ELECTRICAL MATERIAL SPECIFICATION

E- 1 H. T. BREAKER

1.0 SCOPE:

This specification covers the requirements of supply, installation, testing, commissioning of HT indoor metal clad cubicle switch gear having 1 incoming 2 out going Vacuum Circuit Breakers. These are general requirements of switchgear panel.

1.1 APPLICABLE STANDARDS:

The switch gear panel and components mounted shall conform to the following latest revisions of relevant Indian or equivalent British or International standards. In case of any conflict between the BS/IS and this specification, the tendered shall assume the more stringent of the two and furnish his rates accordingly.

IS: 2516 (Part1 sec.2)	Specifications for circuit breakers. General & Definitions (for voltages above 1000V A.C.).
IS: 2516 (Part1 sec.3)	Specifications for Alternating circuit breakers requirements (voltage above 11KV).
IS: 2516 (Part 2 sec.2)	Circuit breaker tests voltage (range 1 KV to 25 KV D.C.)
IS: 4710	Switches and switch isolators (above 1 KV but not exceeding 11 KV.)
IS: 375	marking and arrangement of switch gear Copper bus bars.
IS: 2707 (Part 1 to 4)	Current Transformers for controlling.
IS: 3156	Voltage Transformers for metering.
IS: 1248	Electrical Indicating Instruments.
IS: 3231	Electrical relays for power system protection.
IS: 6875h	Control switches and push buttons.
IS: 4483	Preferred panel cutout for relays.
IS: 9046	HT Vacuum contactors.
IS: 3427	Degree of protection provided for metal enclosed switch gear and control gear.
IS: 5578	Guide for marking of insulated conductors.
IS: 5082	Material for data for Aluminum/ Copper conductors.
IS: 3618	Phosphate treatment of iron and steel for protection against corrosion.
IS: 6005	Code of practice of phosphating of iron and steel.
IS: 5	Painting.
IS: 722	Integrating meters.
IS: 2544	Specifications for HV post insulators.

1.2 CONSTRUCTION:

1.2.1 The switch gear panel shall be metal enclosed, rigid, free standing, floor mounted, draw out, dead front type and fabricated from standard prefabricated, cold rolled sheet steel units. The vertical units shall be assembled in such away that uniform height can be achieved while line up of each vertical units on floor. Entire panel should be suitable for extension on both sides to connect additional VCB panel in future.

1.2.2 The minimum thickness of the sheet steel shall not be less than 2.5 mm. Necessary stiffeners shall be provided.

1.2.3 The switchboard shall be totally enclosed, vermin -proof, except bus bar compartment. Degree of protection of enclosure shall be minimum IP56 as per IS: 3427. If necessary, openings for natural ventilation louvered with wire mesh shall be provided. For bus bar compartment wire mesh shall be such as to protect against object of 1.0 mm size and above.

1.2.4 All doors, removable covers, gland plates and other openings shall be gasketed all round the perimeter with neoprene gaskets.

1.2.5 Switch gear shall be provided with an ISMC channel as a base frame. Minimum height of the base frame shall be of 100 mm.

1.2.6 All doors shall be supported by strong hinges of concealed type and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.

1.2.7 Switchboards shall be suitable for site conditions as specified in the Technical Data Sheet.

1.2.8 Each unit of the switch gear shall be provided with necessary internal sheet metal barrier to form separate components for buses/Indicating instruments/protective relays/control and power cable connection etc. Compartment for cable connection shall allow adequate space for cable pulling, termination and connection work with energised switch gear. Suitable arc propagation barrier shall also be provided. Terminal strips for outgoing control cable connection should be accessible to facilitate working and testing with breaker in test/service condition with the energised switchboard.

1.2.9 After isolation of the power and control connection of a circuit, it shall be possible to safely carry out maintenance or a repair work in a compartment with the bus bars and adjacent circuits alive.

1.2.10 At a future date, it shall be possible to extend the switch gear in either direction. Ends of the bus bars shall be suitably drilled for this purpose. Panels at the extreme ends shall have openings which shall be covered with plate screw to the panel with necessary gaskets.

1.2.11 Switch gear shall be vertical isolation and horizontal draw out type.

1.2.12 All draw out circuit breaker trucks/trolley of the same rating for all outgoing breakers shall be identically wired/equipped for complete interchangeability at site. `Service', `Test', `Draw Out' positions of the draw out carriage of the switchboard shall be provided. Automatic safety shutters shall be provided to ensure the inaccessibility of all live parts after the breaker is drawn out.

1.2.13 Dummy panels required for rear extensions for cable terminations or to mount the components shall be included in the offer and details of each type of such panels shall be furnished along with offer.

1.3 SAFETY INTERLOCKS:

It shall not be possible to draw out the carriage with circuit breaker closed. The breaker feeder trolley shall remain inside the cubicle even in the `draw out' position. There shall be distinct overall door for the breaker compartment and it should be lockable. Suitable interlocks to prevent following faulty operations shall be provided.

1.3.1 `Plugging in' or `drawing out' of a closed breaker.

1.3.2 `Plugging in' a breaker with earthing isolator closed.

1.3.3 `Closing' of earthing isolator with breaker `Plugged in

1.3 4 Pulling out of auxiliary circuit plug with breaker in service position.

1.3.5 Pushing in breaker to service position with auxiliary circuit plug not in position.

1.3.6 Opening of compartment door with isolating switch in ON position and vice versa.

Necessary mechanical and electrical interlocks between H.T. and L.T. switch gears shall be provided in closing and tripping circuits of breakers which shall be a part of the specification. The total bill of material and scheme designed by the manufacturer will be subject to client/consultant's approval and any addition or deletion shall be binding to the manufacturer on the basis of unit rates available in the offer.

1.4 ACCESSIBILITY:

1.4.1 Checking and removal of components shall be possible without disturbing adjacent components. All components shall be easily accessible. It shall be possible to set all `measuring' and `protective' relays without de- energising the

switchboard. All mounted equipment shall have painted identification labels at the front & rear also. In addition to that identification numbers shall be painted on the panel wall to give permanent identification mark. Mounting of the relays for a particular breaker panel shall be limited to that particular panel.

1.4.2 Unused CT secondary terminals must be short circuited and wired to the terminal block. All terminals shall be shrouded with plastic covers to prevent accidental contact.

1.5 BUS BAR ARRANGEMENT

1.5.1 The switchboard shall comprise 3 phase bus bars as indicated in the Technical Data Sheet or SLD which shall extended through all units of the switch gear. All phase bus bars shall be of uniform cross section throughout the switch gear and shall be sized to carry continuously the current specified in the Technical Data Sheet or SLD. Bus bars shall be housed in a separate air insulated chamber and shall be accessible for inspection only with special tools. Wire guards/mesh shall be provided inside the sheet steel enclosure to allow visual inspection of bus bars, CT's, PT's and cable terminations and to avoid accidental touch when rear cover is removed.

1.5.2 Bus bars shall be made of electrolytic copper or as indicated in the Technical Data Sheet or SLD and shall be sleeved and joints shall be shrouded. Fiber glass/metal sheet with cast resin bushing partitions shall be provided at every junction between two adjacent cubicles. All bus bar joints shall be shrouded with shrouds having sufficient insulation level suitable for nominal system voltage.

1.5.3 Bus bars shall be supported at regular intervals and both, bus bars and the supports shall be adequately sized and braced to withstand the specified short circuit level without permanent deformation. Dynamic stresses shall be calculated on the basis of the specified peak short circuit currents. All bus supports shall be of none carbonizing material resistant to acids and alkalis and shall have non hygroscopic characteristics such as SMC, DMC epoxy bonded fiber glass.

1.5.4 Thermal design of the bus bars shall be based on installation of the switch gear in ventilated conditions. The cooling air volume shall take into account only the bus enclosure.

1.5.5 The maximum operating temperature of the bus bars at the maximum design temperature inside the panel shall be as per IS: 1272 and IEC 298

1.5.6 Bus bars shall be sleeved with colour coded type sleeve having insulation level suitable for nominal system voltage. If the insulating sleeve is not coloured bus bar shall be colour coded with coloured bands at suitable intervals.

1.5.7 All busbars joints and bus tap joints shall be of the bolted type and shall be shrouded. Spring washers shall be provided to ensure good contact at the joint locations and suitable contact grease shall be applied just before making a joint.

1.5.8 Live terminal or busbar shall be located at the top or on the left for vertical and horizontal layout respectively.

1.5.9 Sequence of Red, Yellow, Blue phases shall be left to right and top to bottom for horizontal and vertical layout respectively.

1.6 POWER CABLE CONNECTION:

1.6.1 The incoming and outgoing power cable connection shall be through PILC/XLPE/PVC cables of various sizes as indicated in the Technical Data Sheet or SLD. Ample space for connection for these cables shall be provided at the rear of the switchboard. In order to avoid accidental contact in the cable compartment while carrying out inspection by opening the back cover, a removable expanded metal barrier shall be provided in the cable compartment.

1.6.2 The cable entry of the switchboard shall be from the bottom side.

1.6.3 Cable lugs and the requisite bushes for sealing power cable entries shall be supplied along with the switchboard.

1.6.4 Bimetallic spring washers shall be provided for copper busbar to aluminum cable terminations.

1.6.5 The switchboard shall be supplied complete with supports for clamping outgoing and incoming cables. Terminal blocks shall not be used to support cables. The distance available between cable gland plate and terminal lug shall not be less than 750 mm for switchgear upto 11 KV. cables.

1.6.6 In case, cable termination cannot be accommodated in side the panel, a suitable box for mounting at the rear side and at the bottom of panel shall be supplied. Earth strip shall also be brought to this box. In lieu of this a dummy panel may be provided.

1.6.7 The individual switchgear panel shall have adequate space and terminal busbar clearance for accommodating no. of cables as specified in Technical Data Sheet and SLD. The type of cable termination units to be considered shall be heat shrinkable type.

1.7 CONTROL WIRING AND TERMINALS:

1.7.1 Inside the cubicle the wiring for control, indication, signaling, protection and instrument circuits shall be done with PVC insulated stranded conductors. The insulation grade shall be 650 V. The wiring shall preferably be enclosed in plastic channels or neatly bunched together.

1.7.2 10% spare terminals shall be provided on each terminal block. Conductors shall be terminated with adequately sized compression type copper lugs for connection to equipment terminal block. All auxiliary equipments terminals shall be made with pressure type terminals. Sufficient terminals shall be provided on each terminal block to ensure that not more than one outgoing wire is connected per terminal. Terminal strips shall preferably be separated from power circuits by metal barriers or enclosures. All spares contacts of aux. relays, timers etc. shall be wired upto the terminals.

1.7.3 Each wire shall be identified at both the ends by, correctly sized PVC ferrules. Shorting links shall be provided for all CT terminals.

1.7.4 For CT circuits 2.5 sqmm copper conductor shall be used. Other control wiring can be with 2.5 sqmm copper conductors.

1.7.5 Control cables shall enter the switchgear from the bottom/ top. It shall be possible to have the control cable entry from both the left and right side corners at the front portion of the switchgear without cutting any standard part of for these cables are also included in the scope of supply of the switchboard. The cable glands shall be compression type, supporting facilities shall be provided for clamping the control cables. All control cables shall be with 2.5 sqmm Cu stranded conductors.

1.7.6 All inter panel control wiring shall be done by the switch gear supplier. The inter panel wiring shall be taken through PVC sleeves or suitable grommets. Multi pin plug shall be provided and should have scraping earth terminal.

1.7.7 Control cable cutout and gland plate shall be provided preferably at the place where the power cable cutout will be provided. Gland plate for the control cables shall be separate from those provided for the power cables.

1.8 CONTROL AND INDICATION:

Breaker tripping and closing devices shall be operated on D.C. supply. The rated D.C. voltage shall be as specified in the Technical Data Sheet. The supply for breaker opening, closing and indication devices shall be provided as under:

a) One D.C. feeder shall be provided for each bus section. The Bus coupler panel may be fed from any of the two supplies.

b) One separate 240 V AC supply shall be provided for space heater etc.

Mechanical indication for breaker positions such as ON, OFF, Spring charged, test position/Service position shall be provided. Various Electrical indications with colours are indicated below shall be provided.

a)	Breaker `ON'	-	Red lamp
b)	Breaker `OFF'	-	Green Lamp
c)	Breaker `Auto Trip'	-	White lamp
d)	Trip circuit healthy	-	White lamp
e)	DC fail	-	Blue lamp.
f)	Red phase ON	-	Red
g)	Yellow phase ON	-	Yellow
h)	Blue phase ON	-	Blue

1.9 EARTHING CONNECTIONS:

1.9.1 Continuous earth bus-bar running throughout the length of the switchboard shall be provided. All doors and movable parts shall be connected to the earth bus with flexible copper connections. Provision shall be made to connect the earthing busbar to the plant earthing grid at two ends. All non-current carrying metallic parts of the equipment shall be earthed. Earth bus shall be brought back to cable compartment and earthing bolts shall be provided to ground cable Armour. Mating surfaces of all bolted parts shall be specifically zinc passivated to ensure continuity between them.

1.9.2 The material of the earth bus shall be copper or equivalent size of aluminum. The earth bus size shall be minimum 180 mm2 copper upto short circuit withstand capacity of 31.5 KA and 300 mm2 above 31.5 KA.

1.9.3 All instruments, relays and other components shall be connected to earth busbar by means of 650 V grade, PVC insulated, stranded tinned copper conductor of 2.5 sq.mm.

1.10 LABELS AND NAMEPLATES:

1.10.1 A nameplate with the switchgear designation at the top of the central panel and separate nameplate giving feeder details shall be provided at front and rear side of each panel.

1.10.2 Name plates shall be provided for each equipment (Lamps, PBs, Switches, Relays, Auxiliary contactors etc.) mounted on the switchboard. Special warning plates shall be provided on all removable covers or doors giving access to high voltage cables, busbars. Special warning label shall be provided inside the switchboard also, wherever considered necessary. Identification tags shall be provided inside the panels matching with those shown on the circuit diagram.

1.10.3 Engraved nameplates shall preferably be of 3-ply (Red-white- red or Black-white-Black lamicoid sheets or anodized aluminum or back engraved perspex sheet nameplates shall be provided. Engraving shall be done with square groove cutters. Hard paper nameplates will not be acceptable. Name plates shall be fastened by Screws and not by adhesives.

