based, Unshielded Twisted Pair, Category 6, TIA /EIA 568-B.2-1 and IEC 60603-7-4	Yes / No	
2	Modular Jack	750 mating cycles	Yes / No	
3	Wire terminal	200 termination cycles	Yes / No	
4	Accessories	Integrated bend-limiting strain-relief unit for cable entry		
		Integrated hinged dust cover	Yes / No	
		Support cable pair termination process on the jacks at 90 degree angle.	Yes / No	
		Bidder should have a mechanism to maintain the quality of the termination ir-respective of the skill level of the termination staff.	Yes / No	
5	Housing	Polyphenylene oxide, 94V-0 rated.	Yes / No	
6	110 Blocks	polycarbonate, 94V-0 rated	Yes / No	
7	Jack contacts	Beryllium copper, plated with 1.27 mm [.000050] thick gold in localized area and 3.81 mm [.000150] minimum thick tin-lead in solder area over 1.27 mm [.000050] minimum thick nickel under plate	Yes / No	
8	Wiring blocks	Polycarbonate, 94V-0 rated	Yes / No	
9	Approvals	(a) UL Listed / CSA Approved	Yes / No	

S No.	Detail	Specification	Compliance	Deviation
		(b) ETL verified to TIA / EIA Cat 6	Yes / No	
10	Performance Characteristics to be provided with bid	Attenuation, NEXT, PS NEXT, FEXT and Return Loss	Yes / No	
11	ROHS	ROHS/ELV Compliant	Yes / No	

#### 11.4 Patch Cords

S.No.	Details	Specification	Compliance	Deviation
1	Type	Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2-1	Yes / No	
2	Conductor	24 AWG 7 / 32, stranded copper conductors 100 Ohm	Yes / No	
3	Length	4 feet, 7 feet, 10 feet	Yes / No	
4	Plug Protection	Transparent Slim boot	Yes / No	
5	Warranty	25-year component	Yes / No	
6	Insulation	Flame Retardant Polyethylene	Yes / No	
7	ROHS	ROHS/ELV Compliant	Yes / No	

#### 11.5 UTP Jack Panels

S. No.	Details	Specification	Compliance	Deviation
1	Type	24/48-port, Modular, PCB based, Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2-1 and IEC 60603-7-4	Yes / No	
2	Ports	24/48	Yes / No	
3	Port arrangement	Configured as 6 Port Module with individually replaceable CAT-6 Jacks		
4	Circuit Identification	Front of each module shall be capable of accepting 9 mm to 12 mm labels	Yes / No	
5	Port Identification	9mm or 12mm Labels on each of 24-ports (to be included in supply)	Yes / No	
6	Modular Jack	750 mating cycles		
7	Wire terminal	200 termination cycles	Yes / No	
8	Accessories	Integrated bend-limiting strain-relief unit for cable entry	Yes / No	
9	Materials			
	Housing	Polyphenylene oxide, 94V-0 rated	Yes / No	

S. No.	Details	Specification	Compliance	Deviation
	Wiring blocks	Polycarbonate, 94V-0 rated	Yes / No	
	Jack contacts	Beryllium copper, plated with 1.27 mm [.000050] thick gold in localized area and 3.81 mm [.000150] minimum thick tin-lead in solder area over 1.27 mm [.000050] minimum thick nickel under plate	Yes / No	
	Panel	Black, powder coated steel	Yes / No	
10	Approvals	UL listed / ETL Verified	Yes / No	
11	Termination Pattern	TIA / EIA 568 A and B;	Yes / No	
12	ROHS	ROHS/ELV Compliant	Yes / No	

#### 11.6 FACE PLATE

S No.	Details	Specification	Compliance	Deviation
1	Type	Single Gang	Yes / No	
2	Material	ABS / UL 94 V-0	Yes / No	
3	No. of ports	One/Two	Yes / No	
4	ROHS	ROHS/ELV Compliant	Yes / No	

#### 11.7 Core Multi Mode Outdoor Fiber OM2

S. No.	Specifications	Requirement	Compliance	Deviation
1	Cable Type	6-core MM, OM2, Corrugated Steel Armored, Gelly Filled; Loose tube OFC	Yes / No	
2	Fibre Type	50/125um MM	Yes / No	
3	No. of cores	6	Yes / No	
4	Armour	Corrugated Steel Tape Armour	Yes / No	
5	Attenuation	@ 850nm <=2.9 Typical and <=3.5 Max	Yes / No	
		@1300nm <=0.9 Typical and <=1.0 Max	Yes / No	
6	Bandwidth	@ 850nm >500 MHz-KM	Yes / No	
		@1300nm >500 MHz-KM	Yes / No	
7	Clad Diameter (um)	125 + - 2	Yes / No	
8	Concentricity Error(um)	<=3	Yes / No	
9	NON-Circularity (%)	<=2	Yes / No	
10	Coat Diameter	245 + - 10	Yes / No	
11	Tensile Strength	1500 Newtons	Yes / No	



S. No.	Specifications	Requirement	Compliance	Deviation
12	Crush Resistance	440 N/cm	Yes / No	
13	Bend Radius (Installation/Unloaded)	10 D / 20 D	Yes / No	
14	Cable Diameter	8.5 + - 0.5 mm	Yes / No	
15	Loose Tube Diameter	2.8 + - 0.15 mm	Yes / No	
16	Operating Temperature	-30 Degree C to +70 Degree C	Yes / No	

**11.8. Core Multi Mode Outdoor Fiber OM3**

S. No.	Specifications	Requirement	Compliance	Deviation
1	Cable Type	6-core, Multimode, 10G Ethernet OM3, Armored, loose-tube, Gel Filled	Yes/No	
2	Fiber type	50 / 125, Laser Grade, primary coated buffers	Yes/No	
3	No. of cores	6	Yes/No	
4	Cable Construction	BELLCORE GR 20 / IEC 794-1	Yes/No	
5	Fiber Attenuation			
	@850nm	<=2.7 dB / KM	Yes/No	
	@1300nm	<=.7 dB / KM	Yes/No	
6	Bandwidth			
	@850nm	>1500 MHz-KM	Yes/No	
	@1300nm	>500 MHz-KM	Yes/No	
7	Network Support			
	10 / 100 Ethernet	2000m	Yes/No	
	155 Mbps ATM	2000m	Yes/No	
	1000 Base SX	900m	Yes/No	
	1000 Base Lx	550m without Mode Conditioning launch patch cord.	Yes/No	
8	Tensile rating	1200 N	Yes/No	
9	Maximum Crush resistance	3000N	Yes/No	
10	Operating Temperature	-40 Degree C to +60 Degree C	Yes/No	

S. No.	Specifications	Requirement	Compliance	Deviation
11	Armor	Corrugated Steel tape Armor	Yes/No	
12	ROHS	ROHS/ELV Compliant	Yes / No	

**11.9 Multi-Mode 50/125 um Indoor OFC**

S. No.	Specifications	Requirement	Compliance	Deviation
1	Fiber type	50 / 125, Laser Grade, primary coated buffers	Yes/No	
2	No. of cores	6	Yes/No	
3	Fiber Attenuation		Yes/No	
	@850nm	<=2.7 dB / KM		
	@1300nm	<=.7 dB / KM	Yes/No	
4	Bandwidth		Yes/No	
	@850nm	>1500 MHz-KM		
	@1300nm	>500 MHz-KM	Yes/No	
5	Tensile rating	1000 N	Yes/No	
6	Maximum Crush resistance	2000 N		
7	Operating Temperature	-40 Degree C to +60 Degree C	Yes/No	
8	Outer Jacket	LSZH	Yes/No	
9	Should comply below mentioned standards			
9.a	Fire Propagation	IEC 332-1 and 332-3	Yes/No	
	Flammability	IEC 1034	Yes/No	
	Smoke Emission	IEC 1034		
	Acid Gas Emission	IEC 754-1	Yes/No	
	Toxicity	NES 713	Yes/No	
	Water Absorption	IEC 811-1-3 (<2mg/cm <sup>2</sup> 10 days @ 70 Degree C)	Yes/No	
10	ROHS	ROHS/ELV Compliant	Yes / No	

**11.10 Fiber Optic LIU with Pigtails, Splice Trays& Splice Protectors (Fully Loaded)**

S. No.	Specifications	Requirement	Compliance	Deviation
1	Connector Type	SC-Style, Simplex	Yes / No	
2	Operating temperature	-40 Degree C to +85 Degree C	Yes / No	
3	Durability & color		Yes / No	
3	MM connectors	500 cycles, Beige	Yes / No	
4	SM connectors	220 cycles, Blue	Yes / No	
5	Ferrules	Pre-radiused Ceramic Ferrules	Yes / No	
6	Attenuation	Not more than 0.75 dB per mated pair	Yes / No	
7	Fiber Optic Patch panels			
9	FMS- Front Patching / Splicing Shelf	1U • 19” / ETSI versions available	Yes / No	
		The FMS fiber management shelf series is ideal for high density front patching applications.	Yes / No	
		Its compact design and high density capacity allows it to deliver carrier class fiber management to central offices, POPs, FTTx, mobile systems and LANs.	Yes / No	
		• High Density:	Yes / No	
		1U: 12/24 Fiber terminations	Yes / No	
		• Should be supplied loaded with secondary coated SC pigtails	Yes / No	
		• Mounting brackets can be placed in different positions	Yes / No	
10	• Drawer concept allows for	o Easy access to splicing tray	Yes / No	
		o Easy access to back side of connector	Yes / No	
		• Trays with hinges(book type) which allows facilitates easy fiber management and greater access during installation and rework	Yes / No	
		• Fiber guides, radius controls & secure tie downs provided	Yes / No	
11	Dimensions	Width- 450 mm & Depth - 280 mm , Height – 44 mm	Yes / No	
12	Color	RAL 7035 / Black	Yes / No	