1.11 SHEET STEEL TREATMENT AND PAINT:

1.11.1 All metal surfaces shall be thoroughly cleaned and digressed to remove mill scale, rust, grease and dirt. Fabricated structure shall be pickled and then rinsed to remove any trace of acid. The under surface shall be prepared by applying a coat of phosphate paint, and a coat of yellow zinc chromate's primer. The under surface shall be made free from all imperfections before undertaking the finishing coat.

1.11.2 After preparation of the under surface, the switchboard shall be spray painted with two coats of final paint. Colour shade of final paint shall be smoke gray shade no. 631 as per IS: 5 unless otherwise specified. The finished panels shall be dried in stovings ovens in dust-free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, runoff, paint etc. The supplier shall furnish painting procedure details along with the offer.

1.11.3 All unpainted steel parts shall be cadmium plated or suitable treated to prevent rust corrosion. If these parts are moving elements, then these shall be greased.

1.12 SPACE HEATERS:

1.12.1 Each vertical cubical shall be provided with space heater to prevent moisture condensation and maintain required temperature. The space heaters shall be located at the bottom of the switchboard and shall be controlled through a thermostat with an adjustable setting with single pole MCB with overload and short circuit release in the phase, link in the neutral. The thermostat shall preferably be located in the metering/ relay chamber.

1.12.2 Space heater shall be of strip type rated for operation on a 240 V, single phase, 50 Hz., A.C. supply system.

1.13 BASE FRAME:

1.13.1 The switchboard shall be suitable to be installed on a base frame supplied in one piece along with foundation bolts. These base channels shall be dispatched two months in advance from the date of dispatch of switchboard so that they can be buried and grouted in the concrete floor. Ample dimensioned oblong holes shall be provided at the bottom of all the switchboards for their installation of base frame. In addition, the switchboard shall have an additional base channel at the bottom with smooth surface.

1.14 BREAKERS:

1.14.1 Vacuum circuit breaker shall be used in the switchboard. Exact type and rating shall be as indicated in the Technical Data Sheet.

1.14.2 Vacuum circuit breaker shall be designed with low switching over voltage level and long switching life. The interrupter shall be leak free with a target value of vacuum life as 25 years.

1.14.3 The breakers shall have at least 8 NO + 8 NC spare auxiliary contacts. If these are not available an auxiliary contactor shall be used to multiply the auxiliary contacts of the breakers. All auxiliary contacts shall be wired to the terminal block. Auxiliary contacts and limit switches shall be in dust tight enclosures.

1.14.4 The breaker shall have motor operated spring charged mechanism. In addition to this, it shall be possible to charge the springs manually, if required. In case the limit spring fails to cut out the spring charging motor when the springs are fully charged the motor shall be automatically decoupled and annunciation for this shall be provided. The control circuit shall be suitable for local as well as remote control. Breaker shall trip free and shall have an anti pumping device. Breaker operating duty shall be 0-3'-CO-3'-CO except for switchgear line up having motor feeders stage wise,

receleration feature in which case the duty shall be 0-0.3"- CO-3'-CO. Whenever a PT is mounted on the breaker carriage all auxiliary wiring shall be done in PVC flexible conduits.

1.14.5 Adequate provision shall be made in Vacuum circuit breaker for motor switching to limit the over voltage.

1.14.6 Mechanical trip push buttons shall be provided for all the breakers. Mechanical closing device will not be acceptable for motor feeders. Complete motor assembly should have interchangeability with identical rating of the breaker. Each motor breaker feeder shall be provided with an operation counter.

1.14.7 All integral earthing system or separate earthing carriage be provided. After withdrawing the circuit breaker, this can be inserted to facilitate earthing of the cables. Unit rate in the panel shall be furnished.

1.15 SWITCHBOARD COMPONENTS:

1.15.1 **CURRENT TRANSFORMER:**

Current transformers shall generally conform to IS: 2075. and of cast resin type and shall be mounted on the switch-gear stationary part. The C.T. ratings shall be as shown in the Technical Data Sheet or SLD. For general guidance, the protective current transformers shall have an accuracy class `5P' and an accuracy limit factor greater than `10'. Low reactance C.T.s shall be used for protection. Current transformers for instruments shall have an accuracy class 0.5 and an accuracy limit factor less than 5.0. If a metering load is fed from a protection C.T., suitable 1/1 or 5/5 ratio interposing C.T.s shall be used.

1.15.2 **VOLTAGE TRANSFORMERS:**

1.15.2.1 The voltage transformers shall be cast resin and draw out type and provided with primary and secondary fuses.

1.15.2.2 The drawout mechanism shall disconnect the busbars and V.T. primary and secondary terminals shall be earthed. The primary connection shall be disconnected before the V.T. or its primary fuses become accessible.

1.15.2.3 The voltage transformers shall have an accuracy class 1.0 from 10% to 120% of normal voltage.

1.15.2.4 Secondary and tertiary windings of voltage transformer shall be rated for a three phase line to line voltage of 110V except as noted.

1.15.2.5 The voltage transformer shall be on the incoming side.

1.15.3 MEASURING INSTRUMENTS:

All measuring and recording instruments shall be of square pattern 144 mm x 144 mm flush mounted type. Instruments shall be provided wherever specified in the Technical Data Sheet or SLD. All auxiliary equipment such as shunts, transducers C.T.s, V.T.s that are required shall be included in the supply of switchboard.

Technical Specification For Transformer Operated Panel Mounted Multi- parameter/Muti-Function Electronic Energy Meters for On line monitoring system

SCOPE :

This specification covers design, manufacture, testing and supply of HT or LT , 3 Phase 4 wire panel mounted Multi-Functional Electronic Energy Meters of accuracy class 1.0

STANDARDS:

The meters shall conform in all respects to the relevant Indian / International Standard Specifications with latest amendments thereto.

Indian Standard No.	Title	International Standard
IS 13779/1993	Specification for AC Static Watt-hour Meter for class 1	IEC: 1036

CLIMATIC CONDITIONS:

The equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

Location	At various locations in India
Max. ambient air temperature (deg.C)	55
Min. ambient air temperature (deg.C)	-10
Max. Relative Humidity (%)	55%
Max. altitude above mean sea level (m)	55 mtr. approximate
Average Annual rainfall(mm)	925

PRINCIPAL PARAMETERS:

The meter shall conform to the following specific parameters:

S.N.	**Detail**	**Specification**
1.	Type of Installation	Indoor panel /Flush mounted
2.	System voltage	110V(240V) +/- 30% Phase to neutral
3	System frequency	50 Hz +/- 5%
4.	No. of phases	Three Phase 3/4wire for meters

TECHNICAL REQUIREMENTS:

Materials used:

The meter shall be made extruded aluminum meter casing. The entire design and construction shall be capable of withstanding the most severe stresses likely to occur in actual service. The latest state of the art technology of surface mounting of components must be used for this purpose. Soldering used if any, shall be perfect without dry solders.

Ratings:

1. Three phase meters shall be rated as follows:
a) Voltage : 2x110V / (3x240V) (Phase to Neutral)
b) Current : I_{basic}= 1A / 5A OR I_{max}= 1.2A / 6A
c) Frequency : 50Hz
d) Accuracy : Class 1.0 (class 0.5)

Power Supply Variation:

The extreme power supply variation which an operating meter should withstand without damage and without degradation of its meteorological characteristics when it is subsequently operated under its operating conditions:

Voltage	+/- 30%
Frequency	+/-5%
P F .range	Zero lag-unity-zero lead

However manufacturer can offer meters which can withstand higher variations.

Accuracy: Class of accuracy of meter shall be 1.0. The accuracy should not drift with time.

Power consumption:

(i) Voltage circuit: The active and apparent power consumption in each voltage circuit including power supply of meter at reference voltage, reference temperature and reference frequency, shall not exceed 1VA per phase.

(ii) **Current circuit:** The apparent power taken by each current circuit at basic current, reference frequency and reference temperature, shall not exceed 1 VA.

- **Starting current:** The meter should start registering energy at 0.4% (for Class 1.0) of basic current.

The meter shall have a built in **"Real Time Clock"** with an accuracy of +/- 3 minutes per year or better.

Measuring parameters:

The meter shall be capable to measure and display the following parameters

S.No.	Parameter
1	Display Test
2	Date & Time
3	Power ON / OFF hours
4	Voltage (Phase to Phase & phase to neutral)
5	Current (Line & Neutral)
6	Current (Zero sequence)
7	Current (Active & Reactive)
8	Frequency
9	Power Factor (Phase-wise)
10	Power Factor (average)
11	Demand kW (Rising & Maximum)
12	Demand kVA (Rising & Maximum)
13	TOD maximum demand
14	Instantaneous load KW
15	Instantaneous load kVar, Kva
16	Energy kWh (import)
17	Energy kWh (export)
18	Energy kVarh (lag)
19	Energy kVarh (lead)
20	Energy kVah
21	TOD energies
22	Maximum & minimum values for voltage, current, Frequency, kW, kVar & kVA

Interactive display : The meter shall have an interactive keypad on the front so as to be able to scroll through various parameters with ease and minimum number of button presses. Also it shall be possible to continuously monitor any particular parameter, as per the users choice.

A facility to log date and time stamped **trend data** for various parameters must be provided. The meter must have a facility for a minimum of 140 parameter days of data for a data integration period of 30 minutes.

NOTE: All display values must be scaled to primary values. Further it shall be possible for user to configure the CT / PT ratio at site.

Display & recording: The meters shall have a minimum legible 6 digit backlit LCD Electronic display with atleast 6 additional digits for identification legend. The minimum character height (main digits) shall be 12 mm.

The registered parameters shall not be affected by loss of power. The non-volatile memory shall have a minimum retention time of 10 years.

Output devices :

The meters shall have a separate kWh **calibration LED** for testing purpose. The meter constant shall be mentioned on the rating plate.

The meter shall have serial communication port RS 485 which can be used with MODBUS protocol for online monitoring if connected with a computer or a serial communication port for meter reading instrument connectivity. A detailed topology of wiring of the system which is spread over in a area of 2 KM should be submitted. The bidder should also quote necessary type of wiring to be done for connectivity from each monitoring point and computer with necessary H/W Prices for the same may be quoted accordingly.

CONSTRUCTION:

Meter case:

The mete shall be suitable for flush mounting and its facial shall conform to industry standard of 96 x 96 mm.

The casing of the meter may be made of extruded Aluminum. The material should be highly non flammable having high rigidity in combination with high heat resistance. Also it should have high impact strength.

Further the meter casing should have an "EARTH STUD" for proper earthing.

Window :

A viewing window made transparent polycarbonate / engineering material may be provided for reading the display.

The fixing of window shall be tight with single complete frame all round and shall permit clear view of the register. There should not be ingress of moisture and dust through the window (i.e the front plate should conform to a degree of protection of IP 51 or better)

TERMINALS AND TERMINAL BLOCK:

The terminal block shall be of moulded type made of high quality engineering plastic. It should be non hygroscopic, non ignitable and with material of good dielectric and mechanical strength.
The terminals shall be of suitable rating to carry the maximum current and shall be of detachable type. Also the current terminals must be provided with additional securing screws so that accidental detachment of these do not cause damage to the CTs.

Connection diagram: Every meter shall be indelibly marked with a connection diagram. In case any special precautions need to be taken at the time of testing the meter, the same may be indicated along with the circuit diagram.

Connection Check & self diagnostic features:

The meter should check the following conditions and indicate abnormalities if any for the following conditions:

1. **Display segments check**
2. **Self diagnostic checks**
3. **Phase sequence reversal**
4. **Current reversal in current Circuit**
5. **Missing potentials**
6. **Phase angles incorrect**
7. **Over voltage**
8. **Unbalanced voltage**
9. **Low power factor**

RUNNING WITH NO LOAD:

When the voltage of 115% of rated voltage is applied with no current flowing in the circuit, the test output of the meter shall not produce more than one pulse / count.

TESTS:

Type tests :

The meters shall be fully type tested at any independent test laboratory as per the relevant standards. One set of type test reports shall be submitted for approval.

Tests for Energy Meters: As per IS-13779/ IEC-1036 for class 1.0.

QUALITY ASSURANCE PLAN :

The Bidder shall invariably furnish the following information along with his bid,

i. Accredition for ISO9000 by a competent authority
ii. List of manufacturing facilities available.
iii. Lists of testing equipment available with the bidder for final testing of equipment specified and test plant limitation.

DRAWINGS :

The bidder shall furnish one set of drawings showing clearly the general arrangements, fitting details, electrical connection etc. along with bid

PACKING & FORWARDING :

The equipment shall be packed suitably and the packing shall be adequate to withstand handling during transport and indoor storage during transit.

GENERAL :

Principle of operation of the meter, outlining the methods and stages of computation of various parameters starting from input voltage and current signals including the sampling rate if applicable shall be furnished by the supplier.

1.15.4 AUXILIARY EQUIPMENTS:

1.15.4.1 AUXILIARY RELAYS/CONTACTORS:

Auxiliary relays/contactors shall generally be used for interlocking and multiplying contacts. Auxiliary contacts shall be capable of carrying the maximum estimated current. In any case their rating must not be less than 5A - for 230 volts A.C. at a power factor between 0.3 and 1, and 2A for 110 volts D.C.(inductive load).

1.15.4.2 TRIPPING RELAYS:

All tripping relays shall be lockout type with hand reset contacts and shall be suitable to operate off the specified d.c. voltage. These relays shall have self coil cut - off contacts and shall be provided with hand reset operation indicators. Tripping relays will be acceptable in non drawout cases. The number of contacts shall be as shown on the approved schematic drawings.

1.15.4.3 PROTECTIVE RELAYS:

All protective relays shall be back connected, drawout type, suitable for flush mounting and fitted with dust tight covers. Alternatively, `plug in' type of relays will also be acceptable. The relay cases shall have provision for insertion of test plug at the front for `testing' and calibration' using an external power supply, without disconnecting the permanent wiring. It shall be possible to short the C.T.'s through the test plugs. Non protection relays can be in fixed execution.

All relays shall preferably be mounted in front of the panel and shall be as specified in the Technical Data Sheet or SLD. The cur rent and voltage coils shall be rated as specified. The relays should be Tripple pole non – directional IDMT realy with highest protection / Restricted E/F with stabilizing resistor.

All measuring relays shall have `built in' flags to indicate relay operation. It shall be possible to reset the flag without opening the relay case. Anti fungus treatment shall be provided for all relays & o/c relay.

1.15.4.4 PUSH BUTTONS:

Push button colours shall be as follows:

Stop, Open, Emergency - Red

Start - Close - Green

Trip circuit `Healthy' check-Black

Red push buttons shall be on the left side and green push buttons on the right side. Push button ratings shall be 5A at 240 V AC or 2A at 110 V DC (inductive load). Emergency stop push buttons shall be lockable in the operated position.

The key shall be released from the push button in both `Released' and `Operated' positions and operation of the push button shall be possible in the key release position. Push button knobs for emergency stop push buttons shall be released to prevent accidental operation.

1.15.4.5 CONTROL SWITCHES:

All control switches shall be rotary, back connected type having a cam operated contact mechanism. Phosphor bronze contacts shall be used on the control switches. Unless otherwise stated, circuit breaker control switches shall be 3 position spring return to `neutral' from both `ON' and `OFF' positions. They shall have `pistol grip' handle. Number of ways, locking system, lost motion device if required etc. Two spare ways shall be provided on these switched.
Ammeter and Voltmeter selector switches shall have ` make before break' feature on its contacts. The selector switch shall generally have four positions, three for reading three phase currents and phase to phase voltages respectively and the fourth as off position.

1.15.4.6 INDICATING LAMPS:

Indicating lamps should be cluster LED type. Switchboard type low consumption indicating lamps shall be used. Indicating lamps shall be suitable for the voltage indicated in the Technical Data Sheet. Lamps shall be supplied complete with the necessary current limiting resistor duly tested for its rating. Aging test for the resistors shall have been carried out. Lamps shall be provided with translucent lamp covers to diffuse light.

1.15.4.7 CUBICLE LIGHTING:

Each cubicle of switchgear shall be provided with interior lighting by means of a 20 W fluorescent tube lighting fixture with ON - OFF switch. The lighting fixture shall be suitable for operation from a 240 V, single phase, 50 Hz, A.C. supply. A 240 V, single phase, 15 A A.C. plug point shall be provided in the interior of each cubicle with an ON - OFF switch for connection of hand lamps.

1.16 TESTS AND INSPECTION:

1.16.1 During fabrication, switchgear shall be subject to inspection by Owner/Consultant or by an agency authorized by the Owner. Manufacturer shall furnish all necessary information concerning the supply to inspectors. The client/ Consultant has right to witness the test carried out on all the equipment.

1.16.2 Tests shall be carried out at the manufacturers' works under his care and expense.

1.16.3 All routine tests as specified by the applicable standard code shall be conducted. Type test certificates for the switchgear panel and CB from a recognized testing organization shall be furnished with the offer. The supplier shall also submit a list of guaranteed technical particulars with the offer.

1.16.4 In addition specific tests shall be conducted to check mechanical and electrical operation and switchboard wiring to this specification and approved schematic drawings.

1.16.5 These tests shall be provisionally conducted at manufacturer's works by providing temporary connection to switchgear units in order to simulate the actual conditions.

1.16.6 Shop tests shall be witnessed by an inspector of Owner / Consultant or of an agency authorized by owner.

Acceptance tests shall be as follows:

a) A general visual check. This shall cover measurement of overall dimensions, location, number and type of devices, terminal boxes, location and connection of terminals etc.

b) Manual and electrical operation of CB/Relays shall be checked under the worst conditions of auxiliary supply voltage.

c) Dry insulation test with power frequency voltage shall be conducted for the main and auxiliary circuits.

d) Insulation resistance of the main and auxiliary circuits shall be checked.

e) Operation check shall be carried out for every control function as per the approved schematic diagrams by manually stimulating the fault conditions and operation of control switches/relays etc.

f) Relays shall be tested with secondary injection test equipment.

For equipment bought from other sub - suppliers certified test reports of tests carried out at the manufacturer's works shall be submitted. Normally, all routine tests as specified in the relevant standards shall be conducted by the sub - supplier at his works.

1.17 DRAWINGS:

1.17.1 The manufacturer shall develop his own general arrangement and schematic drawing adding necessary auxiliary devices, accessories, components particular to supplied equipments etc. which are required for safe, convenient, efficient and proper operation of the HT switchgear.

1.17.2 Manufacturer shall submit for owner/consultant's approval the single line diagrams, general arrangement drawings, flooring and mounting detail drawings and schematic diagrams.

1.17.3 Owner's/consultant's approval of GA drawings is required before the fabrication of the cubicle is started. Approval of the schematic drawings is required before the manufacturer proceeds with the cubicle wiring. The owner/consultant's approval as the manufacturer's drawings shall not relieve the manufacturer of his responsibility for supplying equipment conforming with the relevant specifications and standards or for any other mistakes, errors or omissions in drawings.

1.17.4 Once manufacturer's schematic diagrams have been finally approved by owner/consultant, the manufacturer shall prepare wiring connection diagrams for each cubicle. These diagrams shall show any wiring inside the cubicle starting from the cubicle terminal strips. These diagrams shall be used by the owner for trouble shooting and shall show any device, terminal and wire number.

1.17.5 The manufacturer shall submit all the drawings in four copies for owner/consultant's approval. owner/consultant's shall approved the drawing within fifteen days.

1.17.6 Manufacturer shall submit four prints and reproducible of schematic, GA and wiring diagrams in final.

1.18 GUARANTEE:

The switchboard shall be guaranteed for trouble free operation for a period of 12 months from the date of commissioning or 18 months from the date of arrival at site, whichever is earlier. Any defects discovered during this period shall be rectified free of cost.

1.19 TECHNICAL DATA SHEET

SR NO	PARTICULARS	SPECIFICATION
1	Ambient Temperature	: 55° C
	Maximum Ambient Temperature	: 55° C
	Design Ambient Temperature	: 55° C
	Rated voltage, phases and frequency	:11KV, 3 Phase, 50 Hz
2	Maximum system voltage	: 12 KV
3	One minute power frequency withstand voltage	: 28 KV (rms)
4	1.2/50/u sec impulse withstand voltage	: 75 KV (peak)
5	SHORT CIRCUIT WITHSTAND	
a)	Rated symmetrical service service breaking capacity	: 350 MVA
b)	Short time (1 sec) at rated voltage	: 18.40 KA (rms)
c)	Dynamic rating	: 46.84 KA (peak)
6	Continuous rating of busbars under site reference ambient temp. of 55 degree centigrade	: 400 A
7	One minute dry withstand power frequency voltage	: 35 KV
8	Impulse withstand voltage	: 75 KV
9	Auxiliary supply for using shunt trip at power pack	: 110 V D.C. through power pack with storage facility for one tripping and one closing (To be provided by Vendor)
10	Auxiliary supply for motor	: 240 V AC, 50 Hz
11	Maximum temperature of busbars, droppers, connectors and contact at continuous current rating under site reference ambient temp.	: 85^{o} C
12	Busbar material	: Copper (Tinned Electrolytic)
13	Cable entry	: Bottom

14	Thickness of sheet in mm. Cold rolled	
	Frame	: 3.0/2.5
	frame enclosure	: 2.5/2.0
	Doors / covers / partitions	: 2.5/2.0
15	Colour finish shade	
	a) Interior	: Uniformely painted with IS 631of IS : 5
	b) Exterior	: Uniformely painted with IS 631of IS : 5
16	Earthing bus	
	a) Material	: Copper
	b) Size	: Suitable for 18.4 KA for 1 sec.
17	Earthing conductor	
	a) Material	: Copper
	b) Size	: 30 x 6 mm
18	Bus bar insulation	: Air insulated , PVC heat shrinkable type sleeved

19	Circuit Breakers	
	a) Type	: Vacuum
	b) Voltage, frequency and no. of phases	: 11 KV, 50 Hz, 3 ph.
	c) Rated operating duty	: 0-3'-CO-3'-CO
	d) Rated current at site (Reference ambient temp)	: 400 A
	e) Rated service service breaking capacity	: 350 MVA, 18.40 KA (rms)
	f) Rated making current	: 47 KA (peak)
	g) Short time current withstand for 1 sec. duration	: 18.40 KA (rms)
	h) Total break time	: Less than 5 cycles
	I) Type of operating	: Manually and motor mechanism charged spring suitable for manual and remote trip and close operations
	j) Minimum no. of auxiliary	: 8 NO, 8 NC on fixed contacts part of breaker for owner's use.
	k) Withstand test voltage	
	One minute power Frequency KV (rms) 1.2/50 u sec.	: 28
	impulse KV (peak)	: 75
l)	**Auxiliary control voltage**	
	a) For closing coil for tripping coil 30 V D.C. through power pack	: 240 V, 1 ph, 50 Hz
	b) For space heaters and lighting AC with MCB and thermostat unit	: 240 V, 1 ph, 50 Hz
	c) Motor type	: Universal
	m) Anti pumping feature	: Both electrical and mechanical shall be provided
	n) Circuit breaker operation	: Local control switch for trip and close. Remote electrical trip and close for testing manual
	o) Protection required	: As per single line diagram / Requirement of breaker panel.
20	Current Transformers	
	a) Type	: Cast resin, bar primary
	b) System voltage and frequency	: 11 KV, 50 Hz.
	c) Class of insulation	: Minimum Class "E"

	d) Rated primary current ratio	: Incoming Breaker 150/5 A Outgoing breaker 75/5 A
	e) Short time 1 sec current rating	:18.4 KA(rms)
	f) Dynamic rating	: 47 KA (peak)
21	Voltage Transformers	
	a) Type	: Cast resin
	b) Rated voltage - primary	: 11000 / √3 volts
	- secondary	: 110 / √3 volts
	c) Method of connection	
	- primary	: star
	- secondary	: star
	d) Rated voltage factor	:1.1 constant
		:1.5 for 30 sec.
	e) Class of insulation	: Minimum Class "E"
	f) VA burden and accuracy	: 200 VA
	g) Withstand test voltage	
	One minute power frequency	: 28
	1.2/50/u impulse KV (peak)	: 75 KV (peak)
	h) Type	: Horizontal Draw out type with vertical isolation
22	Make of Material	
	a) HRC fuse	: Siemens, L & T, Havells
	b) Fuse base	: Siemens, L & T, Havells
	c) Voltmeter	: AE
	d) Ammeter	: AE
	e) Indication lamps	: Teknic, telemechanic,Control
	f) Relays	: ABB, Alstom, Jyoti, EE
	g) Power factor meter (Electronic Type)	: AE
	h) Frequency meter (Electronic Type)	: AE
	I) Selector switch	: Kaycee
	j) Breaker control switch	: GEC Alsthome
	k) L - R switch	: Kaycee
	l) Terminal block	: Elmex/Connect well/ Technoplast
	m) Wires	: Finolex or approved or equivalent
	n) Trivector	: Enercon, Secure, L & T
	o) DIGITAL KWH meter	: Enercon
	p) CT/PT	: AE/INDCOIL/KAPPA
	q) Push buttons	: Teknik
23	Cable Box Arrangement	
	a) Incomer	: As per Single Line Diagram
	b) Outgoing	: As per Single Line Diagram
24	Requirements of Breaker Panel	
1)	Panel Description	: As per Single Line Diagram
2)	Quantity	: **1 I/C + 2 O/G.(Extensible Type)**
3)	Basic rating of breaker	: 400 Amps.
4)	Type of Breaker	: VCB
5)	Red, Amber, Green indicating lamps	: 1 set for each VCB
6)	Potential transformer, three phase, Epoxy cast resin type, 11KV / V3 / /110 volts / V3, 200 VA burden,	

	Accuracy class 0.5	: 1 no at Main I/C VCB
7)	Trivector meter (digital) with KVA/ KVARH/ KVAH with maximum demand indication in KVA	: 1 no at Main I/C VCB
8A)	Epoxy cast resin type current transformer Single primary and dual secondary having detail as under	
	a&b) Core - 1 for metering and core –2 for protection	: I/C – 150/5+5, CL: 1,5P10,15VA O/G 75/5+5,CL: 1,5P10,15VA
	c) VA burden of metering core - 1	: 15 VA
	d) VA burden of protection core - 2	: 15 VA
	e) Accuracy class of metering	: Class 1
	g) Accuracy class pf protection relay	: 5 P 10
9)	Relays	
	a) T.P. IDMTL Relay with 2 O/C & 1 E/F Element type EE or equivalent make	:- CDG-61 (I/C and O/G)
	b) S.P. IDMTL Relay with E/F Element type equivalent to CDG-14 of EE make 4 P	: Not Required
	c)X'mer Auxiliaty protection relay for WTI	: Required (O/G)
	d) High speed tripping relay equivalent to VAJH-13 of Eeh	: Required (O/G)
	e) Antipumping relay equivalent to VAA-11 of EE 4	: Required (I/C and O/G)
	g) Auxiliary relay for winding temperature alarm and trip relay equivalent to VAA21 of EE make	: Required (O/G)
10)	110 volts D.C. shunt trip coil	: 1 no. for each VCB
12)	Emergency trip lockable push button with keys P	: Required
13)	Trip circuit healthy indication lamp with push button	: Required
14)	Auto trip indication	: Required
15)	Spring charged indication	: Required
16)	Common alarm trip and non trip scheme with ACCEPT, RESET push buttons, relays and hotter for audio indication	: Required
17)	Space heater with ON-OFF MCB, HRC fuses and thermostat	: Required
18)	Power pack unit for 110 volts D.C. output	: 1 set for VCB. :-110V/110V DC with storage facility for two tripping and two closing facility
19)	Cubicle illumination with 20w fluorescent tube and with On/Off switch	: Required
20)	15 a plug/socket with ON-OFF switch	: Required
21)	Any Deviation/comments on the specifications	:-Should be furnished along with tender.