**11.11 SC to SC Patch Cord**

S. No.	Specifications	Requirement	Compliance	Deviation
1	Make and Type	SC to SC Duplex Fiber Optic Patch Cord 3 Mtr,9/125 Micron	Yes / No	
2	Cable Sheath	LSZH	Yes / No	
3	Cable Diameter	2.5 mm twin zip	Yes / No	
4	Ferrule	Ceramic	Yes / No	
5	Buffer	.9 mm easy strip	Yes / No	
6	Insertion Loss	MAX .3 db Typical .15 db	Yes / No	
7	Return Loss	> 45 db	Yes / No	
8	Temperature Range	-25 Deg. C +70 Deg. C	Yes / No	
9	ROHS	ROHS/ELV Compliant	Yes / No	

**11.12 SC to LC Patch Cord**

S. No.	Specifications	Requirement	Compliance	Deviation
1	Make and Type-	SC to LC Duplex Fiber Optic Patch Cords 3m 9/ 125 micron	Yes / No	
2	Cable Sheath	LSZH	Yes / No	
3	Cable Diameter	1.8 mm mini twin zip	Yes / No	
4	Ferrule	Ceramic	Yes / No	
5	Buffer	.6 mm	Yes / No	
6	Return Loss	> 45 db	Yes / No	
7	Insertion Loss	.1 db Typical Max .3 db	Yes / No	
8	ROHS	ROHS/ELV Compliant	Yes / No	

**11.13 SC to SC Patch Cord MM**

S. No.	Specifications	Requirement	Compliance	Deviation
1	Make and Type	SC to SC Duplex Fiber Optic Patch Cord 3 Mtr,50/125 Micron OM2/OM3	Yes / No	
2	Cable Sheath	LSZH	Yes / No	
3	Cable Diameter	2.5 mm twin zip	Yes / No	
4	Ferrule	Ceramic	Yes / No	
5	Buffer	.9 mm easy strip	Yes / No	
6	Insertion Loss	MAX .3 db	Yes / No	
7	Return Loss	> 20 db	Yes / No	
8	Temperature Range	Minus -10 Degree C to +60 Degree C	Yes / No	

S. No.	Specifications	Requirement	Compliance	Deviation
9	ROHS	ROHS/ELV Compliant	Yes / No	

**11.14 SC to LC Patch Cord MM**

S. No.	Specifications	Requirement	Compliance	Deviation
1	Make and Type	SC to LC Duplex Fiber Optic Patch Cord 3 Mtr 50/125 Micron OM2/OM3	Yes / No	
2	Cable Sheath	LSZH	Yes / No	
3	Cable Diameter	1.8 mm twin zip	Yes / No	
4	Ferrule	Ceramic	Yes / No	
5	Buffer	.6 mm easy strip	Yes / No	
6	Insertion Loss	MAX .3 db	Yes / No	
7	Return Loss	> 20 db	Yes / No	
8	Temperature Range	Minus -10 Degree C to +60 Degree C	Yes / No	
9	ROHS	ROHS/ELV Compliant	Yes / No	

**12. CABINETS AND RACKS:**

a. 42 U Floor mounted free Standing cabinets:

- 42 U Floor mounted cabinets having dimensions H 2013 x W 800 x D 800 mm with reversible front door made of safety glass of thickness 4 mm supplied with cable manager.
- Removable side panels fitted with key lock and solid rear door fitted with key lock.
- Integrated base with ventilated plate at the front
- Solid cable entry plate at the top & bottom
- IP 20 as per IEC 60529 with solid sealing.
- IK 08 as per NF EN 62262 and IEC 62262
- RAL 9002

b. 36 U free standing floor Mounted cabinets:

- 36 U Floor mounted cabinets H1747mm x W 800 mm x D800 mm with reversible front door made of safety glass of thickness 4 mm supplied with cable manager.
- Removable side panels fitted with key lock and solid rear door fitted with key lock.
- Integrated base with ventilated plate at the front
- Solid cable entry plate at the top & bottom
- IP 20 as per IEC 60529 with solid sealing.

- IK 08 as per NF EN 62262 and IEC 62262
- RAL 9002

## UPS SYSTEM

### 1. GENERAL REQUIREMENTS

- 1.1 The scope of work for supply and installation of UPS system shall include design manufacture, supply, installation, testing and commissioning of all related equipments together with all accessories and auxiliaries as per specifications.

The system shall be fully operational and shall comply to the specified codes and standards.

The contractor shall be responsible for providing all materials, equipments and engineering services specified or which are required to fulfill the intent of ensuring reliability of the total work covered under these specifications within his quoted price.

- 1.2 Supply and installation of the UPS system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable Standards.

- |     |  |   |   |
|-----|--|---|---|
| a.  | IEEE Standard 446-1987                         | : | Emergency and standby power systems.  |
| b.  | IEEE Standard 450-1975                         | : | cable termination on UPS  |
| c.  | IEEE Paper 4-177                               | : | Some discharge characteristics of lead acid batteries.                        |
| d.  | IEC 60140-3                                    | : | UPS Performance   |
| e.  | IEC 60140-2                                    | : | Electro Magnetic Compatibility  |
| f.  | IEC 60140-1                                    | : | Safety  |
| g.  | ANSI C 37.90a,<br>IEEE Standard 472            | : | Surge withstand capability test.  |
| h.  | ANSI C 34.2                                    | : | Practices and requirements for semiconductor power rectifiers.                |
| i.. | ANSI C 37.90                                   | : | Relays and relay system associated with electrical power apparatus.           |
| j.  | NEMA PE-1-1983                                 | : | Uninterrupted Power System Standard   |
| k.  | IS 2208 & IS 9224<br>(Part 1 & 2) (I.E.C. 269) | : | Cartridge fuses for voltages upto and including 650 V                         |
| l.  | IS 9224 (Part - 4)                             | : | Fuses for protection of semiconductors.                                       |
| m.  | BS 2709 (I.E.C 119)                            | : | The Electrical Performance of Semiconductor Rectifiers.<br>(Metal Rectifiers) |
| n.  | BS 4417 (I.E.C 146)                            | : | Semi-conductor Rectifier Equipments.  |
| o.  | IS 13947 : 1993                                | : | Specification for Low voltage Switchgear & Control gear                       |
| p.  | IS 3961(Part 2) :1967                          | : | Recommended current rating for PVC insulated Cables                           |

- q. IS 1652 & IS 1652 : Lead-acid stationary cells and batteries.
  - r. BD 9720 : Custom-built transformers and inductors of assessed quality.
  - s. IP20 : Degree of protection.
  - t. IEC : Semi Conductor Convertor Standards.
  - u. JEC : Standard of the Japanese Electro technical committee
  - v. JIS : Japanese Industrial Standard.
  - w. JEM : The standard of the Japan Electrical Manufactures Association.
  - x. ISO 9001 approved
- 1.3 The contractor shall submit his offer for UPS systems as indicated in the tender document.
- 1.4 All components of the UPS equipment shall have Surge Withstand Capability (SWC) to meet the requirements of ANSI C62.41-1980. ANSI C 37.90a, IEEE Standard 472-1974.
- 1.5 All components of UPS system shall withstand short circuit current without any damage.
- 1.6 Following general requirements shall be met for ensuring proper circuit protection.
- a. Fuses shall not be larger than 125% of the transformer primary circuit current where the secondary circuit fuse protection has not been provided.  
  
Where the secondary fuses are sized not larger than 125% of the secondary current of the transformer, fuses shall not be required in the primary circuit, provided the primary feeder fuses are not larger than 250% of the transformer primary current.
  - b. All the neutral conductors in three phase UPS systems shall be sized equal to at least 150% of the maximum phase current. In addition, all the isolators and circuit breakers used in three phase UPS system shall also rate such that the neutral poles shall take at least 150% of the maximum phase current.
  - c. All control shall be designed and positioned such that possibilities of inadvertent or accidental operations are eliminated.
  - d. All UPS system cabinets, frames and power equipment shall be double earthed.
- 1.7 The UPS design shall ensure that a single component/ device failure shall not result in failure of the entire UPS system. The design of UPS System shall be modular to permit easy maintenance.
- 1.8 The various overload capacities of inverters, static switch, step down transformer/voltage stabilizer as specified herein are the minimum requirements. However, if the Contractor's offered system has better overload capacities for the above devices, the same shall be highlighted by the Bidder in his bid.
- 1.9 The UPS system offered by the contractor shall be suitable for operating continuously at the rated capacity indicated in tender with in ambient temperature 0-40°C and relative humidity of 0 to 95%. Also the UPS system shall be suitable for operation as per full rating upto 1000 meters above sea level without derating. The Contractor shall furnish a certificate towards compliance on ambient conditions permissible.

- 1.10 The UPS system to be supplied by the contractor shall have maximum humming noise level of 69 DB one meter away from the UPS cabinets.
- 1.11 Suppression of Radio Interference shall be provided to meet statutory requirements.
- 1.12 Detailed literature should be provided showing Quality Assurance Procedure adhered to.
- 1.13 The contractor shall submit detailed item by item compliance statement along with the tender.

## **2. FUNCTIONAL REQUIREMENTS**

- 2.1 Contractor shall furnish On-Line Uninterruptible Power Supply (UPS) system of continuous duty of the ratings mentioned in Bill of Quantities. Each UPS shall give regulated filtered & uninterruptible power supply as described in the specifications.
- 2.2 Contractor shall note that the KVA ratings of the UPS systems shall be guaranteed at 40°C ambient temperature. In case contractor's standard UPS KVA rating are based at a lower temperature, the contractor must consider a derating factor of at least 1.5% per deg.C for arriving at the specified UPS capacity at 40°C ambient temperature.
- 2.3 In case the calculated /specified UPS capacity is not the same as one of the standard KVA ratings of the UPS manufacturer, the next higher standard KVA rating shall be selected. UPS of non-standard rating shall not be acceptable.
- 2.4 UPS system supplied by the contractor shall be the latest state of the art technology system fully digitalized using microprocessor controlled full wave rectification and IGBT inverter.
- 2.5 Batteries shall be valve regulated lead acid specially ment for UPS application.
- 2.6 Monitoring and control system shall also be state of the art technology LCD touch panel type providing all relevant data described in this document.
- 2.7 The monitoring and control system shall be capable of RS485 with MODBUS protocol input software for connecting to customer's computer system for data display and monitoring.
- 2.8 All necessary components required for protecting UPS equipment and connected inputs and outputs shall be furnished by the Contractor as an integral part of the UPS system.
- 2.9 The control logic power supply shall have redundant power supply AC input and the system battery as power sources.
- 2.10 The UPS systems shall include but not be limited to the following equipment :
  - a. UPS system including 100% capacity float-cum-boost charger with 100% sealed valve regulated lead acid batteries with guaranteed battery life of 5 years.
  - b. Suitable factory built battery cabinet for housing the batteries, including terminal isolator / breaker and power disconnect device. The enclosure shall conform to IP 20 as minimum.
  - c. All cables, connectors, accessories like trunking, cable trays, conduits etc. required for connection between battery and the UPS unit.