1.20 TECHNICAL DATA SHEET (TO BE FILLED BY BIDDER)

SR NO	PARTICULARS	SPECIFICATION
1	Ambient Temperature	: ° C
	Maximum Ambient Temperature	: ° C
	Design Ambient Temperature	: ° C
	Rated voltage, phases and frequency	:11KV, 3 Phase, 50 Hz
2	Maximum system voltage	: KV
3	One minute power frequency withstand voltage	: KV (rms)
4	1.2/50/u sec impulse withstand voltage	: KV (peak)
5	SHORT CIRCUIT WITHSTAND	
a)	Rated symmetrical service service breaking capacity	: MVA
b)	Short time (1 sec) at rated voltage	: KA (rms)
c)	Dynamic rating	: KA (peak)
6	Continuous rating of busbars under site reference ambient temp. of 55 degree centigrade	: A
7	One minute dry withstand power frequency voltage	: KV
8	Impulse withstand voltage	: KV
13	Cable entry	: Side / Rear
14	Thickness of sheet in mm. Cold rolled	
	Frame	:
	frame enclosure	:
	Doors / covers / partitions	:
15	Colour finish shade	
	a) Interior	
	b) Exterior	
16	Earthing bus	
	a) Material	:
	b) Size	: KA for 1 sec.
17	Earthing conductor	
	a) Material	:
	b) Size	: x mm
18	Bus bar insulation	
20	Current Transformers	
	a) Type	
	b) System voltage and frequency	
	c) Class of insulation	
	d) Rated primary current ratio	
	e) Short time 1 sec current rating	: KA(rms)
	f) Dynamic rating	: KA (peak)

21	Voltage Transformers	
	a) Type	: Cast resin
	d) Rated voltage factor	
	e) Class of insulation	:
	f) VA burden and accuracy	: As per the single line dia / specs
	g) Withstand test voltage	
	One minute power frequency	:
	1.2/50/u impulse KV (peak)	: KV (peak)
	h) Type	
22	Make of Material	
	a) HRC fuse	:
	b) Fuse base	:
	c) Voltmeter	:
	d) Ammeter	:
	e) Indication lamps	:
	f) Relays	:
	g) Power factor meter (Electronic Type)	:
	h) Frequency meter (Electronic Type)	
	I) Selector switch	
	j) Breaker control switch	
	k) L - R switch	
	l) Terminal block	
	m) Wires	
	n) Trivector	
	o) DIGITAL KWH meter	
	p) CT/PT	
	q) Push buttons	
23	Cable Box Arrangement	
	a) Incomer	
	b) Outgoing	
24	Requirements of Breaker Panel	
8A)	Epoxy cast resin type current transformer Single primary and dual secondary having detail as under	
	a&b) Core - 1 for metering and core –2 for protection	
	c) VA burden of metering core - 1	
	d) VA burden of protection core - 2	
	e) Accuracy class of metering	
	g) Accuracy class pf protection relay	
18)	Power pack unit for 110 volts D.C. output :- 11KV/110V DC with storage facility for two tripping and two closing facility	
19)	Cubicle illumination with 20w fluorescent tube and with On/Off switch	: Required
21)	Any Deviation/comments on the specifications	:-Should be furnished along with tender.

Special Note : The breaker should be extensible type with suitable cable box arrangement for future.

E – 2 OIL COOL TYPE TRANSFORMER

1.0 SCOPE:

This standard specification covers the general requirements for the design, manufacture, supply, installation, testing and commissioning of outdoor type oil cool transformer (having general requirements listed in the following paragraphs). This specification is accompanied by the transformer data sheet.

1.1 STANDARDS:

The oil cool transformer shall comply with the applicable clauses of the latest editions of the following standards. In case of any conflict, the requirements of these standards shall prevail.

IS: 1271	: Classification of Insulating Materials
IS: 3639	: Power Transformer - Fittings and Accessories
IS: 2026(Part I to IV)	: Power Transformers
IS: 11171	: Specifications for dry type power transformer
IEC : 726	: Oil cool Power Transformer
CBIP Specifications	: Power & Distribution Part-II Transformers.
IS : 2099	: Bushing for alternating voltages above 1000 volts.
IS : 2705	: Current transformers
IEC : 76	: Power transformers.
IEEE : Std. 141	: Recommended Practice for Electrical Power Distribution for Industrial plants
IS : 3202	: Code of practice for climate proofing of electrical equipment.

1.2 CONSTRUCTIONAL DETAILS

1.2.1 The Transformer shall be oil cool type. AN cooled suitable for indoor/ outdoor installation as asked in data sheet. This shall be provided with welded sheet steel, free-standing enclosures with expanded metal screens of suitable size or louvers backed by wire-mesh. Transformer and upper body shall be suitably reinforced to prevent distortion during handling. Base channels shall be provided with skids and pulling eyes to facilitate handling.

1.2.2 All the fasteners and bolts shall be hot dip galvanized or zinc passivated.

1.2.3 The Transformer shall be double wound core type with cold rolled grain oriented silicon steel laminations perfectly insulated and clamped to minimize vibrations and noise. Core fastening bolts shall be insulated to reduce losses and avoid hot spots. All parts of the magnetic circuit shall be effectively connected to earth system.

1.2.4 The winding shall be of copper and shall be designed for full load current to withstand the thermal and electromagnetic stresses arising due to maximum fault level. The current carrying winding joints shall be electrically brazed.

1.2.5 The windings shall be provided with Class-F insulation. (As applicable to dry type transformers as per IS- 2026 part II for power transformers.

1.3 TERMINALS AND MARSHALLING BOX

1.3.1 Winding shall be brought out and terminated in outdoor bushing, cable boxes or bus duct chamber which will be located as specified on data sheet.

1.3.2 Cable boxes shall be supplied with cable lugs and glands. H.T. cable box shall be suitably dimensioned to accept terminations of XLPE cable specified in data sheet.

1.3.3 The H.V./L.V. terminal boxes shall be located on the side/top respectively and at right angle or oposite to each other as specified in the data sheet . Suitable flange shall be provided for bus duct on LV side where specified in the Data sheet.

1.3.4 For L.T. PVC control cables compression glands:("Type HW") shall be supplied. Gland plate shall be removable type. For single core cables, gland plate shall be of non - magnetic material. Such cable boxes shall have arrangements for grounding the armour of cables.

1.3.5 Cable lugs shall be non-soldering crimping type.

1.3.6 LV side terminal chamber for bus duct termination shall have a gasketted cover plate bolted to it. A seperate cover plate shall be provided to facilitate the connection and inspection. Phase sequence of busbar shall be as specified in MR or data sheet. The arrengment may be from top or side entry.

1.3.7 Marshalling box shall be weather - tight. All prospective devices and neutral CTs shall be wired by means of PVC insulated armoured cable upto marshalling box . Terminals shall be Elmex type or approved equal. Removable gland plate with compression type cable glands as stated in 4.4 shall be provided.

1.3.8 For transformers having provisions for terminating TPN bus duct on 433 V side neutral of the star connected scondary winding shall be brought out to a secondary terminal chamber. A CT shall be mounted (if specified) on the neutral terminal with C.T. Secondary wired upto marshalling box.

1.3.9 Separate neutral terminal/bushing shall be provided for grounding.

1.4 TESTING

Client's representative shall be given free access in the works from time to time for stagewise inspection and progress reporting. The following routine and type test shall be performed on the transformers as per IS-2026 in the presence of client's representative and should have to submit the test certificates. About one week's notice shall be given to the client's to witness the tests at the vendor's works.

1.4.1 TYPE TEST

Only certificates for Type test as indicated in IS: 11171/IEC 726 (like HV impulse test, Heat run test etc,.) for similar rating and type of transformer should be submitted.

1.4.2 ROUTINE TEST

The routine tests, including but not limited to the following shall be performed on each of the transformers, as per the relevant standards.

i. Measurement of winding resistance.
ii. Measurement of voltage ratio Test, Vector group test.
ii. Measurement of impedance voltage/short circuit impedance and load loss.
iv. Secondary injection test.
v. Insulation Resistance tests.

1.4.3 ACCEPTANCE TESTS

1.4.4 FIELD TESTS

1.5 ACCESSORIES

Accessories as specified in the attached data sheet shall be included in the scope of supply.
Tapping and control gears shall be provided on the H.V. side. Tap changer shall be off- circuit or OLTC with RTCC panel as specified in data sheet. The tap changing equipment shall be suitable for carrying the fault current under condition of external or internal faults.

1.6 PAINTING

All metal parts shall be thoroughly cleaned to remove rust, scale, grease etc. and painted with two coats of approved colour shade over one coat of rust resisting primer . The paint shall not scale-off crinkle or removed due to normal handling.

All metal surfaces not accessible for painting shall be made or corrosion resistant material.

1.7 RATING PLATE DETAILS

Each transformer shall be provided with a rating plate giving the details as per IS:2026 (Pt.I). The marking shall be indelible and the rating plate shall be located on the front the side.

Exact value pf transformer % impedance, as determined by tests shall be marked on it and also on the final submission of name plate drawing.

1.8 NOISE

Noise level shall be precribe as per NEEMA standard depending on the rating of transformers.

1.9 DRAWINGS & DOCUMENTS

i. All drawings and documents shall be submitted as per the requirements specified in vendor data requirements.
ii. Complete technical particulars as per Appendix-B of IS:2026 as applicable to Dry type resin impringated transformers shall be furnished with quotations.
iii. Make and type of various accessories and protective devices shall be furnished with the quotation.

1.10 GUARANTEE

The transformer shall be guaranteed for trouble-free service for the period of 12 months from the date of commissioning or 18 months from the date of receipt at site, whichever is earlier . Any defects discovered during this period shall be rectified free of charge.

1.11 INFORMATION TO BE FURNISH BY SUCCESSFUL BIDDER

1.11.1 Clause wise deviations to this specification. If the same are not furnished it will be assumed that the offered equipments meet the enquiry specifications in total.

1.12 TAPPINGS AND CONTROL

1.12.1 The tap changer shall be **ON LOAD TYPE**. These shall be provided on high voltage side to get constant voltage on LV side and connected to on load tap changing gear. Under conditions of external short circuit, the tap changing equipment must be capable of carrying the same current as the winding.

1.12.2 On Load Tap Changer (OLTC)

1.12.2.1 The OLTC gear shall be designed to complete successfully tap changes for the maximum current to which transformer can be loaded i.e., 150% of the rated current. Devices shall be incorporated to prevent tap change when the through current is in excess of the safe current that the tap changer can handle. The OLTC gear shall withstand through fault currents without injury.

1.12.2.2 When a tap change has been commenced it shall be completed independently of the operation of the control relays and switches. Necessary safeguard shall be provided to allow for failure of auxiliary power supply or any other contingency, which may result in the tap changer movement not being completed once it is commenced.

1.12.2.3 **OLTC** driving mechanism and its associated control equipment (Local) shall be mounted in indoor, weather-proof cabinet which shall include:

- Driving motor (415V, 3 Phase, 50 Hz. AC squirrel cage)
- Motor starting contactor, thermal overload relays and MCB.
- Control Switch : Raise / off / Lower (Spring return to normal type)
- Remote / Local selector switch (maintained contact type)
- Mechanical tap position indicator showing rated tap voltage against each position and resettable maximum and minimum indicators.
- Limit switches to prevent motor over-travel in either direction and final mechanical stops.
- Brake or clutch to permit only one tap change at a time on manual operation.
- Emergency manual operating device (hand crank or hand wheel)
- A five digit operation counter.
- Electrically interlocked reversing contractors. (Preferably also mechanically interlocked)
- 240V, 50 Hz. AC space heaters with MCB.
- Interior lighting fixture with lamp, door switch and HRC fuses.
- Gasketted and hinged door with locking arrangement.
- Terminal blocks, internal wiring, earthing, terminals and cable glands for power and control cables.
- Necessary relays, contactors, current transformers etc.

1.12.3 Control Requirements for OLTC

- The following electrical control features shall be provided:
- Positive completion of load current transfer, once a tap change has been initiated, without stopping on any intermediate position, even in case of failure of external power supply.

- Only one tap change from each tap change impulse even if the control switches or push button is maintained in the operated position
- Cut-off of electrical control when manual control is resorted to. Cut-off of a counter impulse for a reverse tap change until the mechanism comes to rest and resets the circuits for a fresh operation.
- Cut-off of electrical control when it tends to operate the tap beyond its extreme position.

1.12.4 Automatic Control of OLTC

- Automatic OLTC Control shall include the following items:
- Voltage setting device
- Voltage sensing and voltage regulating devices.
- Timer for delaying the operation of the tap changer in the first step for every tap change operation.
- Adjustable dead band for voltage variation.

1.12.4 RTCC Panel:

1.12.4.1 The OLTC remote control equipment shall be suitable for A.C supply and shall be housed in an indoor sheet steel cubicle to be located in a remote control room. The RTCC shall comprise of rigid welded structural frames made of structural steel section or of pressed and formed cold rolled steel and frame enclosures, doors and partitions shall be of cold rolled steel of thickness 2mm. Stiffeners shall be provided wherever necessary. All doors, removable covers and plate shall be gasketed all around with neoprene gasket. Panel shall be dust, weather and vermin proof providing degree of protection suitable for INDOOR/OR as asked in data sheet. Colour of finish shade for interior and exterior shall be glossy white and Siemens grey RAL-7032 respectively. Earthing bus shall be of 25 x 6 mm copper. Following (not limited), equipment/ components shall be provided in RTCC

i) Control switch
: Raise/Off/Lower.
(Spring return to normal type)

ii) Master /Follower Switch & Auto/Manual selector switch (maintained contact type) (To be Provided if asked in data sheet)

iii) Tap position indicator (potentiometer type or solid state electronic type)

iv) Facia type alarm annunciators with “Accept” ,“Reset” and “Lamp Test” facilities.
- A.C. supply failure
- Drive motor auto tripped
- Tap change delayed

v) Out of step relay, time delay relay, voltage sensing relay and necessary auxiliary relays (To be Provided if asked in data sheet)

vi) Out of step buzzer (To be Provided if asked in data sheet)

vii) Lamp indications for:
- Tap change in progress
- Lower limit reached
- Upper limit reached
- Out of step

viii) Cable glands for power and control cables.

ix) 240V rated panel space heater with ON-OFF switch
- Fluorescent type interior lighting fixture with lamp and door switch
- HRC fuses.
- Terminal blocks.
- Internal wiring.
- Earthing terminal.