## **3. STATIC CONVERTER**

### **3.1 General**

The static converter (rectifier) shall be a multi-functional converter providing functions of power conversion, battery charging and shall have the additional functions of input power factor improvement



and current harmonics reduction. The converter equipment shall include all necessary control circuitry and device to conform requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. as given below.

The converter shall be a solid state static PWM converter utilizing utilize Insulated Gate Bipolar Transistors (IGBT) or Intelligent Power Module (IPM) transistors and shall include intelligent features like the drive circuitry, over current protection, over temperature protection, control power failure protection and short circuit protection.

The IGBT / IPM transistors shall enable high speed switching at 6 KHz thus reducing the heat dissipation in the UPS and thereby providing high efficiency.

The PWM converter shall utilize the above and achieve unity power factor and reduce input current harmonics as given earlier and thus improve the overall power factor of the converter achieving input KVA savings.

During any step inverter load change (0-100%) the converter shall only supply 100% current to the inverter. The battery shall not be cycled at any time during this step load changes.

### **3.2 Input Current Limit**

The converter logic shall provide input current limiting by limiting the DC output current. Two (2) line-side current transformers shall be employed as a means of sensing the current amplitude. The converter logic shall also be capable of providing auxiliary current limited when the logic is signaled to do so via an external dry contact closure (e.g. UPS fed from generator). The converter shall be capable of supplying overload current in excess to the full load rating. It shall also have sufficient capacity to provide power to a fully loaded inverter while simultaneously recharging the system battery to 95% of full capacity within 10 times the discharge time. The DC output current limit values shall be as follows:

- Rectifier output current (maximum) 100%.
- Rectifier output current (aux.) 25% - 100% variable.

Note : 100% current shall be under the battery recharging mode.

### **3.3 Battery Charge Current Limited**

The converter logic shall provide current limiting function of battery charging to prevent the battery from damage. The following battery current limit and protection shall be provided.

- Battery charge current limit 10% of battery Ah rate.
- Over-current protection at 120% of above item.

### **3.4 Voltage Regulation**

The rectifier / charger output voltage including variation effects of input voltage does not deviate by more than +/- 1% of the nominal output voltage, due to the following conditions:

- Form 0 to 100% loading.
- Rectifier input variations of voltage and frequency within the limitations set in Section 3.10.
- Environmental condition variations within the limitations set in Section 3.10.

### 3.5 Automatic Input Current Walk-in

The converter logic shall employ circuitry to allow a delayed and timed ramping of input current. Subsequent to energizing the converter input, the ramping of current shall be delayed by a maximum of 3 seconds. Upon starting the walk-in process, the ramping of current is timed to assume the load gradually within 1 through 60 seconds (every 1 second selectable).

### 3.6 Input Overload Protection

The A/C input fuses shall be provided at the converter input as a means of overload protection.

The AC maximum current shall be controlled by the Converter.

### 3.7 Equalizing Charge Timer

The UPS logic shall provide an electronic automatic equalize charge timer which shall be selectable 24 hours for Lead Acid type or 8 hour for Alkaline type batteries. The timer circuit, once activated shall provide a high rate equalizing charge voltage to the system battery for the selected time. The circuit shall also be capable of manual activation via the LCD touch panel mounted on the front door. The level of equalizing voltage shall be equal to that stated by the battery manufacturer. Upon completion of the timer count, the converter output voltage shall automatically return to the specified float voltage.

### 3.8 Step Load Change

During any step inverter load change (0-100%), only the converter shall supply 100% current to the inverter. The batteries SHALL NOT be cycled at any time during these step load changes.

### 3.9 Input Voltage

The converter shall be fed from the Normal Power Supply source.

### 3.10 The converter shall meet the following specifications in addition to other requirements stated herein :

Nominal Voltage	:	415V, 3 Phase, 3 Wire
Voltage Range.	:	+ 15% / - 30% AC
Normal Frequency	:	50 Hz $\pm$ 8 %
Frequency Range	:	$\pm$ 8% ( $\pm$ 4 Hz)
Input Power Factor	:	0.9 lagging or more at full load (PF improvement)
Input Harmonic Current THD	:	3% typical at 100% load 6% maximum at 50% load
Duty	:	Continuous at 40 deg.C
Cooling	:	Forced cooling using fans with thermal relays using a latched cut out for re-setting as protection for cooling fans. Each individual fan shall have its own thermal relay.
Ambient operating temperature range	:	Operating - 0 to 40 deg.C maximum.  Storage & Transport -20°C to 70°C

Operating Relative Humidity	:	0-95% non-condensing.
Operating Altitude	:	Altitude Operating: to 3,000 ft. (1,000 meters) above Mean Sea Level. Derated for higher altitude applications.  Storage/Transport: to 40,000 ft. (12 200 meters) above Mean Sea Level
Magnetized sub-cycle in rush current	:	Typically 8 times normal full load current
Converter Walk-in time	:	1 through 60 seconds (every 1 second selectable, (0 to 100% rated load)
Input	:	Suitable terminals shall be provided for termination of cables from the AC distribution board.

#### **4. STATIC INVERTER**

##### **4.1 General**

The static inverter shall be of solid state type using proven Pulse Width Modulation (PWM) technique. The inverter equipment shall include all necessary control circuitry and devices to conform requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. as given below.

The inverter shall utilize Insulated Gate Bipolar Transistors (IGBT) or Intelligent Power Module (IPM) Transistors which shall provide intelligent features like the drive circuitry, over-current protection, over temperature protection, control power failure protection and short circuit protection.

The IGBT / IPM transistors shall enable high speed switching of 6 Khz thus reducing the heat dissipation in the UPS and thereby providing high efficiency.

The UPS shall utilize both Voltage and Current feedback control circuits so that the inverter shall act not only as a constant voltage source but also as a load required current source. This shall enable the inverter to quickly adapt to the changing load current value and wave shape.

##### **4.2 Voltage Regulation**

The inverter output voltage shall not deviate by more than + 1% RMS due to the following steady state conditions :

Form 0 to 100% loading

Inverter DC input voltage varies from maximum to minimum.

Environmental conditions variations within the limitations set in the section 4.8.

##### **4.3 Frequency Control**

The inverter output frequency shall be controlled by an oscillator internal to the UPS module logic. It shall be capable of synchronizing to an external reference (e.g. the bypass source or another UPS module) or operating asynchronously. The oscillator shall maintain synchronization with the external reference within the limitations set hereunder. The inverter shall operate on self-run mode without synchronism if the bypass frequency exceeds the set value. The oscillator, while running asynchronously, shall maintain the frequency as 50 Hz  $\pm$  0.01% (or + 0.005 Hz). Automatic adjustment of phase relationship between inverter output and standby bypass source shall be gradual at a controlled slew rate which shall be adjustable at the rate of 0.5, 1.0, 2.0, 3.0 Hz / second. (Default 2.0 Hz / second).

The inverter output frequency shall not vary during steady state or transient operation due to the following conditions:

- a. From 0 to 100% loading.
- b. Inverter DC input varies from maximum to minimum.
- c. Environmental condition variations within the limitations set in section 4.8.

#### **4.4 Output Voltage Harmonic Distortion**

The inverter output shall limit the amount of harmonic content to the values stated in section 4.9. The use of excessive or additional filtering shall not be required to limit the harmonic content thus maintaining a high level of efficiency, reliability and original equipment footprint.

#### **4.5 Output Overload Capability**

The inverter output shall be capable of providing an overload current while maintaining rated output voltage to the values stated in section 4.8. An LED indicator shall be located on the control panel to identify this condition. If the time limit associated with the overload condition expires or the overload is in excess of the set current amplitude, the load shall be transferred to the bypass source without interruption.

#### **4.6 Inverter Current Limit**

The inverter output shall be limited to 150% of rated load current. The two sensing locations shall operate separately and independently thus providing redundancy and, in the event of a failure, preventing unnecessary damage to power transistor components / fuses. Load current above 150% shall cause an immediate transfer of the load to the bypass source for fault clearing.

#### **4.7 Inverter Overload Protection**

The AC output from the inverter shall utilize fuses for overload protection. The inverter shall utilize a contactor to isolate the inverter output from the critical bus.

The inverter fuses shall be the fast acting semiconductor type.

The inverter output isolation contactor shall be located in the UPS module and shall be controlled by the internal UPS module system logic.

#### **4.8 The inverter shall meet the following specifications in addition to other requirements stated herein:**

Voltage Input	:	Three Phase UPS : Nominal 360 V DC (Range 290 V to 414 V DC to maximum DC bus voltage during charging the batteries).
Nominal Voltage Output	:	415 V $\pm$ 1% AC 3 Phase, 4 Wire
Inverter Capacity	:	
Voltage Regulation	:	
a. For 0 to 100% loading	:	< $\pm$ 1%
b. Inverter DC input voltage vary from	:	

maximum to minimum	:	<± 1%
c. Environmental conditions given below	:	<± 1%
Transient Voltage Regulation	:	
a. AT 100% step load change.	:	<± 3%
b. At loss or return of AC input.	:	<± 1%
c. At load transfer from bypass to inverter.	:	<± 3%
Time to recover from transient to normal voltage.	:	10 milli seconds
Wave form	:	
a. Normal frequency	:	50 Hz
b. Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination (automatically controlled).	:	± 0.05%
c. Synchronization limits for synchronism between the inverter and standby AC source.	:	49 Hz to 51 Hz.
d. Field adjustment range for above	:	50 ± 0.25 Hz to 50 ± 1.5 Hz
4.9 <b>Total voltage harmonic distortion</b>	:	< 2% THD for 100% linear load < 4% THD for 100% non-linear load
Duty	:	Continuous
Cooling	:	Forced cooling using fans.
Ambient operating temperature range	:	0 to 44 <sup>0</sup> C maximum continuous.
Operating relative humidity	:	0-95% non-condensing.
Operating altitude.	:	Sea level to 1000 meters.
Output	:	Suitable terminals are provided for termination of cables for connecting inverter output to AC distribution board.