1.13 NOISE

The noise level of transformer should not exceed the specified NEMA standards

1.14 Successful tenderer should have to submit four sets of following drawing of manufacturerer to client/consulatant for approval.

1. General arrangement to the scale of transformer showing plan, elevation, sections with dimensioins with all accessories, fittings, locating dimensions of cable/Bus Duct entries, foundation / floor fixing details, weights of the OLTC and RTCC with dimensions.
2. HV & LV cable box details
3. Marshalling box with all control wiring diagram
4. Schematic circuit details with terminal details of control and power circuits.
5. Rating and Diagram name plate
6. Quality assurance plan.

1.15 Auotmation Connectivity.

The Transformer shall be completely compatiable interface with centralized building automation. System to have monitoring of temperature and status. Adequate potential free contacts should be provided for desire functions. Thermo pockets to be provided for points of interest in transformer.

DATA - SHEET

1.0 GENERAL DATA

1.1	No. of transformers	:	As per SOQ
1.2	Duty	:	Continuous
1.3	Type of cooling	:	Air cooled
1.4	Installation	:	Indoor
1.5	Climate	:	Dusty
1.6	Location	:	Dahod
1.7	Oil included/excluded	:	excluded - Dry type Cast Resin
1.8	System earthing	:	Solidly earthed
1.9	Painting	:	Epoxy
1.10	Colour shade	:	Siemens Grey for Dry type

2.0 ELECTRICAL DATA

2.1	No. of windings	:	Two
2.2	Phase	:	Three
2.3	Frequency	:	50 +/- 3%
2.4	Rated power	:	1250 KVA
2.5	Voltage ratio	:	11000/415 V
2.6	Inter phase connection	:	
2.7	Vector group	:	DYn 11
2.8	% impedance	:	Should be 5.5% (To be furnished by the tenderer)
2.9	Insulation class	:	F
2.10	Winding Insulation	:	Uniform
2.11	Neutral	:	Earthed
2.12	Terminal detail		
	Primary	:	Cable box
	Cable size/type	:	3Cx240mm² XLPE
	Secondary	:	Busbar box to make connection to 2000 A busduct.
2.13	On Load tap changer	:	Required ON LOAD TYPE with RTCC / Off Load Tap changer with Tap handle.(As Per SOQ)
2.14	On MV/LV winding	:	On HV winding
2.15	Regulation range	:	+5 TO -15% IN STEP OF 1.25%
2.16	No. of steps	:	as Above
2.17	Primary fault level	:	350 MVA

3.0 PERFORMANCE (TO BE FURNISHED BY BIDDER WITH TENDER)

3.1 Losses (Must compliance to ECBC standard)

No load at 100 % V	:	_____ KW
No load at 110 % V	:	_____ KW
Full load at 75 centigrade @ 100 % V	:	_____ KW

3.2 Rated efficiency %

Power factor Load	4/4	3/4	1/2
0.8			
1.0			

3.3 Impedance voltage

Primary	:
Secondary	:

3.4 Load at which maximum Efficiency occurs :

3.5 Maximum efficiency :

4.0 MECHANICAL DATA (TO BE FURNISHED BY BIDDER WITH TENDER)

4.1	Weights	
	Core and windings	:
4.2	Dimensions	:

5.0 ACCESSORIES REQUIRED

5.1	Bidirectional flat/rollers	:	Required
5.2	Separate neutral bushing	:	Required
5.3	On circuit tap changer with RTCC	:	Required
5.4	Lifting lugs for active part	:	Required
5.4	MV and LV connectors/lugs	:	Not Required
5.5	Cable glands	:	Not Required
5.6	HV Cable box	:	Required
5.7	LV Side Cable end termination Box	:	Required
5.8	Rating and Diagram Plate	:	Required
5.9	Earthing Terminals	:	Required
5.10	J.B. for winding test indicator	:	Required
5.11	Off Load Tap Changer with handle	:	Required (As per SOQ)

DATA – SHEET (TO BE FILLED BY BIDDER)

1.0 GENERAL DATA

1.1	No. of transformers	:	
1.2	Duty	:	
1.3	Type of cooling	:	
1.4	Installation	:	
1.5	Climate	:	
1.6	Location	:	
1.7	Oil included/excluded	:	
1.8	System earthing	:	
1.9	Painting	:	
1.10	Color shade	:	

2.0 ELECTRICAL DATA

2.1	No. of windings	:	
2.2	Phase	:	
2.3	Frequency	:	
2.4	Rated power	:	_____KVA
2.5	Voltage ratio	:	
2.6	Inter phase connection	:	
2.7	Vector group	:	
2.8	% impedance	:	Should be 5% (To be furnished by the tenderer)
2.9	Insulation class	:	
2.10	Winding Insulation	:	
2.11	Neutral	:	
2.12	Terminal detail		
	Primary	:	
	Cable size/type	:	
	Secondary	:	_____ A FP bus duct
2.13	On Load tap changer	:	
2.14	On MV/LV winding	:	
2.15	Regulation range	:	_____ % by on load tap changer
2.16	No. of steps	:	_____
2.17	Primary fault level	:	_____ MVA

3.0 PERFORMANCE (TO BE FURNISHED BY BIDDER WITH TENDER)

3.1	% Losses		
	No load at 100 % V	:	_____ KW
	ON load at 110 % V	:	_____ KW
	Copper at 75 centigrade	:	_____ KW

3.2 Rated efficiency %

Power factor Load	4/4	3/4	1/2
0.8			
1.0			

3.3	Impedance voltage		
	Primary	:	
	Secondary	:	
3.4	Load at which maximum		
	Efficiency occurs	:	
3.5	Maximum efficiency	:	

4.0 MECHANICAL DATA (TO BE FURNISHED BY BIDDER WITH TENDER)

4.1	Weights		
	Core and windings	:	
4.2	Dimensions	:	

5.0 **ACCESSORIES REQUIRED**

5.1	Bidirectional flat/rollers	:	YES / NO
5.2	Separate neutral bushing	:	YES / NO
5.3	On circuit tap changer	:	YES / NO
5.4	Lifting lugs for active part	:	YES / NO
5.4	MV and LV connectors/lugs	:	YES / NO
5.5	Cable glands	:	YES / NO
5.6	HV Cable box	:	YES / NO
5.7	LV Side Cable end termination Box	:	YES / NO
5.8	Rating and Diagram Plate	:	YES / NO
5.9	Earthing Terminals	:	YES / NO
5.10	J.B. for winding test indicator	:	YES / NO

E – 3 SUBSTATION & AUXILIARIES INSTALLATION

1.1 Scope :

The specification covers H. T. cable laying and H. T. joints of outdoor type and certain safety materials required to be kept in the substation for the safety purposes.

1.2 HIGH VOLTAGE XLPE –FRLS CABLE

1.2.1 H. V. Cable type

11KV unearthed grade with standard and compacted aluminum conductor triple extruded semi conducting compound screen extruded XPLE insulated (dry cured) with triple extruded semi conducting compound with a layer of non magnetic metallic tape for insulation screen extruded PVC (ST-2) inner sheathed (for multi-core cable) extruded FRLS PVC 9 (TYPE ST-2) outer sheathed cables conforming to IS-7098part_2

Cables shall be capable of operating at a sustained conductor temperature of 90 C and suitable for a maximum conductor short- circuit temperature of 250 C.

This specification gives the requirement of cable. However, it is the responsibility of the contractor to obtain clients approval before the purchase of cable.

1.2.2 REFERENCE CODES & STANDARDS

IS-8130-1984	-	Conductors of Insulated Cables.
IEC-228	-	Conductors of Insulated cables.
IEC-230	-	Impulse Tests on cables and their accessories.
IEC-502	-	Extruded Solid Dielectric-Insulated Power Cables for rated voltage from 1 KV up to 30 KV.
IEC-540	-	Test Methods for Insulation and Sheaths of Electric cables and chords.
IEC-229	-	Test on Cable over sheaths which have a special protective functions and are applied by extrusion.
IEC-287	-	Calculation of continuous current rating of cables (100% load factor).
IS-708(part-II)	-	Cross linked polyethylene insulated PVC sheathed cable for voltage from 3.3 KV upto 33 KV.
IS-5831-1984	-	PVC insulation & sheath for electrical cables.
IS-3975	-	Mild steel wires / strips and tapes for armouring of cables.
IEC-885(2)-1987	-	Electrical test methods for electric cables part-II partial discharge test.
IS-10810	-	Methods of test for cables.
IEC-811	-	Common test methods for insulating and sheathing materials of electric cables.
IEC-230	-	Impulse test on cables & other accessories.
IEC-859	-	Cable termination for gas insulated switchgear.

1.2.3 OPERATING CONDITIONS

Electric System

- System Voltage	11.0 KV RMS
- Frequency	50 Hz.
- Short Circuit current	21 KA for 1 Second.

Environment

- Ground Temperature	45° C
- Design Ambient Air temperature	50° C
- Atmospheric Conditions	Dry and dusty

1.2.4 CONSTRUCTION

a) Conductors

The conductors shall be of circular stranded Copper to IEC- 228. Sizes shall be from 3x50 mm^2 upto 3x400 mm^2. Final cable sizes shall be approved by Client. The conductors shall be compacted stranded circular. It shall be clean, reasonably uniform in size & shape smooth & free from harmful defects. Any other form of conductor may also be accepted if in line with modern trends.

b) Semi conducting barrier tape / tapes

The semi conducting barrier tape/tapes shall be provided over the conductors.

c) Conductor Screen

The conductor screen shall consists of an extruded layer of thermosetting semi-conducting compound which shall be extruded simultaneously with the core insulation.

d) Insulation

The insulation shall be super clean XLPE compound applied by extrusion and vulcanized to form a compact homogeneous body.

e) Insulation Screen

Each insulation have an insulation screen in two parts consisting of
(I) A water barrier tape/ Non-metallic semi conducting sellable tape part and a metallic screen part
(ii) The non-metallic part shall be directly applied upon the insulation of each core and may consist of an impregnated butylnylon tape or a similar approved material or, an extruded semi-conducting material extruded simultaneously with the conductor screen and insulation (triple extrusion).
The semi-conductor shall be readily strippable and must not be bonded in such a manner that it has to be shaved or scraped to remove.

The metallic part shall consist of a copper tape helical applied with a 30 % overlap. Over the water barrier tape/ blocking tape. A binder tape of copper shall be applied over the copper wire metallic screen.

f) Laying Up

The cores shall be identified on the non-metallic part of the insulation screen by legible printing on the length of each conductor or, by the inclusion of a marker tape.

The cores shall be laid up with a right-hand direction of lay.

Binder tape /Moisture barrier

During lay up, a suitable open spiral binder may be applied, at the manufacturers discretion, before the application of an extruded inner covering.

g) Fillers

Fillers shall be polypropeline.

h) Inner Covering /Sheath

The inner covering shall be extruded over the laid up cores to form a compact and circular bedding for the metallic layer.

i) Metallic Layer

The metallic layer shall be round galvanized steel wire.

j) Outer sheath

The outer sheath, black colored FRLS polyethylene for the operating temperature of the cable shall be provided over the armour as specified in relevant standards by extrusion process.

k) Cable Marking

- Embossing of outer sheath :

The PVC outer sheath shall be legibly embossed with the legend : "ELECTRIC CABLE 3300/11000 VOLT"

The letter and figures shall be raised and shall consist of upright block characters. The maximum size of the characters shall be 13 mm and the minimum size 15 % of the cable circumference or 3 mm whichever be the greater. The gap between the end of one set of embossed characters as above and the beginning of the next shall not exceed 150 mm.

- Identification of Manufacturer & year of manufacture.

An identification of the manufacturer and indication of the year of manufacture shall be embossed at regular intervals on the PVC outer sheath. This shall not affect the spacing between repetitions of the legend as given above.

1.2.5 Sealing and Drumming

After tests at the manufacturers works, both ends of the cable shall be sealed to prevent the ingress of moisture during transportation and storage.
Cable shall be supplied in lengths of 500 meters on non- returnable drums of sufficiently sturdy construction.

The spindle hole shall be 110 mm minimum diameter.

Each drum shall bear on the outside flange, legibly and indelibly in the English language, a distinguishing number, the manufacturer's name and particulars of the cable, i.e. Voltage, length, conductor size, cable type, insulation type and gross weight shall also be clearly visible. The direction for rolling shall be indicated by an arrow.

e.g. Manufacturer's Name :
3.3/11 K.V. 3 x 185 mm^2 Aluminum XLPE drum Number.

1.2.6 TESTING

Type tests and Routine tests shall be carried out in accordance with the relevant IEC standards/IS.

1.3 H. V. CABLE TERMINATION

The cable joints shall be suitable for the outdoor application with EPDM (ethylene Propylene Diene Monomer) Rubber Components. The joint should impair optimum combination of both impulse strength of the termination and field grading at the outer semi conducting screen edge. There should not be formation of air pockets in the joints and also formation of cavities should be avoided. Creepage should be approximately 4 cm/KV. The joint should have flame retardant properties and should be easily re-opened. The joint should confirm to IS 13573.

1.4 Safety Equipments (Rubber mats, rubber gloves, First aid kit, Sign boards, Sand Buckets, Fire Extinguishers etc.)

The Danger notice labels shall be made on indestructible non deteriorating material with lettering engraved in red, black, white background except where otherwise specified. The letters shall be atleast of 12 MM and shall be of radium sticker type so as to be visible in the night time also.

Rubber mats, Rubber gloves, boots shall confirm to the safety equipments standard and shall with ISI approval.

Sand Buckets and Fire extinguishers shall be as per the fire safety norms and shall be operated as specified in the item.

Emergency lights shall be with maintenance free rechargeable batteries.

E - 4 LT SWITCHGEAR & POWER PANEL

1.1 Scope :

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

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

IS : 4237	:	General requirements for switch gear and control gear for voltage not exceeding 1000 v.
IS : 375	:	Switchgear bus-bars, main connection and auxiliary wiring, marking and arrangement.
IS : 2147	:	Degree of protection provided by enclosures for low voltage switch gear and control gear.
IS : 8197	:	Terminal marking for electrical measuring instrument and their accessories.
IS : 2557	:	Danger notice plates.