#### 4.10 Built-in Isolation Transformer

This shall provide neutral separation which shall mean that output neutral will be independent of incoming neutral, hence critical load shall be isolated from the problems like incoming neutral open or, short or, variations in neutral to earth voltage due to sudden loading in neighboring installation.

#### 4.11 Reverse Phase Sequence Protection

In the event of Phase sequence reversal at the input, UPS system shall continue to work on the main power supply, or UPS systems shall go into battery mode, and shall not trip the UPS system.

**4.12 Overall efficiency (AC to AC)**

94% at 100% load  
92% at 75% load  
87% at 25 % load

**5. UPS BATTERY SYSTEM**

- a. The UPS system shall, as an integral part, provide battery system for backup time as specified in the Schedule (Full Load) standby capacity.
- b. The latest state of the art Valve Regulated Sealed Maintenance Free Lead Acid Batteries shall be used with a 20 hours discharge rating.
- c. The battery system shall be sized to provide backup time as specified in the schedule of quantity when the UPS is supplying 100% rated load at 0.8 load power factor.
- d. An ageing factor of 15% shall be applied to the capacity arrived at, to allow for compensation against capacity loss during float operation.
- e. The battery system design shall be provided with necessary devices to prevent deep discharge beyond recommended limits to prevent the batteries discharging beyond end cell voltage specified by the battery maker. The connections from battery to battery shall be by using copper bus bar strips and the entire battery system shall be used in IP20 steel cabinet enclosure and shall be similar to the UPS enclosure.
- f. All batteries shall be clearly identified and identification numbers marked on the batteries and a schematic diagram along with the complete calculations, including manufacturers supporting curves, shall be submitted with the tender.
- g. The UPS shall have a properly rated and sized circuit breaker to isolate it from the battery.

**6. OPERATION**

- a. Under normal operation, the UPS load will be fed from the Inverter with the bypass switch inhibited. The Converter, apart from providing DC power to the Inverter, also charges the battery under the float charge mode. The battery charge system shall have float charge, equalizing charge and recovery charge modes, to replenish the batteries self-discharging part while the battery is fully charged, equalizing the battery cell voltage to a constant value forcibly, and recharging the battery system to the required values when the batteries have been used, respectively.
- b. The Inverter shall constantly monitor the AC source frequency and shall be in synchronization with the AC input source till the frequency of the AC input source is within synchronizing limit and if the frequency of the standby source exceeds the synchronizing limit the Inverter will work on its own internal oscillator maintaining an output frequency of 50 Hz +/- 0.01% under all conditions of load. When the Inverter operates on its internal oscillator, it shall continuously monitor the frequency of the input source and when the input source frequency returns to within synchronization limit, the Inverter shall automatically synchronize itself with the input A/C source frequency and use it as a signal for Inverter output frequency control.
- c. Battery Operation:

- i. When the A/C input voltage drops below specified limits or in case of a power failure the Inverter continues to supply AC power of constant voltage and constant frequency utilizing the battery system as a power source until the input voltage returns to normal requirement. When the power supply is resumed or the input voltage returns to limits, the Converter shall automatically start and the load fed for normal operation status.
  - ii. If the power failure continues beyond battery backup time or the battery voltage drops to the final discharge voltage, the Inverter should automatically stop and at the same time transferring the load to the bypass circuit. On resumption of power supply, the Converter shall automatically re-start the operations and charge the batteries whereas the Inverter should inhibit automatic start and should be started manually.
- d. Bypass Operation:
- When power is supplied from the Inverter in synchronization with the bypass, it shall accomplish the following:
- i. When the UPS output current reaches overload status it shall automatically transfer the load to bypass circuit with no interruption and when the overload status is cleared it automatically re-transfers the load to Inverter.
  - ii. When the battery final discharge condition is reached, the load shall automatically be transferred to the bypass circuit without interruption.
  - iii. In case of failure of the UPS, the load shall be automatically transferred to the bypass circuit with no interruption and when the failure is cleared, re-transfer the load to the Inverter shall be done manually.
  - iv. There should be provision made in the system to prevent, when necessary, asynchronous transfer.
  - v. When the UPS goes on bypass mode in any of the conditions described above and if at that time there is no bypass power supply available due to power failure, the UPS shall remain in standby mode and as soon as the bypass power supply is available will transfer the load to bypass.
  - vi. A maintenance bypass transfer switch shall be provided with lock and key arrangement and should be manually done by authorized personnel only.

## 7. CONTROL AND MONITORING

- a. The UPS shall utilize state of the art full DDC control software driven Control and Monitoring System.
- b. It shall be provided with LED displays.  
  
Metering should display the following parameters on the control panel
  - i. Input AC voltage line-to-line and line-to-neutral for each phase
  - ii. Input AC current for each phase
  - iii. Input frequency
  - iv. Battery voltage

- v. Battery charge/discharge current
- vi. Output AC voltage line-to-line and line-to-neutral for each phase
- vii. Output AC current for each phase
- viii. Output frequency
- ix. Percent of rated load being supplied by the UPS
- x. Battery time left during battery operation.
- xi. Bypass power available.

Following alarm messages to be displayed at the control panel:

- i. Input power out of tolerance
- ii. Input phase rotation incorrect
- iii. Incorrect input frequency
- iv. Charger in reduced current mode
- v. Battery Charger Problem
- vi. Battery failed test
- vii. Low battery warning (adjustable 1 to 99 minutes)
- viii. Low battery shutdown
- ix. DC bus overvoltage
- x. Bypass frequency out of range
- xi. Load transferred to bypass
- xii. Excessive retransfers attempted
- xiii. Static switch failure
- xiv. UPS output not synchronized to input power
- xv. Input power single phased
- xvi. Input voltage sensor failed
- xvii. Inverter leg over current in X-phase
- xviii. Output under-voltage
- xix. Output over-voltage
- xx. Output over-current
- xxi. System output overloaded



- xxii. Load transferred to bypass due to overload
  - xxiii. Overload shutdown
  - xxiv. Control Error
  - xxv. Critical power supply failure
  - xxvi. Load transferred due to internal protection
  - xxvii. External shutdown (remote EPO activated)
  - xxviii. Fan failure
  - xxix. Over temperature shutdown impending
  - xxx. Over temperature shutdown.
  - xxxi. Lamp test.
- c. The UPS logic should provide one set of normally open dry contact / relay output to allow interfacing of UPS operating status to an external system and should be capable of providing, as a minimum, 10 numbers status and, should the UPS manufacturer's standard product does not provide such software, the bidder must add additional equipment and cost for the same.
- d. The UPS shall also have an RS485 port with MODBUS interface card if required for interfacing to BAS system or client's centralized computer network.
- e. LCD touch panel (Optional)
- i. The UPS shall be provided with a operator friendly large scale LCD touch panel.
  - ii. The LCD touch panel shall also include graphic measurement display, operational procedures of each activity, fault status display and also have capability to record at least 200 faults.
  - iii. The touch screen panel shall clearly define specified areas for operational function, execution and message display.
  - iv. It should be possible to operate the entire UPS system and its components and obtain all measurements and data through the touch screen operation. The measurement software should provide capability to measure phase voltage, current in each phase, frequency, power factor, available battery time etc.
  - v. Under all operating conditions, the system software should have capability for displaying fault alarm automatically. The tenderer should describe in detail the faults that would be displayed under this mode.

## **8. UPS TESTING**

- a. The Contractor shall perform the following tests, as a minimum, at site prior to handing over, to confirm the functional and the performance specification of the UPS as specified. All required test equipment like Digital Oscilloscope, Voltage Regulator and Measurement Meters etc. shall be the responsibility of the Contractor without any additional cost.
- b. The Contractor shall demonstrate as a minimum the following features on site by providing all required test equipment, such as power factor improvement, input current THD, output

voltage THD, output frequency and all other performance monitoring requirements detailed before as required by the Owner.

**SPECIFICATION FOR UPS SYSTEM**

RATING OF UPS	:	AS PER BOQ
TYPE	:	ON LINE
INPUT:		
VOLTAGE	:	415V $\pm$ 15%
FREQUENCY	:	50Hz $\pm$ 10%
OUTPUT:		
VOLTAGE	:	415V $\pm$ 1% (True sine wave)
OVER LOAD CAPACITY	:	110% for 20 Minutes 125% for 05 Minutes 150% for 01 Minutes
FREQUENCY	:	50Hz $\pm$ 0.05
DC CHARACTERSTICS	:	DC ripple with battery connected = $\pm$ 1 %
OPERATING TEMPERATURE	:	40 Degree centigrade maximum 95% Humidity
CABLE ENTRY	:	Cable entry provision to be given for bottom entry.
BYPASS	:	Manual bypass to be provided.
PROTECTIONS & INDICATIONS	:	Standard protections and indications to be provided as required. No Filter.
THD DATA OUTPUT	:	Harmonic distortion shall be less than 20% on linear load 5% on non linear loads as per IEC.
CREST FACTOR	:	Crest Factor should be $>3:1$ . UPS should be parallel upto six units without using any separate synchronization panel.
BATTERIES	:	Batteries to be sealed maintenance free complete with all the required mounting accessories.
BACKUP TIME	:	30 Minutes as per BOQ.
COOLING	:	Forced Air.
BATTERY CHARGING CURRENT	:	Vendor to specify.
BATTERY CAPACITY	:	To be indicated, Calculations to be furnished by the tenderer. Specify VAH.
DIMENSIONS OF UPS & BATTERY	:	To be filled by the tenderer
OVERALL SPACE FOR MOUNTING ALONG WITH ROOM SIZE.	:	To be filled by the tenderer.
EARTHING	:	To be filled by the tenderer.