IS : 2516	:	Specification for AC circuit breaker.
IS : 1818	:	Specification for AC isolator and earthing switch.
IS : 3072	:	Code of practice for installation and maintenance of switchgear.
IS : 8623	:	Specification for factory built as symbolize of switch gear and control gear for voltage up to and including 1000v. A.C.& 1200 v. D.C.
IS : 8828	:	Miniature Circuit Breaker.
IS : 4064	:	Fuse switch and switch fuse unit.
IS : 9224	:	HRC fuse unit.
IS : 2705	:	Current transformer.
IS : 3155	:	Voltage transformer.
IS : 3231	:	Electrical relay for protection.
IS : 1248	:	indicating instrument.
IS : 722	:	Integrating instrument.
IS : 6875	:	Control switches & push buttons.
IS : 2959	:	Auxiliary contactor.
IS : 1822	:	AC motor starters of voltage not exceeding 1000V.

1.3 TYPE OF LT SWITCH GEAR :

1.3.1 All the PCC's / PDB's / MCC's shall be metal clad, totally enclosed, rigid, floor / wall mounted, air - insulation, cubical type suitable for operation on three phase / single phase, 415 / 230 volts, 50 Hz. neutral effectively / Non effectively grounded at transformer and short circuit level not less than 30 MVA at 415 volts.

1.3.2 The PCC's / MCC's shall be designed the withstand and heaviest condition at site, with minimum expected ambient temperature of 55 degree celsius, 90 percent humidity and dusty weather.

1.3.3 Should confirm to Indian Electricity Act and rules. (as amended up to ate) & approval of FIA. of India.

1.4 STRUCTURE :

1.4.1 The PCCs, MCCs & PDBs shall be metal clad enclosed and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor mounting type.

1.4.2 All CRCA sheet steel used in the construction of PCCs / MCCs / PDBs shall be 2 mm thick and shall be folded and braced as necessary to provided a rigid support for all components. Joints of any kind in sheet shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal.

1.4.3 The PCCs / MCCs / PDBs shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP-43 for Indoor panels & IP -54 for outdoor panels . Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasket with foam rubber and / or rubber strips and shall be lockable.

1.4.4 All panels and covers shall be properly fitted and secured with the frame, and holes in the panel correctly positioned. Fixing screw shall enter into holes taped into an adequate thickness of metal or provided with bolts and nuts. Self threading screws shall not be used in the construction of PCCs / MCCs / PDBs.

1.4.5 A base channel of 75 mm x 75 mm x 5 mm thick shall be provided at the bottom.

1.4.6 PCCs / MCCs /PDBs shall arranged in multi-tier formation. The PCCs / MCCs / PDBs shall be of adequate size with a provision of 20 percent spare space to accommodate possible future additional switch gear. The size of the PCCs / MCCs / PDBs shall be designed in such a way that the internal space is sufficient for hot air movement, and the electrical component dose not attain temperature more than 40 degree celsius. If necessary openings shall provided for natural ventilation, but the said openings shall be screened with fine weld mesh.

1.4.7 Knockout holes of appropriate size and number shall be provided in the PCCs / MCCs/ PDBs in conformity with number, and size of incoming and outgoing conduits / cables.

1.4.8 Alternatively the PCCs / MCCs / PDBs shall provided with removable sheet plates at top and bottom to drill holes for cable / conduit entry at site.

1.4.9 The PCCs / MCCs / PDBs shall be designed to facilitate easy inspection, maintenance and repair.

1.4.10 The PCCs / MCCs / PDBs shall be sufficiently rugged in design and shall support the equipment without distortion under normal and short circuit condition, they shall be suitable braced for short circuit duty.

1.5 PROTECTION CLASS :

All the indoor PCCs / MCCs / PDBs shall have protection class as IS.

1.6 PAINTING :

All sheet steel work shall undergo a process of decreasing pickling in acid, cold rinsing, phosphating, pesivating and then sprayed with a high corrosion resistant primer. The primer shall be backed in an oven. The finishing treatment shall be by application. Three coats of synthetic enamel paint of approved colour shall be applied by spray and stoves in dust free atmosphere or the panel shall be powder coated.

1.7 CIRCUIT COMPARTMENT :

1.7.1 Each circuit breaker and switch fuse units shall be housed in separate compartments and shall be enclosed an all sides. Sheet steel hinged lockable door shall be duly inter locked with the breaker / switch fuse units in ON and OFF position. Safety interlocks shall be from being drawn out when the breaker is in ON position.

1.7.2 The door shall not form as integral part of the drawout position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tires in a vertical section.

1.8 INSTRUMENT COMPARTMENT

Separate and adequate compartment shall provided for accommodating instruments, indicating lamp, control contactors, relays and control fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, switch fuse units, busbars and connections.

1.9 BUSBARS

1.9.1 The busbar shall be air insulated and made high quality, high conductivity, high strength Copper / Aluminium and as per relevant IS code. The busbar shall of three phases and neutral system with separate neutral and earth bar. the busbar and interconnection between busbar and various components shall be of high conductivity, hard drawn, electrolytic copper / Aluminum. the busbar shall be of rectangular cross section designed to withstand full load current for phase busbar and full rated current for neutral busbar and shall be extensible type on either side. The busbar shall be rated for the frame size of the main incoming breaker but in any case not less than 200 amp capacity. The busbar shall have uniform cross section through out the length.

1.9.2 The busbar and interconnection shall be insulated with heat shrinkable PVC sleeves and be colour coded in red, Yellow, Blue and Black to identify the three phases and neutral of the system. The busbar shall be supported on unbreakable, non hygroscopic DMC insulated supports at sufficientevely close interval to prevent busbar sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 50 KA RMS symmetrical for one second and a peak short circuit withstand of 105 KA minimum.

1.9.3 The busbar shall be housed in a separate compartment. The busbar shall be isolated with 3 mm thick bakalite sheet to avoid any accidental contact. The busbar shall be arranged such that minimum clearance between the busbar are maintained as per below.

Between phases	:	27 mm min.
Between phases and neutral	:	25 mm min.
Between phases and earth	:	25 mm min.
Between neutral and earth	:	23 mm min.

1.9.4 All busbar connection shall be done by drilling holes in busbars and connecting by chromium plated brass bolt and nuts. Additional cross section of busbar shall be provided in all PCCs / MCCs / PDBs to cover-up the holes drilled in the busbars. Spring and flat washers shall be used for tightening the bolts.

1.9.5 All connection between busbar and circuit breaker / switches and between circuit breaker/ switches and cable terminals shall be through solid copper strips of proper size to carry full rated current. These strips shall be insulated with insulating strips.

1.9.6 Busbar shall be of sufficient cross section so that a current density of 160 A/ Sq.cm (1000 A/ sq. inch) for Copper & 100 A/ Sq.cm for Aluminium shuld not exceeded at nominal current rating.

1.10 ELECTRICAL POWER & CONTROL WIRING CONNECTION

a) Terminal for both incoming and outgoing cable shall be suitable for 1100 volts grade, aluminum/copper conductor PVC insulated and sheathed, armoured cable and shall be suitable for connections of solder less sockets for the cable size as indicated on the appended drawing for the PCCs, MCCs, PDBs.

b) Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.

c) Both control and power terminals shall properly be shrouded.

d) 10% spare terminal shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block so that not more than one outgoing wire connected per terminal.

e) Terminal strip for power and control shall preferably be separated from each other by suitable barriers of enclosures.

f) Wiring inside the module for power, control protection and instrument etc. shall be done with use of 660/1100 confirming to IS 694 and IS 8130. Power wiring inside the starter module shall be rated for full current rating of contactor, but not less than 4 sq mm cross section area. **For current transformer circuits, 2.5 sq mm copper conductor wire shall be used.** Other **control wiring shall be done with 2.5 sq mm copper conductor wires**. Wires for connections to the door shall be flexible. All conductors shall be crimped with solder less sockets at the ends before connections are made to the terminals.

i) Control power for the motor starter module shall be taken from the respective module switchgear outgoing from R phase and Neutral. Control wiring shall have control fuse (HRC type).

j) Particular care shall be taken to ensure that the layout of wiring neat and orderly. Identification ferrules shall be filled to all the wire termination for ease of identification and to facilate and testing.

k) "CUPAL" washers shall be used for all copper and aluminum connections.

l) Final wiring diagram of the PCC, MCC, PDB power and control circuit with ferrules number shall be submitted along with the PCC/MCC/PDB as one of the documents.

1.11 TERMINALS

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

1.12 WIREWAYS

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

1.13 CABLE COMPARTMENT

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

1.14 EARTHING

a) Copper earth busbar of 25 mm x 3 mm shall be provided in the PCCs, MCCs, PDBS for the entire length of panel. The frame work of the PCCs, MCCs, PDBs shall be connected to this earth busbar. Provisions shall be made for connection from earth busbar to the main earthing bar coming from the earth pit on both side of the PCCs, MCCs, PDBs.

b) The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp and the clamp shall be ultimately bounded with the earth bar.

1.15 LABELS

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

1.16 NAME PLATE

a) A name plate with panel designation in bold letter shall be fixed at top of the central in panel. A separate name plate giving feeder giving feeder details shall be provided for each feeder module door.

b) Inside the feeder compartment, the electrical component, equipments, accessories like switchgear, contactor, lamp, relays etc. shall suitably be identified by providing stickers.

c) Engraved name plates shall preferably be of 3 ply, (red-white-red or black-white-black) lamicold sheet. However black engraved perplex sheet name plates shall also be applicable. Engraving shall be done with square groove cutters.

d) Name plate shall be fastened by counter sunk screws and not by adhesives.

1.17 DANGER NOTICE PLATE

a) The danger plate shall be affixed in a permanent manner on operating side of the panel.

b) The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.

c) The danger notice plate in general shall meet to requirements of local inspecting authorities.

d) Overall dimension of the danger notice plate shall be 200 mm wide and 150 mm high. The danger notice plate shall be made from minimum 1.6 mm thick mild steel sheet and after due pretreatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.

e) The letter, the figure, the conventional skull and bones shall etc. shall be positioned on the plate as per recommendations of IS : 2551-1982.

f) The said letter, the figure and the sign of skull and bones be painted in single red colour as per IS : 5-1978.

g) The danger plate shall have rounded corners. Locations of fixing holes for the plate shall be decided to suit design of the panel.

h) The danger notice plate, if possible, be of ISI certification mark.

1.18 INTERNAL COMPONENTS

a) The PCC / MCC / PDB shall be equipped complete with all type of required number of air circuit breakers, switch fuse unit, contactor, relays, fuses, meters, instruments, indicating lamps, push buttons, equipment, fittings, busbar, cable boxes, cable glands etc. and all the necessary internal connections /wiring as required and as indicated on relevant drawings. Components necessary for proper complete functioning of the PCC / MCC / PDB but not indicated on the drawings shall be supplied and installed on the PCC / MCC / PDB.

b) All part of the PCC / MCC/ PDB carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at any part of the PCC / MCC / PDB.

c) All units of the same rating and specifications shall be fully interchangeable.

1.19 INSPECTIONS

Each equipment should inspect and witness by client & consultant.

a) The PCC / MCC / PDB shall be inspected and checked as per inspection manual of the PCC / MCC / PDB manufacturer.

b) Various electrical components and accessories of the PCC / MCC / PDB shall be checked as per drawing for the respective PCC / MCC / PDB.

c) The PCC / MCC / PDB shall be checked for rigid mounting, earthing connections, proper rating and size of components, internal wiring, etc.

d) All mechanical fasteners and electrical connections shall be checked and tightened before installation.

e) Type test certificates for all ACB for similar rating shall be submitted.

f) Test :

a) Prior to dispatch of the PCC / MCC / PDB following tests shall be carried out.
b) Mechanical endurance test shall carried out by closing and opening of all the ACB's, MCB's switches etc.
c) Over voltage and Insulation resistance test shall be carried out between phases and between phase to earth bus, keeping the isolating switch in ON position. Similar test shall be carried out keeping the isolating switch in closed position.
d) All the interlocks, controls and tripping mechanism of the switch gears shall be tested for their proper functioning.

1.20 COMPONENTS :

A) GENERAL

a) The type, size, and rating of the components shall be as indicated on the relevant drawings.

b) While selection od the capacity of the components resulting from the prevailing conditions like room temperature shall be allowed for the Thermal and magnetic trip rating shall be compensated for the ambient temperature.

c) The rating indicated on the drawings are rating anticipated at prevailing site condition.

B) Fuse Switch Units : Not required

C) MINIATURE CIRCUIT BREAKER

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

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

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

D) FUSE:-

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

E) AIR CIRCUIT BREAKER

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

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

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

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

Interlocks shall be provided to :
Prevent the breaker from being isolated unless it is in the "OFF" position.

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

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

Facilities shall be provided for earthing the circuit breaker.

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

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

F) MOULDED CASE CIRCUIT BREAKER

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

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

Operating handle of the MCCB shall be in front and clearly indicate ON / OFF / TRIP positions.
The electrical contact of the circuit breaker shall be of high conducting non deteriorating silver alloy contacts.

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

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

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

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

G) CONTACTORS :

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

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

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

H) LOAD MANAGER:

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

I) CURRENT TRANSFORMER

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

J) PUSH BUTTON :

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

K) INDICATING LAMP :

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

Colour shade for the indicating lamps shall be as below :

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

L) CAPACITOR BANKS WITH APFCR/RTPF PANEL:

1.0 Scope

1.1 The design, manufacture and performance of the power factor improvement capacitor / capacitor banks shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable Indian / British / IEC standards. In particular the equipment shall conform to the latest revisions of the following:

IS:2834 : Shunt capacitors for power system.

IS:2208 : HRC cartridge fuse and links upto 660 V.

When the above standards are in conflict with the stipulation of this specification, this specification supersedes them.