<b>Electrical Lighting Specifications</b>	
<b>Area</b>	<b>Item Description</b>
<b>Auditorium</b>	XAL Make sasso 80 Recessed Lighting , One Spot Light Installation with Ball Catch System 18W COB LED with 2210 Lumens, 5000K with 40 Degree Light Distribution along with Honeycomb Louver, 360* Rotatable and 35* Tilttable, less than 3 MacAdam Binning, CRI > 90, Minimum 80% Luminous Flux after 50,000 Hours. DALI LED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, DALI control input, 1 %-100 % dimming range, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours
<b>Auditorium</b>	XAL Make SASSO+ 150 Recessed Lighting Level, One Spot Light Installation with Ball Catch System 46W COB LED with 5030 Lumens, 5000K with 25 Degree Light Distribution along with HoneyComb Louver, 360* Rotatable and 35* Tilttable, less than 3 MacAdam Binning, CRI > 80, Minimum 80% Luminous Flux after 50,000 Hours. DALI LED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, DALI control input, 1 %-100 % dimming range, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours
<b>AUDITORIUM STAGE</b>	XAL Make Clax 80 K Deep Recessed Round Spot Light with Honey Comb Louver, Fixture Made of Die Cast Aluminium, 18W COB LED with 2210 Lumens, 5000K, Tilttable 18*, Improved Glare Reduction through Deep Recessed mounting with Passive cooling of LEDs with Optimised Heat sink Geometry and High Quality Reflector made of Pure Aluminium having precise radiation characteristics, less than 3 MacAdam Binning, CRI > 80, Minimum 80% Luminous Flux after 50,000 Hours. DALI LED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, DALI control input, 1 %-100 % dimming range, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input,

	<p>and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>
<p><b>AUDITORIUM PREFUNCTION</b></p>	<p>XAL Make Sasso 100 Deep Recessed Round Spot Light with Louver, Fixture made of Die cast Aluminium with Trimless Offset Mounting set, 26W COB LED with 3200 Lumens , 5000K, 360* Rotatable and Tltable 35*, Improved Glare Reduction through Deep Recessed mounting with Passive cooling of LEDs with Optimised Heat sink Geometry and High Quality Reflector with Spherical facet finish, Precise radiation characteristics, less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. Non Dim LED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>
<p><b>AUDITORIUM BACK STAGE</b></p>	<p>XAL Make MIRA Round 150, Round Luminaire housing made from Die Cast Aluminium housing with Trim, 19W LED with 2100 Lumens, 5700k , DLOR 77%, Homogeneously illuminated Micro Prismatic Cover for reducing Luminance and Glare, LEDs having less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. Tunable White Color Temperature against Controls to match different lighting scenarios. NON DIMLED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use,, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>

<p><b>AUDITORIUM                  PREFUNCTION</b></p>	<p>XAL Make Clax 80 K Deep Recessed Round Spot Light with, Fixture Made of Die Cast Aluminium, 18W COB LED with 2210 Lumens, 5000K, Titable 18*, Improved Glare Reduction through Deep Recessed mounting with Passive cooling of LEDs with Optimised Heat sink Geometry and High Quality Reflector made of Pure Aluminium having precise radiation characteristics, less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. NON DIM LED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>
<p><b>Exhibition Area</b></p>	<p>Qlite make COB LED source downlight QL R-FJAA FRDL 10W with Dali Dim driver 43mm cutout, optical lens for enhanced lighting output, LED driver 9V-250mA, 230V-50Hz, housing and mounting ring made of high pressure die cast aluminum with white/silver/black powder coating options, light source COB LED with optical lens, long life LED source with 50000 hours L70F10, CRI&gt;80, minimum 500 lumens output, CCT 3000K, beam angle 25°/40°, IP20, CE, RoHS.</p>
<p><b>Exhibition Area</b></p>	<p>XAL Make TIMO 80 Free 3 Phase Track Light made of Die Cast Aluminium, 18W COB LED having 2210 Lumens, 5000K, with Honey Comb Louver, 38* Degree Beam Angle, 355* Rotatable and 90* Tilttable Outward, White/Black Powder Coated with Integrated Converter, Passive cooling of LEDs with Optimised Heat sink Geometry and High Quality Reflector made of Pure Aluminium having precise radiation characteristics, less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. DALI LED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, DALI control input, 1 %-100 % dimming range, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>

<p><b>Exhibition Area</b></p>	<p>XAL Make TIMO 80 Free 3 Phase Track Light made of Die Cast Aluminium, 26W COB LED having 3200 Lumens, 5000K, with Honey Comb Louver, 38* Degree Beam Angle, 355* Rotatable and 90* Tilttable Outward, White/Black Powder Coated with Intereg rated Converter,</p> <p>Passive cooling of LEDs with Optimised Heat sink Geometry and High Quality Reflector made of Pure Aluminium having precise radiation characteristics, less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. DALI LED Driver should be</p> <p>Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, DALI control input, 1 %-</p> <p>100 % dimming range, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature).</p> <p>Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>
<p><b>Exhibition Area</b></p>	<p>Global make Led surface mounted track patti with live end cap with Dead end with St connector</p>
<p><b>EXHIBITION AREA (CENTER CEILING)</b></p>	<p>XAL Make Clax 80 K Deep Recessed Round Spot Light with , Fixture Made of Die Cast Aluminium, 18W COB LED with 2210 Lumens, 5000K, Tilttable 18*, Improved Glare Reduction through Deep Recessed mounting with Passive cooling of LEDs with Optimised Heat sink Geometry and High Quality Reflector made of Pure Aluminium having precise radiation characteristics, less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. DALI LED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, DALI control input, 1 %-</p> <p>100 % dimming range, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>
<p><b>TEMPORARY EXHIBITION FIRST FLOOR</b></p>	<p>XAL Make MIRA Square 150, Square Luminaire housing made from Die Cast Aluminium housing with Trim, 19W LED with 2100 Lumens, 5700K, DLOR 77%, Homogeneously illuminated Micro Prismatic Cover for reducing Luminance and Glare, LEDs having less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. Tunable White Color Temperature against Controls to match different lighting scenarios. LE</p>

	<p>D Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>
<p><b>TEMPORARY EXHIBITION SECOND FLOOR</b></p>	<p>XAL Make MIRA Square 150, Square Luminaire housing made from Die Cast Aluminium housing with Trim, 19W LED with 2100 Lumens, 5700K, DLOR 77%, Homogeneously illuminated Micro Prismatic Cover for reducing Luminance and Glare, LEDs having less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. Tunable White Color Temperature against Controls to match different lighting scenarios. LED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>
<p><b>Banquet hall</b></p>	<p>XAL Make Sasso 100 Deep Recessed Round Spot Light with , Fixture made of Die cast Aluminium with Trimless Offset Mounting set, 26W COB LED with 3200 Lumens , 5000K, 360* Rotatable and Tilttable 35*, Improved Glare Reduction through Deep Recessed mounting with Passive cooling of LEDs with Optimised Heat sink Geometry and High Quality Reflector with Spherical facet finish, Precise radiation characteristics, less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. LED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature) . Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>



<p><b>Banquet hall</b></p>	<p>XAL Make Sasso 80 Deep Recessed Round Spot Light with , Fixture made of Die cast Aluminium with Trimless Offset Mounting set, 18W COB LED with 2210 Lumens , 50 00K, 360* Rotatable and Titable 35*, Improved Glare Reduction through Deep Recessed mounting with Passive cooling of LEDs with Optimised Heat sink Geometry and High Quality Reflector with Spherical facet finish, Precise radiation characteristics, less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. LED Driver should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>
<p><b>Banquet hall</b></p>	<p>XAL Make Clax 80 K Deep Recessed Round Spot Light with , Fixture Made of Die Cast Aluminium, 18W COB LED with 2210 Lumens, 5000K, Titable 18*, Improved Glare Reduction through Deep Recessed mounting with Passive cooling of LEDs with Optimised Heat sink Geometry and High Quality Reflector made of Pure Aluminium having precise radiation characteristics, less than 3 MacAdam Binning, CRI &gt; 80, Minimum 80% Luminous Flux after 50,000 Hours. LED Drivers should be Protected up to 4 kV power network fast transients, High efficiency, 0.87, Built in strain relief for independent use, lacquer coating provides improved robustness in challenging climate conditions (humidity, temperature). Operating Voltage range 198 - 264 VAC, External NTC thermal input, and considering all recommendations in EN 60598 having Driver life time of more than 50000 Hours</p>
<p><b>AUDI(GROUND FLOOR) CELLING DESIGN, CORRIDOR</b></p>	<p>Qlite make LED strip QL DLS19.2W 5630-30-24X, high brightness single colour LED strip with aluminum profile, 19.2w/M, 60 LED/M, 30 LED/module, 5630 SHARP SMT package, efficacy 112 lumens/ watt, CCT 3000 K/6000K, high luminous intensity, size 12mm (W) x 495mm (L) x 1.6mm (H), slim design, with DALI dimming driver 24V DC, high reliability, 0.4A current, solid state high shock vibration resistant, beam angle 120°, maintenance free easy installation long life &gt; 50000 hours L70, operating temperature -20° to +60°, very low power consumption and low heat, cuttable size 99mm, good thermal conductivity, aluminum PCB, 9.6 watt/module, LED package size: 5.6mm x 3.0mm x 0.87mm, SMD type top view, IP20.</p>