CONSTRUCTION :

CAPACITOR BANK

Capacitors should be marked as per IS: 13340, IS: 13341 and should conform to IS: 12672. It should be suitable for temperature category of 50 deg. Cen. Capacitor banks shall comprise of identical delta connected three phase units. The individual capacitor unit shall be manufactured out of double layer mixed dielectric design comprising of basally oriented polypropylene film and capacitor tissue paper. Each individual element of the capacitor tissue unit shall be provided with silver fuse wire . The capacitor unit shall consist of many such elements in series / parallel combinations for getting the desired KVAR output. The capacitor shall be vacuum impregnated with liquid dielectric having high thermal stability. The dielectric losses of the capacitor shall be restricted to 1 watts per KVAR. The phase terminal connections of the capacitor unit shall be brought out at the top through metal insulators which should be soldered to the fabricated top cover. The capacitor shall be provided with suitably rated discharge resistors. The capacitor shall be designed to withstand the electrodynamics and thermal stresses caused by transient over current during switching. The capacitors should be provided with over pressure safety interrupter mechanism, which will automatically disconnect faulty capacitor unit from the network silently without bursting, bulging or exploding the capacitor.

BUSBAR CHAMBER

Capacitor bank shall be provided with a bus-bar chamber. The chamber shall be dust and vermin proof in construction, fabricated from 2 mm thick sheet steel. Continuous neoprene rubber gaskets shall be provided on all mating surfaces. TP Bus-bars shall be of copper supported on epoxy insulators of adequate rating and strips.

The bus-bar sizes and clearances shall be suitable for connection of cables through crimping type cable lugs. Bus-bar chamber shall be extended suitably on one side to enable termination of cable. There shall be a provision of cable end box at the end of bus-bar chamber undrilled removable gland plate and access covers to be provided for cable entry as required.

EARTHING :

The enclosure of individual capacitor unit shall be provided with 2 nos. 10 mm dia earth terminals, each complete with two plain and one spring washer, nuts etc. These terminals shall be effectively bonded to the common sheet steel frame work. Each bank will have two external earth terminals in the bus-bar chambers complete with hardware.

PAINTING :

All sheet steel shall be thoroughly cleaned, decreased and phosphated, painted with two coats of suitable primer and finished with two coats of paint. The type and shade of paint be as specified in Data Sheet.

DRAWINGS :

The following drawings shall be submitted alongwith the bid:

a. General arrangement drawing showing overall dimensions, weight, internal arrangement and mounting details.

b. Terminal chamber, showing bus-bar arrangement with all dimensions.

TEST & TEST CERTIFICATES :

Vendor shall carry out all routine tests as specified in IS:2834 and shall furnish the test certificates.

The vendor shall also carry out the thermal stability test on the units in the presence of purchasers representatives.

The capacitor units shall be tested from electric supply authorities like G. E. Board / A. E. Co. and the test certificates in duplicate shall be furnished to client and also the copy shall be submitted to the electric supply authority while getting the power supply released from them.

CAPACITOR PANEL :

Capacitor control panel should be automatic type .

The panel for capacitor shall be fabricated from 2.0 mm thick sheet steel and shall be finished as per clause no. 5.0. Earthing terminals shall be provided as per clause no.4.0. The panel shall be provided with suitably rated TPN copper bus-bar supported on epoxy insulators and with heat shrinkable type sleeves. Each capacitor unit shall be connected to main busbar through contactors of suitable rating with safety margin. Protective breaker for each capacitor banke of suitable rating should be provided.

Connections shall be made with PVC insulated flexible copper cables having crimped copper lugs. Continuous earthing conductor / strip of G.I shall run through and all capacitor units shall be earthed. Sufficient ventilation shall be provided in the capacitor compartment to limit the temperature rise. Cooling fans shall be provided with ON-OFF switches as per requirements.

The main bus-bar shall be terminated on suitably rated MCCB. Vertical compartment with detachable gland plate shall be kept for incoming cable connections from bottom or top as specified.

Capacitors units shall be mounted on angle frame of strong construction.

The panel shall be mounted on M.S. channel section at bottom for easy installation.

The panel shall be provided with lifting hooks / Eye bolts for handling.

Automatic power factor correction sensing relays (RTPFC) shall be provided with all related circuits and contactors for controlling the power factor by energizing the contactor and related capacitor bank "ON" or "OFF" as per load conditions.

The controller shall be set for time lag of 45 seconds so that on sensing the low or high power factor it energies or de energizes the contactor after 45 seconds.

The Dust and vermin proof switching compartment shall be isolated from capacitor mounting compartment.

The panel shall be provided with :

a. MCB /MCCB of adequate capacity as per rating.
b. 100 x 100 mm. flush type 0-500 V voltmeter with selector switch.
c. 100 x 100 mm. flush type Ammeter with suitably rated C.T. and selector switch.
d. Supply "ON' indication lamp (R-Y-B).
e. Power Factor meter 0.5 lag to 0.5 lead.
f. KVAR meter of suitable rating.
g. Each outgoing feeder should be provided with adequate size breaker, contactor, relay,ON/OFF push button with indicating lamp, auto/manual by pass switch with indicating lamp.
h. By - pass switch for each capacitor unit.
i. Automatic Power Factor correction relay unit with ON - OFF mode selector switch.
j. Exhaust Fan for cooling.

The capacitor panel shall be installed away from wall with sufficient distance for better cooling and ease of maintenance.

The following drawings shall be submitted before procurement for approval from the client.

1. General arrangement and Fabrication details.
2. Power wiring diagram of capacitor panel.
3. Control wiring diagram of capacitor panel.
4. C.T. connection.

RTPFC PANEL :

Incomer:

SDF, 3-pole + neutral, with suitable HRC fuse links is part of the systems. This shall have overcurrent – short circuit protection & main CTs. RYB phase indication. RTPFC microprocessor based intelligent controller. Digital Metering chamber including voltmeter and ammeter with phase selector switches.

Outgoing:

All the outgoing feeders will also be provided with

1. MCCB, TP, TM release suitable rating
2. Thyristor switch modules, firing circuits, zero-crossover switch, heat sinks, fans, etc.
3. Copper flexible wiring 0f 1100 VAC grade, multi-strnaded HRLS type.
4. Line choke reactors for limiting dv/dt for each capacitor feeders 0.2 %.
5. PFC capacitors EPCOS (SIEMENS) PhiCap Premium SH / equi. 440 VAC, 50 Hz, 3-ph Capacitors.

RTPFC controller:

Microprocessor based relay displaying various parameters like voltage, current, KVA, KW, KVAr, p.f., THD V, THD I, etc.

- Switching outputs with a relay or transistor output
- Twenty pre-programmed control series with a self-optimized intelligent response
- Four-quadrant operation
- Display of various grid parameters (V, I, F, Q, P, S...)
- Storage of maximum line-parameter and switching-operation values
- Manual / automatic operation
- Programming of fixed stages and the option of skipping individual outputs
- No-voltage (short term voltage interruption) turn-off
- Fault detection for various statuses and interference-message output
- Control-series editor - set your own control series.
- Complete menu-guided operation and display
- Illuminated LCD graphic display with 2 x 16 characters
- Intelligent control
- Storage of values : Max V, KVAR, KW, KVA, no. of switching operations of each step, operation time of each step, max. temp in deg C, Max THD V & I.

Thyristor/SSR:

TSM The Thyristors/SSRs will be of 1600 PIV rating and mounted on suitable heatsinks and control cards for firing control. Every module is controlled through special Zero Cross Switches. These are protected against overvoltage/current and overtemperature.

Operating Voltage range : 24V to 660V
Peak Voltage : 1600 PIV
Non repetitive overload current : 500A
On State Voltage drop : 1 V
Off State leakage current : Less than 20 micro amps
Tune in milliseconds for :
a) Turn On : less than 1 millisecond
b) Turn Off : Natural. Max 10 milliseconds.
Operating frequency range : 50 Hz/60 Hz
Off state dv/ dt in V / us : 50V/sec
Operating temperature range : 0 deg. To 50 deg.C.

1.2 Approval, Testing & Co-ordination :

1.2.1 Bidders Should Study The Existing Distribution Boards/Panels Which Have Been Already Erected In The New Campus. Those Distribution Boards/Panels Are Required For The First Phase Of New Campus. These New Db's/Panel's Should Match In All Respect With The Existing Db's/Panel's In The New Campus. All The New Db's/Panel's Should Match In Size,Guage,Colour,Dimension And All Other Arrangement With Existing Db's/Panel's..

1.2.2 The following drawings shall be submitted before procurement for approval from the client.

1. General arrangement and Fabrication details.
2. Power wiring diagram of the panel.
3. Control wiring diagram of panel.
4. C.T. ratios with connection.
5. Material list with make, catalogue nos and

1.2.3 Testing and setting the relay set – point and co-ordination between relay on LT/HT fuses, breaker, setting shall be done by cotractor. The down stream of the setting should be provided.

1.2.4 The relay should be tested by reputed agencies and test report of the relay should be submitted by the contractor.

M) Technical Specifications for Single Phase & Three phase Electronic Energy Meter of Class 1.0 Accuracy

1.0 SCOPE

This specification covers the design, engineering, manufacture, testing and calibration at manufacturer's works before dispatch, packing, supply and delivery of Class 1.0 accuracy, electronic energy meter, suitable for connection to LT
A)single phase 2 wire 240V system
B)Three phase 3-phase, 4- wire 415V system
The static whole current electronic meter shall offer current range of 5-30 A, 10-60A (first digit indicates the Basic Current & second digit indicates the Maximum Current of the respective meters) for tariff purposes, as per requirement given in this specification.

2.0 STANDARDS APPLICABLE

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

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

3.0 CLIMATIC CONDITION

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

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

4.0 SUPPLY SYSTEM

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

5.0 POWER SUPPLY VARIATION

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

System	1 Phase 2 Wire	3 Phase 4 Wire
Specified range of operation	70% to 120% of reference Voltage i.e. 240 V	70% to 120% of reference Voltage i.e. 415 V

Frequency	50Hz+/-5%	50Hz+/-5%

6.0 ACCURACY

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

7.0 POWER CONSUMPTION

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

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

11.0 GENERAL & CONSTRUCTIONAL REQUIREMENTS

11.1 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured.
a)Personal safety against electric shock
b)Personal safety against effects of excessive temperature.
c)Protection against spread of fire
d)Protection against penetration of solid objects, dust & water

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

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

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

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

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

11.7 The meter-base, meter cover, terminal block and ETBC shall be made of unbreakable, high grade, fire resistant, reinforced, non-flammable, polycarbonate or equivalent high grade engineering plastic.

11.8 The meter cover shall have a fully transparent window. The window shall be of transparent, high grade UV stabilized engineering plastic for easy reading of all the displayed values/parameters, and observation of operation indicator. The window shall preferably be an integral part of meter cover.

11.9 The meter cover shall be sealable to the meter base with at least 2 nos. seals. Also terminal cover shall have provision for sealing with at least one seal.

11.10 The terminal block shall be made of high grade non-hygroscopic, fire retardant, low tracking, fire resistant, reinforced poly-carbonate or equivalent high grade engineering plastic with terminal holes of minimum dia 8.5 mm and shall be suitable to accommodate the insulation of the conductors, meeting the requirement of IS 13779 /CBIP technical report-88.

11.11 The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Meter shall have 2 screws in each terminal for effective clamping of cables. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The clearance and creepage distance shall conform to relevant clause of IS 13779/CBIP technical report No.88.

11.12 The meter shall be compact in design. The entire construction shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.

11.13 The meter shall have 3 fixing holes, one at top and two at bottom. The top hole shall be such that the holding screw is not accessible to the consumer after fixing the meters. The lower fixing screws shall be provided under the sealable terminal cover.

12.0 ANTI-TAMPER FEATURES

The meter registration shall be immune to reversal in current direction. The meter shall have anti-tamper features

13.0 DISPLAY

13.1 The measured value(s) shall be displayed on a Liquid Crystal display (LCD) register. The height of the digit shall be minimum 8.5 mm. The KWh energy registration shall take place with 6 complete digits. The display shall have backlit capability for easy reading.

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

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

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

14.0 DISPLAY SEQUENCE

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

A) **Auto Display Mode:**

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

LCD Test
Real Time
Date
Cumulative Active energy (forwarded) reading (kWh)
Instantaneous Load (KW)
Billing period counts

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

B) **Push Button Mode:-**

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

C) **LCD Test**
Real Time
Date
Instantaneous voltage, current
The meter shall also be capable of offering a high resolution display which shall enable conducting of dial testing by the user in the shortest possible time and as a minimum, the meter shall be capable of offering a resolution of 4 digits after decimal (and 2 digits before decimal) for the high resolution KWh display.

15.0 COMMUNICATION PORT

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

16.0 MARKING OF THE METER

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

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

a) Manufacturer’s name & trade mark

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

17.0 CONNECTION DIAGRAM & TERMINAL MARKINGS

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

18.0 OUTPUT DEVICE

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

E – 5 L T DISTRIBUTION BOARDS

1.1 Scope :

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

1.2 Standards :

IS : 8623 : Distribution Boards

1.3 Distribution Boards :

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

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

b) Conduit knockouts shall be provided as required/shown on drawings and the entire board shall be rendered dust and vermin proof with necessary sealing gaskets. The top and bottom side of DB should be detachable.

c) All DB's shall be internally pre-wired using copper insulated Busbars of appropriate rating.Bus bars shall be suitable for the incoming switch rating and sized for a temperature rise of 35° C over the ambient. Each board shall have two separate earthing terminals. Circuit diagram indicating the load distribution shall be pasted on the inside of the DB as instructed. Two earthing terminal for single phase and two terminals for 3 phase DB's shall be provided with one earth strip connecting the studs and the other earth link should be provided with base insulator in such a way that link should in contact with body of distribution board.

1.4 RCCB/RCBO:

a) The RCCB should suffices all the requirements of IS as per code IS - 12640 (Part I) - 2000. The RCA should be current operated and not on line voltage.

a) The RCCB/RCCB should ensure mainly the following functions.

1) Measurement of the fault current value.
2) Comparison of the fault current with a reference value.

c) The RCCB/RCBO should have a torroidal transformer witch has the main conductors of primary (P - N) which check the sum of the current close to zero.All metal parts should be inherently resistant to corrosion and treated to make them corrosion resistant.It should be truly current operated.It should operate on core balance torroidal transformer.It's accuracy should be ± 5 %.It should operate even in case of neutral failure.It should trip at a present leakage current within 30 M.S.It's enclosure should be as per IP 30.It's mechanical operation life should be more

than 20,000 operations.It should provide full protection as envisaged by IE rules - 61-A, 71 - ee, 73 - ee, 1985 and also rule 50 of IE rule1956.It should conform to all national and international standards like IS, BS 4293 - 1983, CEE 27 (International commission Rules for the approved of electrical equipment).