<p><b>AUDI(GROUND FLOOR) WALL</b></p>	<p>Qlite make LED strip QL DLS9.6W 3014-TWIN, high brightness single colour dual line LED strip with aluminum profile, 9.6w/M, 120 LED/M, 84 LED/module, 3014 SHARP DURIS E3 SMT package, efficacy 112 lumens/watt, CCT 3000K/6000K, high luminous intensity, size 8mm (W) x 700mm (L) x 1.6mm (H), slim design, with DALI dimming driver 24V DC, high reliability, 0.56A current, solid state high shock vibration resistant, beam angle 120°, maintenance free easy installation long life &gt; 50000 hours L70, operating temperature -20° to +60° very low power consumption and low heat, cuttable size 50mm, good thermal conductivity, FR4 PCB, 6.72 watt/module, LED package size: 3.0mm x 1.4mm x 1.2mm, SMD type top view, IP20</p>
<p><b>Exhibition Area (GROUND FLOOR) CEILING</b></p>	<p>Qlite make LED strip QL DLS19.2W 5630-30-24X, high brightness single colour LED strip with aluminum profile, 19.2w/M, 60 LED/M, 30 LED/module, 5630 SHARP SMT package, efficacy 112 lumens/watt, CCT 3000K/6000K, high luminous intensity, size 12mm (W) x 495mm (L) x 1.6mm (H), slim design, with DALI dimming driver 24V DC, high reliability, 0.4A current, solid state high shock vibration resistant, beam angle 120°, maintenance free easy installation long life &gt; 50000 hours L70, operating temperature -20° to +60°, very low power consumption and low heat, cuttable size 99mm, good thermal conductivity, aluminum PCB, 9.6 watt/module, LED package size: 5.6mm x 3.0mm x 0.87mm, SMD type top view, IP20.</p>
<p><b>AUDI PREFUNCTION (GROUND FLOOR) CEILING</b></p>	<p>Qlite make LED strip QL DLS19.2W 5630-30-24X, high brightness single colour LED strip with aluminum profile, 19.2w/M, 60 LED/M, 30 LED/module, 5630 SHARP SMT package, efficacy 112 lumens/watt, CCT 3000K/6000K, high luminous intensity, size 12mm (W) x 495mm (L) x 1.6mm (H), slim design, with DALI dimming driver 24V DC, high reliability, 0.4A current, solid state high shock vibration resistant, beam angle 120°, maintenance free easy installation long life &gt; 50000 hours L70, operating temperature -20° to +60°, very low power consumption and low heat, cuttable size 99mm, good thermal conductivity, aluminum PCB, 9.6 watt/module, LED package size: 5.6mm x 3.0mm x 0.87mm, SMD type top view, IP20.</p>

## II. **Technical Specifications for HVAC System**

### **SPECIAL CONDITIONS**

#### 1. GENERAL

These special conditions are intended to amplify the General Conditions of Contract, and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply.

#### 2. SCOPE OF WORK

The general character and the scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative. The contractor shall furnish all labour, materials and equipment (except those to be supplied by the owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete air conditioning system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The central Ventilation and Air-Conditioning system shall comprise of following:-

- a. Air handling units (AHUs) with DX Coiling Coil
- b. VRV Outdoor Unit for AHU
- d. Tube axial & Propeller fans for mechanical ventilation systems.
- g. AHU fan section.
- h. Variable Frequency Drives
- i. Motor control centers.
- j. Automatic balancing valve & thermostats for AHUs.
- k. GI ducts inclusive of external insulation, acoustic lining, canvas connections, volume control dampers, and smoke dampers, motorized fresh air dampers as required.
- l. Supply and return air registers and diffusers.
- m. Insulation of refrigerant pipes.
- n. Vibration isolators for all Air-Conditioning and Ventilation equipment.
- o. Automatic controls and instruments.

- p. Wiring and earthing from MCC panels to various refrigeration, air conditioning, and mechanical ventilation equipment, control wiring and interlocking.
- q. Cutting holes, chases and the like through all types of nonstructural walls, and finishing for all services crossings, including sealing, frame work, fire proofing, providing sleeves, cover plates, making good structure and finishes to an approved standard. No additional payment shall be made by Owners on this account.
- r. Balancing, testing, and commissioning of the entire Air-Conditioning and mechanical ventilation installation.
- s. Test reports, list of recommended spares, as-installed drawings, operation, and maintenance manual for the entire Air-Conditioning and Ventilation installation.
- t. Training of Owner's Staff.

### 3. PROJECT EXECUTION AND MANAGEMENT

The Contractor shall ensure that senior planning and erection personnel from his organization are assigned exclusively for this project. They shall have minimum 10 years' experience in this type of installation. The Contractor shall appoint one Project Director holding senior management position in the organization. He shall be assisted on full time basis by a minimum of two erection engineers & three senior supervisors. The entire staff shall be posted at site on full time basis.

The project management shall be through modern technique. The Contractor's office at site shall be fully equipped with fax, internet facility, computers, plotter, and photocopier. Erection engineer and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, contractor shall assign at least one full-time engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the air conditioning installation.

The Contractor shall arrange to have mechanised & modern facilities of transporting material to place of installation for speedy execution of work.

Following manpower deployment shall be provided by the contractor:-

- a. One Project Director
- b. 1 Senior Engineer (minimum 10 years' experience) & 1 Junior Engineer (5 years' experience).
- c. 3 Senior Supervisors

- d. 1 QA/QC Engineer (Part Time)
- e. 1 Housekeeping in charge with at any given time minimum 3 years experience.
- f. 1 Store Keeper.

4. PERFORMANCE GUARANTEE

The contractor shall carry out the work in accordance with the Approved shop drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.

The contractor shall guarantee that the HVAC system as installed shall maintain the inside conditions in the air-conditioned spaces as described under “Basis of Design” in the specifications. The guarantee shall be submitted in the proforma given in Appendix - II.

Complete set of architectural drawings is available in the Architect/Consultant’s office and reference may be made to same for any details or information. The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

5. BYE-LAWS AND REGULATIONS

The installation shall be in conformity with the Bye-laws, Regulations, and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

6. FEES AND PERMITS

The contractor shall obtain all permits/ licenses and pay for any and all fees required for the inspection, approval and commissioning of their installation. However any receipted amount shall be reimbursed on presentation of proof of payment.

7. DRAWINGS

The HVAC Drawings listed under Appendix-I, which may be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment, controls, grilles, and diffusers.

The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom and space conditions shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Architect/Consultant/Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner.

The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

8. TECHNICAL DATA

Each tenderer shall submit alongwith his tender, the technical data for all items listed in Appendix-IV in the indicated format. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.

9. SHOP DRAWINGS

- 9.1 All the shop drawings shall be prepared on computer through AutoCAD System based on Architectural Drawings, site measurements and Interior Designer's Drawings. All heat load calculations shall be done using latest version of HAP/Trace/ASHRAE HLCP only. Within four weeks of the award of the contract, contractor shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, AHU rooms, fan rooms, ; detailed ducting drawings showing exact location of supports, flanges, bends, tee connections, reducers, guide vanes, silencers, distribution grids, volume control dampers, collars, grilles, diffusers; detailed piping drawings showing exact location and type of supports, valves, fittings etc; acoustic lining and external insulation details for ducts, pipe insulation etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations. These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/Owner's site representative.

These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 12 sets of drawings shall be submitted after final approval along with CD.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in Appendix-III and quoted by the tendered in technical data part of Appendix - IV.

When the Architect/Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The contractor shall submit further twelve sets of shop drawings to the Owner's site representative for the exclusive use by the Owner's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.

- 9.2 Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.

- 9.3 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labelled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number, and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.
- 9.4 Samples of all materials like grilles, diffusers, controls, insulation, pre-moulded pipe section, control wires etc. shall be submitted to the Owner's site representative prior to procurement. These will be submitted in two sets for approval and retention by Owner's site representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.
- 9.5 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supercede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.
- 9.6 Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect/Consultant/ Owner's site representative. Any delay on such account shall be at the cost of and consequence of the Contractor.
- 9.7 HVAC Contractor shall prepare coordinated services shop drawings based on the drawings prepared by Electrical, Plumbing & Low Voltage Contractors to ensure adequate clearances are available for installation of services for each trade.

Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's site representative, the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

- 9.8 Within four weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by



manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.

10. QUIET OPERATION AND VIBRATION ISOLATION

All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Owner's site representative. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the specified at dB / NC levels

11. ACCESSIBILITY

The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his ducting and piping. His failure to communicate insufficiency of any of the above shall constitute his acceptance of sufficiency of the same. The Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed control damper, valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense. Access panel shall be standardised for each piece of equipment / device / accessory and shall be clearly nomenclatured / marked.

12. MATERIALS AND EQUIPMENT

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per Appendix - III.

13. MANUFACTURERS INSTRUCTIONS

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

14. ELECTRICAL INSTALLATION

The electrical work related to air conditioning services, shall be carried out in full knowledge of, and with the complete coordination of the contractor. The electrical installation shall be in total conformity with the control wiring drawings prepared by the contractor and approved by the Architect/Consultant. All air conditioning equipment shall be connected and tested in the presence of an authorised representative of the contractor.

The air conditioning system shall be commissioned only after the contractor has certified in writing that the electrical installation work for air conditioning services has been thoroughly checked, tested and found to be totally satisfactory and in full conformity with the contract Drawings, Specifications and manufacturers instructions. It is to be clearly understood that the final responsibility for the sufficiency, adequacy, and conformity to the contract requirements, of the electrical installation work for air conditioning services, lies solely with the contractor.

15. COMPLETION CERTIFICATE

On completion of the Electrical installation for air conditioning, a certificate shall be furnished by the contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The contractor shall be responsible for getting the entire electrical installation for air conditioning system duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

16. BALANCING, TESTING AND COMMISSIONING

Balancing of all air and water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASHRAE Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season.

The results for summer, monsoon, and winter air conditioning in quadruplicate, shall be submitted for scrutiny. Four copies of the certified manufacturers performance curves for each piece of equipment, high lighting operational parameters for the project, shall be submitted alongwith the test certificates. Contractor shall also provide four copies of record of all safety and automatic control settings for the entire installation.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner's site representative. All tests shall be carried out in the presence of the representatives of the Architect/Consultant and Owner's site representative.

17. COMPLETION DRAWINGS

Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of two sets of CD's and four portfolios (A-1 or A-0 size) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate complete plant room layouts, ducting and piping layouts, location of wiring and sequencing of automatic controls, location of all concealed piping, valves, controls, dampers, wiring and other services. Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The contractor shall frame under glass, in the air-conditioning plant room, one set of these consolidated control diagrams.

18. OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of part HVAC system the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner's site representative and two for Owners Operating Personnel.

These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

19. ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment, and maintenance of all equipment installed.

20. MAINTENANCE DURING DEFECTS LIABILITY PERIOD

20.1 Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

20.2 Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Owner.

21. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperatures, pressures, humidity, and power consumption. Starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance, and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the Owner's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

22. OPERATION AND MAINTENANCE

Contractor may be required to carry out the operation of the HVAC installation for the defects liability period. Further, he may also be required to carry out operation and all inclusive maintenance of the entire system for a period of four years beyond the defects liability period.

22.1 Operation contract (HVAC System)

- i. 24 hours a day, year round.
- ii. All stand-by equipment to be operated as per mutually agreed programme.
- iii. Proper entry and upkeep of relevant log books.

- iv. Maintain complaints register. Submit weekly report.
- v. Proper housekeeping of all areas under the contract.
- vi. Prepare daily consumption report and summary of operation.

22.2 Terms of payment

- i. Monthly at the end of each month on pro-rata basis.

22.3 All Inclusive Maintenance Contract

- a. Routine Preventive Maintenance Schedule to be submitted
  - i. Schedule to cover manufacturer's recommendation and/or common engineering practice (for all plant and machinery under contract).
  - ii. Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.
  - iii. Monthly status report.
  - iv. Entire HVAC installation to be painted in fourth year (from commissioning) before the expiry of operation and maintenance contract.
- b. Uptime during maintenance contract
  - i. 98% uptime of all systems under contract.
  - ii. Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.
  - iii. There shall be no reimbursement for the extended period.
  - iv. Break-downs shall be attended to within ten hours of reporting.

- v. Spare compressor/motor assembly to be made available within seven calendar days in case of total breakdown/burnout.

c. Manpower

- i. Adequate number of persons to the satisfaction of the Owner's site representative shall be provided including relievers.
- ii. Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.
- iii. Duty allocation and Roaster control shall be contractor's responsibility.
- iv. No overtime shall be payable by Owner for any reason whatsoever.

d. Shut Downs

- i. Routine shut downs shall be permitted only during winter season.
- ii. Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.

e. Payment Terms

- i. Quarterly payment at the beginning of each quarter on pro-rata basis.

23. PARTIAL ORDERING

Owner through the Architect/Consultant/ Owner's site representative reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderers.

24. SOFT WATER AND POWER REQUIREMENT

The contractor shall submit with their tender, their requirement of soft make-up water and power requirement

APPENDIX – I

**III GUARANTEE PROFORMA**

**GUARANTEE FOR HVAC INSTALLATION**

We hereby guarantee the year round Air Conditioning & Ventilation System which we have installed in the Complex described below :

Building: **COMMERCIAL BUILDING(BEC BUILDING)**

Location: **DHOLERA**

For a period of 12 months from the date of acceptance of the total installation, WE AGREE TO repair or replace to the satisfaction of the Owner, any or all such work that may prove defective in workmanship, equipment or materials within that period, ordinary wear and tear and unusual abuse or neglect excluded, together with any other work, which may be damaged or displaced in so doing. In the event of our failure to comply with the above mentioned conditions within a reasonable time, after being notified in writing, we collectively and separately, do hereby authorise the Owner to proceed to have the defects repaired and made good at our expense, and we shall pay the cost and charges thereof, immediately upon demand.

WE ALSO HEREBY UNDERTAKE to test the entire installation in first SUMMER, WINTER AND MONSOON on following the completion of the installation, to check and do everything necessary to ensure that the specified indoor conditions in all spaces are maintained, that all water and air systems are properly balanced, that all controls are calibrated accurately, and that all units are functioning satisfactorily.

**SIGNATURE OF CONTRACTOR**

**for HVAC INSTALLATION**

**DATE :**

**SEAL**

## APPENDIX – II

### LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS

<u>S.No.</u>	<u>Details of Materials / Equipment</u>	<u>Manufacturer's Name</u>
1.	Air Handling Unit	Edgetech VTS-poland Zeco Waves
2.	Air Handling Units accessories such as Corners, Profiles, Hinges, Handlesetc.	Hira Arosio
3.	Cooling Coil for AHU	Edgetech VTS-poland Zeco Waves
4.	Variable Refrigerant Flow System	Midea Mitsubishi Toshiba
5.	Axial Flow Fan	Kruger Nicotra System Air Daimair
6.	Pan Type Humidifier	Emerald Rapid Cool
7.	UV Protective coating	Armacell Armachek Amicol Pidelite Emerald
8	Thermometer	H Guru Taylor



9.	AHU Fan Section	Edgetech VTS-poland Zeco Waves
10	GI Sheet	Jindal SAIL TATA
11.	Factory Made Duct	Ductofab Rolastar
12.	Grille/diffuser	Green Air Tanus Tristar
13.	Smoke / Fire Damper	Green Air Tanus Tristar
14.	Anchor Fastener	Fischer Hilti Rawlplug
15.	Pre-Insulated Duct	ALP PAL
16.	Fire Wrap/Board/Paint	Birla 3 M Hilti
17.	INSULATION:  Cross linked Polyethylene	Aeroflex Armacell Eurobatex – Union Foam Supreme
18.	Fiber glass (Foil Faced)	Owens Corning

		UP Twiga
19.	Protective Coating over Pre Insulated exposed duct – Fiber-glass Woven Cloth	Aeroflex Armacell Eurobatex – Union Foam Supreme
20.	UV Protective coating	Aeroflex Armacell Eurobatex – Union Foam Supreme
21.	Fire Sealant	Birla 3 M Hilti
22.	Welding rods	ADVANI (A dove) ESAB
23.	Structural Steel	Jindal Tata
24.	Air Filters	Airtech Puromatic Thermodyne Spectrum
25.	MISCELLANEOUS	
	Vibration Isolator	Dunlop Resistoflex

<u>S.No.</u>	<u>Details of Materials / Equipment</u>	<u>Manufacturer's Name</u>
<b>ELECTRICAL ACCESSORIES</b>		
1	Motor Control Centre & Bus Ducts	Adlec System Pvt Ltd Advance Panels & Switchgear Tricolite Milestone SPC
2	Motor	ABB Siemens Bharat Bijlee Kirloskar
3	Starter	ABB Allen Bradley Schneider Siemens Kirloskar L&T
4	Variable Frequency Drive (VFD)	ABB Danfoss Siemens VACON
5	Air Circuit Breaker ( 3/4 Pole ) (Select any one range only)	ABB (E-Max) L&T (U-Power) Schneider Electric (Master Pact NW) Siemens (3 WL)
6	Moulded Case Circuit Breaker (MCCB)	ABB (T-Max) MDS Legrand L&T (D-Shine)

		Schneider Electric (Compact NS) Siemens (3 VL)
7	Motor Protection Circuit Breaker(MPCB)	Siemens Hager(Marketed by L&T) Schneider Electric ABB
8	Miniature Circuit Breakers (MCB)	Siemens Hager (L&T) Havells (Export Range) Schneider Electric –(Multi 9) ABB MDS Legrand
9	Residual Current Circuit Breaker (RCCB)	ABB Hager (L&T) MDS Legrand Schneider Electric (Multi 9)Siemens
10	Power/Aux. Contactor	ABB Larsen & Toubro Schneider Electric Siemens

<b><u>S.No.</u></b>	<b><u>Details of Materials / Equipment</u></b>	<b><u>Manufacturer's Name</u></b>
11	Change Over Switch	H H Elcon HPL – Socomec Larsen & Toubro
12	Control Transformer/Potential Transformers	Automatic Electric Gilbert & Maxwell
13	Current Transformer (Epoxy Cast Resin)	Automatic Electric Gilbert & Maxwell
14	PROTECTION RELAY	
	a. Numeric Type	ABB Areva
	b. Electromagnetic Type	ABB Areva
15	Indicating Lamps LED type and Push Button	Altos GE Power Controls Larsen & Toubro (ESBEE) Schneider Electric (MG)
16	Overload relays with built in Single Phase preventer	ABB L&T Schneider Electric(Telemechanique) Siemens
17	Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED Display	ABB Automatic Electric Konzerv L & T

		Schneider Electric Secure
18	Dual Energy Meter with centralized metering & billing system	ActarisConserve Secure
19	Prepaid Meters & accessories	Actaris Conzerve Secure
20	Electromagnetic Meters	Automatic Electric Rishabh (L&T) Conserve
21	Static Power Meter & Logger (SPML) with RS 485 port	Conzerv El measure Larsen & Toubro Schneider Electric
22	Autoamtic Power Factor Correction Relay (Numeric Type)	Areva BELUK (Germany) Conzerv Ducati Siemens

<b><u>S.No.</u></b>	<b><u>Details of Materials / Equipment</u></b>	<b><u>Manufacturer's Name</u></b>
23	Thyristerised APFC Control Panel	ABB Ducati Meher(Larsen & Toubro) Power Matrix Solutions Siemens
24	PVC insulated XLPE aluminum/copper conductor armored MV Cables upto 1100 V grade	Finolex Polycab KEI Skytone
25	LT Jointing Kit / Termination	Raychem REPL Safe Kit
26	Cable Glands Double Compression with earthing links	Dowell's Comet Cosmos
27	Bimettalic Cable Lug	Comet Cosmos Dowell's (Biller India) Hax Brass (Copper Alloy India)
28	PVC insulated copper conductor stranded flexible wires (FRLS) -	Finolex Polycab Lapp kabel KEI Skytone
29	Mettalic Conduit (ISI approved)	AKG

		BEC
30	PVC Conduit (ISI approved)	AKG BEC Polypack
31	INDUSTRIAL SOCKET	
	Splash Proof	Clipsal MDS Legrand Schneider Electric
	Industrial Socket Metal Clad	BCH MDS
	Selector Switch, Toggle switch	Kaycee Salzer (Larsen & Toubro)
	Timer	ABB BCH Larsen & Toubro MDS Legrand Schneider Electric Siemens



<b><u>S.No.</u></b>	<b><u>Details of Materials / Equipment</u></b>	<b><u>Manufacturer's Name</u></b>
	Cable Trays (Factory Fabricated) / Raceways	Slotco Indiana Pilco Rico Steel
	Fire Sealant & Fire Retardant Paint	Birla 3 M HILTI Promat

**APPENDIX – III**

**SCHEDULE OF TECHNICAL DATA**

**1. AIR HANDLING UNIT WITH DX COOLING COIL**

**1.1 GENERAL**

- a. Manufacturer
- b. Type of unit (Double/Single skin) (draw-thru/blow thru)
- c. Material and thickness of casing (inner/outer)
- d. Material and thickness of drain pan.
- e. Material and thickness of sandwiched insulation for drain pan
- f. Type of flexible connection
- g. Type of vibration isolator

**1.2 FAN SECTION**

- a. Manufacturer.
- b. Type of fan and model number
- c. Material and thickness of fan wheel blades
- d. Material and thickness of housing.
- e. Confirm statically and dynamically balanced to grade 6.3(complete fan motor assembly)
- f. Type of bearings.
- g. Fan RPM

**1.3 MOTORS**

- a. Manufacturer
- b. Type
- c. Electrical characteristics ( $\pm 10\%$  voltage variation)
- d. Motor speed (RPM)

- e. Motor Efficiency
- f. Class of Insulation
- g. Motor operated through VFD, confirm following :
  - i. Motors do not get derated
  - ii. Higher size motor is not required.

**1.4 DXCOOLING COIL**

- a. Manufacturer
- b. Material of tubes
- c. Material of fins
- d. No of fins/inch
- e. Test pressure.

**1.5 AIR FILTERS**

- a. Manufacturer
- b. Type of filters
- c. Filter medium
- d. Pressure drop across filters (mm. of water) / Clean & Dirty
- e. Efficiency

**1.6 AIR HANDLING UNITS (OPERATING DATA)**

-----  
AHU NO.  
-----

AIR QTY (CFM)

-----  
TOTAL SP (mmWg)

-----  
FAN ABSORBED POWER (BHP/BkW)

-----  
FAN SPEED (RPM)

-----  
FAN OUTLET VELOCITY (FPM or m/s)

-----  
FAN MOTOR (HP/kW)

SOUND POWER LEVEL (DB re  $10^{-12}$ W)

Mid Freq.	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz
SWL(dB)								

-----

SOUND PRESSURE LEVEL(dBA) at fan outlet

Mid Freq.	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz
SPL(dB)								

-----

COIL FACE AREA (Ft<sup>2</sup>)

-----

COIL FACE VEL (FPM)

-----

AIR SIDE PRESSURE DROP ACROSS COOLING COIL (mmWg)

-----

WATER SIDE PRESSURE DROP IN COOLING COIL (Kg/cm<sup>2</sup>)

-----

NUMBER OF ROWS

-----

WATER VELOCITY IN TUBES (m/s)

-----

TYPE OF FILTERS

-----  
FILTER FACE VELOCITY (FPM or m/s)  
-----

-----  
FILTER EFFICIENCY (%) & PARTICLE SIZE ( $\mu\text{m}$ )  
-----

-----  
AIR PRESSURE DROP IN CLEAN & DIRTY CONDITIONS (mmWg)  
-----

-----  
OVERALL DIMENSIONS  
LxWxH (METRES)  
-----

-----  
OPERATING WEIGHT  
-----

## 2. CENTRIFUGAL / AXIAL FLOW FANS

### 2.1 GENERAL

- a. Manufacturer
- b. Type
- c. Bearings
- d. Casing Material
- e. Impeller Material
- f. Shaft Material
- g. Vibration Isolators
- h. Fan Size and Model
- i. Fan speed
- j. Fan efficiency
- k. Noise level
- l. Noise attenuator
  - i. Manufacturers
  - ii. Type
  - iii. DB reduction guaranteed at 2 M & 3 M distance from Noise attenuator
  - iv. length (Metre)
- m. Motor
  - i. manufacturer
  - ii. type
  - iii. operating speed
  - iv. motor efficiency and class of insulation.
  - v. Electrical Characteristics ( $\pm 10\%$  voltage variation).
  - vi. Type of starter & manufacturer
- n. Type of drive
- o. Material of flexible connection
- p. Type of vibration isolators
- q. Motor operated through VFD, confirm following :
  - i. Motors do not get derated
  - ii. Higher size motor is not required.

2.2 OPERATING DATA

Centrifugal

Axial Flow

-----  
FAN MODEL  
-----

FAN CFM  
-----

FAN OUTLET VELOCITY (FPM)  
-----

SP (MM)  
-----

FAN RPM  
-----

NOISE LEVEL (DB)  
-----

DB REDUCTION BY ATTENUATOR  
-----

RESULTANT NOISE LEVEL (DB)  
-----

BHP



-----  
LIMIT LOAD HP  
-----

MOTOR (HP)  
-----

FULL LOAD CURRENT (AMPS)  
-----

STARTING CURRENT (AMPS)  
-----

**3. PROPELLER FANS**

- a. Manufacturer
- b. Motor HP
- c. Capacitors provided.
- d. Speed Regulator for single phase fans
- e. Gravity louvers
- f. Single phase preventor for 3 phase fans
- g. Back draft damper.
- h. Bird Screen
- i. Wire guard

**4 THERMOSTAT FORAHU UNITS**

- a. Make / Type
- b. Model
- c. Cooling only
- d. Range

- e. Differential
- f. Fan Speeds
- g. Sub base provided
- h. Electrical characteristics

5. VARIABLE REFRIGERANT FLOW (VRF) SYSTEM

General

- a. Country of origin
- b. Refrigerant
- c. Remote control for each indoor unit included (Y/N)
- d. Number of zone/floor control panels
- e. BMS compatible (Y/N)

Indoor unit and Treated fresh air unit

- a. Type
- b. Casing material
- c. Air quantity (cfm)
- d. External static pressure
- e. Fan motor rating (kW)
- f. Cooling capacity at design conditions (TR)
- g. Drain pump provided (Y/N)
- h. Overall size (mm)
- i. Operating weight (kg)

Outdoor unit

- a. Type (Top / side discharge)
- b. Casing material
- c. Heat rejection capacity at design conditions (Btu/hr)
- d. Type of compressor / model number
- e. Number of compressors
- f. Saturated suction temperature to produce designed indoor conditions ( $^{\circ}\text{C}$ )
- g. Saturated condensing temperature to produce designed ambient conditions ( $^{\circ}\text{C}$ )

- h. Cooling capacity at above conditions (TR)
  - i. Type of condenser fans
  - j. Number of condenser fans
  - k. Motor rating of condenser fans
  - l. Sound pressure level in dBA at 3m distance
  - m. Overall dimension of unit (mm)
  - n. Operating weight
6. INLINE FANS
- a. Manufacturer
  - b. Motor HP
  - c. Speed Regulator
  - d. Single phase preventer
  - e. Bird Screen
  - f. Wire guard
7. VIBRATION ISOLATION SYSTEM
- a. Manufacturer
  - b. Type
  - c. Stiffness coefficient and Deflection
  - d. Vibration isolation efficiency (%)
  - e. Material of flexible connection at
  - f. Expansion Joints
8. Dry scrubber
- a. Type
  - b. Make
  - c. Material of construction
  - d. Filtration efficiency
  - e. Operating weight
  - f. Power consumption
  - g. Overall dimensions

9. VARIABLE SPEED FREQUENCY DRIVE FOR AHU & FANS

- a. Make / Country of Origin
- b. Model No.
- c. Type
- d. Motor Rating
- e. Rated Current
- f. Maximum Output
- g. PID Controller
- h. Interface with BAS.
- i. Harmonic filter builtin (Confirm)
- j. Fault Indication.
- k. Dimensions (mm)
- l. No. of Steps
- m. Operating Weight

10. ELECTRICAL ACCESSORIES (Make of the following)

- a. Motor Control Centre (Electrical Panel)
- b. Vacuum circuit breaker
- c. Air circuit breaker
- d. MCCB
- e. MCB
- f. Rotary switch
- g. Soft Starter
- h. Auto-transformer Starter
- i. Automatic Star Delta Starter
- j. Direct on line Starter
- k. Contactor
- l. Current Transformer (cast resin type)
- m. Single phase preventor
- n. Push Button Change over switch

- o. Ammeter & Voltmeter KWH meter
- p. Relay
- q. Indication lamp
- r. Cables
- s. Wires
- t. Variable Frequency Drive.

**11. ELECTRICAL TECHNICAL DATA SHEETS**

**For MCC +PDBs+MLDBs/SLDBs/DBs ( To be filled by the bidders)**

	<b>Description</b>	<b>Recommended Specification</b>	<b>Confirmation by the Bidders</b>
	Type of Panel	a. MCC non drawout type compartmentalized.  b. AHU Panels non drawout type, non compartmentalized	
	Type of Mounting	Free standing Floor Mounted	
	Fault kA	50kA -1 Sec for MCC 25kA – 1 Sec for AHU Panels	
	Thickness of CRCA sheets Structural members Covers and doors Base channel Gland plate	3mm 2mm MCC - ISMC 100 3mm	
	Painting/ Process	Synthetic Enamel Paint As per seven tank process Oven baked.	
	Paint shade; a. Inside b. Outside	RAL – 7032 RAL - 7032	

	Details of busbars	Electrolytic grade Copper of specified rating for details see constructional features mentioned in specifications	
	Cable Entry	For MCC & AHU Panels Top or Bottom depending upon location of Panel.	
	Enclosure Protection/ Ventilation	For MCC – IP -52 with louvers for Ventilation.	
	Control Wiring/Power Wiring Voltage Circuit Current Circuit Minimum size of Power wiring CKt	Insulated 660Volts Cu wire. 1.5 sq mm 2.5 sq mm 16 sq mm	
	Maximum Operating Height	2100	
	Mounting height of Relays/Meters Control Switches	Range 350mm to 1900mm	