1.5 MCB/ Isolators:

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

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

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

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

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

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

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

1.6 Voltage Surge Protector Devices (SPDs):

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

SPDs shall be tested in accordance with the requirements of IEC 61643-1.

SPDs shall be suitable for TT, TNC, TNS or TNC-S earthing systems.

SPDs shall provide protection between line to earth (common mode), neutral to earth (common mode) and line to neutral (differential mode).

SPDs shall be of the "withdrawable cartridge" type. The base of the SPDs shall be able to accept cartridges of different discharge ratings of Imax: 15kA, 20kA, 40kA & 65kA (8/20 microseconds waveform).

Optional auxillary contacts for remote indication shall be integrated in the base of the SPDs to eliminate possibility of wrong installation.

SPDs shall limit the transient let-through voltage of not more than 1.4kV in accordance to IEC 60364.

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

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

E – 6,7 L T CABLING AND TERMINATION

1.1 Scope :

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

1.2 Standards :

AS PER SCHEDULE OF INDIAN STANDARDS; ATTACHED IN THE DOCUMENT

1.3 Cables :

A) LV POWER CABLES will be 1100 Volts grade single / multicore standard aluminum conductor extruded XPLE insulated with extruded PVC inner sheath outer sheath made of FRLS PVC compound conforming to IS-7098 part-1. single core will be used for DC application. Cables in buried insulation shall be armoured type.

B) Control cables will be 1100 Volts grade multicore minimum 2.5 sqmm cross section standard copper conductor minimum 7 strands PVC insulated inner extruded sheathed and other sheath made of extruded FRLS PVC compound conforming to IS-1554 part-1. . Cables in buried insulation shall be armoured type.

C) All cables shall be new without any kind or visible damage. The manufacturers name, insulating material, conductor size and voltage class shall be marked on the surface of the cable at every 600 mm centers.

1.4 Cable joints and termination :

A) Connectors :

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

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

B) Cable Glands :

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

C) Ferrules :

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

D) Cable joints :

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

1.5 HEAT / FIRE RESISTANT COATING OF CABLE

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

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

E- 8 CABLE TRAY

1.1 Ladder type cable tray

The cable tray shall be fabricated out of 2 mm thick slotted/ perforated MS sheets as channel sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted as specified.

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

1.1.2 The permissible uniformly distributed load for various type of cables trays and for different supported span shall be as per IS.

1.1.3 The width of the cables tray shall be chosen so as to accommodate all the cables In one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 1000mm.

1.1.4 Factory fabricated bends, reducers, tee / cross junction. Etc shall be provided as per good engineering practice. The radius of bends, junctions etc. shall be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

1.1.5 The cable tray shall be suspended from the ceiling slab with the help of 10 mm dia MS round or 25 mm x 5 mm flats at specified spacing. Flat type suspenders may be used for channels up to 450 mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angle 50 mm x 50 mm x 5mm at the bottom and as specified These shall be grouted to the ceiling slab at the other and through an effective means, as approved by the Engineer – in – charge, to take the weight of the cable tray with the cables.

1.1.6 The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

1.1.7 The cable tray shall be bonded to the earth Terminal of the switch bonds at ends.

1.1.8 The cable tray shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly.

1.1.9 The ladder type of cable tray shall be fabricated of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a center to center spacing of 250 cm as per IS.

1.2 Perforated type cable tray

The cable tray shall be fabricated out of slotted/ perforated MS sheets as channel sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted as specified. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mmx50x6mm as two longitudinal members, with cross bracings between them by 50mmx5mm flats welded/bolted to the angles at 1 m spacing . 2mm thick MS perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

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

1.2.2 The maximum permissible uniformly distributed load for various all the cables trays and for different supported span are given in Table IV. The sizes shall be specified considering the same.

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

1.2.4 Factory fabricated bends, reducers, tee / cross junction. Etc shall be provided as per good engineering practice. The radius of bends, junctions etc. shall be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

1.2.5 The cable tray shall be suspended from the ceiling slab with the help of 10 mm dia MS round or 25 mm x 5 mm flats at specified spacing (based on table III) Flat type suspenders may be used for channels up to 450 mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angle 50 mm x 50 mm x 5mm at the bottom and as specified These shall be grouted to the ceiling slab at

the other and through an effective means, as approved by the Engineer – in – charge, to take the weight of the cable tray with the cables.

1.2.6 The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

1.2.7 The cable tray shall be bonded to the earth Terminal of the switch bonds at ends.

1.2.8 The cable tray shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly.

1.3 Anchor Fastener

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

For Slab / RCC : Hilti make – Cat No. HKD-E M10/40 / Std stud anchor HSA M8x85 35/25/- or equivalent as per requirnments
For Wall / Bricks : Hilti make – Cat No. HRD-C 10x80 / HRD-UGT 10x80/10

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

1.3.2 If require, 1% of total quantity Pull out test will be carried out at site.

1.3.3 Electrical contractor has to submit Material Test Certificate / Material Safety Data Sheet (MSDS) for all material to be used for hanging of cable tray.

E – 9 INTERNAL WIRING

1.1 Scope :

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

1.2 Standards :

AS PER SCHEDULE OF INDIAN STANDARDS, ATTACHED IN THE DOCUMENT

1.3 Rigid and Flexible conduits :

A) All conduits shall be rigid PVC having minimum wall thickness of medium gauge 1.6 to 1.8 approved by F.I.A. & I.S.I. All rigid pipe and its accessories shall be of suitable material complying with IS:3419-1989 and IS :9537 (Part 5) 2000 for flexible conduits.
The conduits shall be circular in cross-section and designated by their nominal outside diarmeter.Minimum thickness of walls shall be as follows:

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

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

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

1.4 Accessories :

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

1.5 Wires :

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

B) All wires shall be colour coded as follows :

Phase	Colour of wire
R	Red
Y	Yellow
B	Blue
N	Black
Earth	Green (insulated)
Control (If any)	Grey
All off wires	Same as Phase wire

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

1.6 Outlets switches & Sockets :

A) Switches shall be moulded plate type flush piano type with silver-coated contacts. Sockets shall be multipin pin with switch and plate type cover. Combination of multiple switch units and sockets should be used to minimize the switch boxes. All screws shall be brass – chromium plated and shall be counter sunk type with half round head or flat headed.

B) For heavy duty, metal clad sockets with M.C.B/ Isolator mounted in a galvanized steel box shall be provided.

C) The switch boxex shall be made of either rigid PVC moulidng or mild steel or cast iron on all sides except at the front. PVC boxes shall comply with the requirements laid down in IS :14772-2000. These boxes shall be free from internal roughness.Wall thickness of PVC boxes shall not be less than 2 mm.Clear depth of the box shall not be less than 60 mm and this shall be increased suitably as per requirements. An earth terminal with stud and washer shall be provided in each MS boxes for termination of protective conductors.

D) All the fan boxes shall be of cast iron type only with minimum wall thickness of 3 mm.

1.7 Additional requirements

1.7.1 Making Chase

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

1.7.2 Fixing conduits in chase

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

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

The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be fixed firmly to the steel reinforecement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same. Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius, which will permit easy drawing in of conductors.Location of inspection/ junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.
At either side of the bends, saddles/staples shall be fixed at a distance of 15 cm from the center of the bends.

1.7.4 Fixing of inspection boxes

As far as possible inspection boxes shall be avoided or to be minized as much as possible. If necessary suitable inspection boxes to the minimum sizes shall be provided to permit inspection and to facilitate replacement of wires

with prior approval of engineer in charge. These shall be mounted flush with the wall or ceiling concrete with minimum depth of 65 mm for slab and as per IS : 2667 – 1988 for other places.

1.7.5 Fish Wire

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

1.7.6 Earthing

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

E – 10 LIGHT FIXTURES AND FANS

1.1 Scope :

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

1.2 Standards :

AS PER SCHEDULE OF INDIAN STANDARDS.

1.3 Type of fixtures :

1.3.1 General Requirement:

1.3.1.1 All fixtures shall be complete with accessories necessary for installation whether so detailed under fixture description or not.

1.3.1.2 Fixture housing, frame or canopy shall provide a suitable cover for the fixture outlet box or fixture opening.

1.3.1.3 Fixtures shall be installed at mounting heights as detailed on the drawings or instructed on site by the Architects/Consultants.

1.3.1.4 Fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the fixture. Design of hangers and method of fastening other than shown on the drawings or herein specified shall be submitted to the Architect/Consultant for approval.

1.3.1.5 Pendant fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation as per Architect's/Consultant's instructions.

1.3.1.6 Flush mounted and recessed fixtures shall be installed so as to completely eliminate light leakage within the fixture and between the fixture and adjacent finished surface.

1.3.1.7 Fixture mounted on outlet boxes shall be tightly secured to a fixture stud in the outlet box. Extension pieces shall be installed where required to facilitate proper installation.

1.3.1.8 Fixture shall be completely wired and constructed to comply with the regulations and standards for Electric Lighting Fixtures, unless otherwise specified. Fixtures shall bear manufacturer's name and the factory inspection label unless otherwise approved.

1.3.1.9 Wiring within the fixture and for connection to the branch circuit wiring shall be not less than 1.0/1.5 sq.mm. copper for 250 volt application. Wire insulation shall suit the temperature conditions inside the fixture and wires bypassing the choke shall be heat protected with a heat resistant sleeve.

1.3.1.10 Metal used in lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with the specification or standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burrs and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

1.3.1.11 Ferrous metal shall be bonderized and given a corrosion resistant phosphate treatment or other approved rust inhibiting prime coat to provide a rust-proof base before application of finish.

1.3.1.12 Non-reflecting surfaces such as fixture frames and trim shall be finished in baked enamel paint.

1.3.1.13 Light reflecting surface shall be finished in baked white enamel having a reflection factor of not less than 80%. All parts of reflector shall be completely covered by finish and free from irregularities. After finish has been applied and cured, it shall be capable of withstanding a 6 mm radius bend without showing sign of cracking, peeling or loosening from the base metal. Finish shall be capable of withstanding 72 hours exposure to an ultraviolet sun lamp placed 10 cm from the surface without discoloration, hardening or warping and retain the same reflection factor after exposure. Test results shall be furnished for each lot of fixtures.

1.3.1.14 Fixture with visible frames shall have concealed hinged and catches. Pendant fixtures and lamp holders shall be provided with ball type Algiers or similar approved means. Recessed fixtures shall be constructed so as to fit into an acoustic tile ceiling or plaster ceiling without distorting either the fixture or the ceiling plaster rings/flanges shall be provided for plaster ceiling. Fixtures with hinged diffuser doors shall be provided with spring clips or other retaining device prevent the diffuser from moving.

1.3.1.15 Detailed catalogue cuts for all fixtures, or, if so required by the Architect/Consultant sample fixtures shall be submitted for approval to the Architect/Consultant before orders for the fixtures are placed. Shop drawings for non-standard fixture types shall be submitted for approval to the Architect/Consultant.

1.3.1.16 Recessed fixtures shall be constructed so that all components are replaceable without removing housing from the ceiling.

1) Lamps shall be supplied and installed in all lighting fixtures furnished under this contract. All lamps shall be rated for 250 volts.

2) Lamps used for temporary lighting service shall not be used in the final lighting of fixtures units.

3) Lamps shall be of wattage and type as shown on the drawings and schedule. Where not shown, the details shall be ascertained from the Architect/Consultant before procurement.

4) Lamps for permanent installation shall not be placed in the fixtures until so directed by the Architect/Consultant, and this shall be accomplished directly before the building portions are ready for occupation.

1.3.2 Fluorescent fittings :

1.3.2.1 Only single and/or two lamp ballast shall be used in any one fixture. Ballast shall be completely enclosed inside sheet steel casing and shall have a corrosion - resistant finish. Ballast shall contain a thermosetting type compound not subject to softening or liquefying under any operating conditions or upon ballast failure. Compound shall not support combustion. All ballast shall be of high power factor compensated to above 0.9PF. Ballast temperature and sound rating shall be specified by the manufacturer and guaranteed. Ballast shall be for operation at the voltages and frequencies indicated and under temperature conditions prevailing in the various locations of the premises. Tapped ballast are preferred.

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

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

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

1.3.3 Incandescent fittings :

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

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

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

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

1.3.4 LED Light Fixtures Specifications :

1.4.1 General Purpose Led Luminaires should be suitable for indoor/outdoor installation for Office applications. The Fixtures should be Operational for 220-240 V Single Phase 50 HZ AC , and operational from 170-280 V without significant variation in output .The LED modules should be from approved make list Only with efficiency of a min 110 lm/watt and efficacy of fixtures should be greater than 80 lm/w for both indoor and outdoor fixtures.

1.4.2 Luminaries should be with built in Integral driver only. The Min degree of Protection for Indoor Fixtures should be IP20 and IP 44 for Semi Indoor an IP65 for Outdoor Fixtures. The THD of fixtures should be strictly <10 % and drivers should be compulsorily provided with overload, short circuit and over voltage protections. Power factor should be >0.90.

1.4.3 For Indoor applications the housing should be made of die cast/ Metal Housing and diffusers should be polycarbonate only, outdoor fixtures should be with die cast aluminium / extruded aluminium housing only .The Fixtures should be prewired upto the terminal block and easy to mount and Install and maintain.

1.4.4 The fixture should comply LM79-08 certification criteria and also module should be backed with LM80-08 Certificate from the OEM. The fixtures should be warranted for minimum period of 3 years from the date of Installation. The fixtures should have some kind of embossing/ engraving to identify the brand name. The manufactures should provide all kind of test report, technical details as and when called for. If required contractor have to provide test certificate from Government approved Lab for Claimed parameters by the manufacturer without any extra cost.

Technical specification of Lighting Fixtures :

S.No.	Description	Value
1	***Site Parameters***	
1.1	Ambient Temperature	0˚C to 50˚C
2	***Electricity Efficiency Management/Electronic Driver***	
2.1	Input Operating Voltage	110 to 270Volts, AC 50Hz±2
2.2	AC Power Factor	Not Less than 0.95
2.3	Efficiency of driver	More than 85%
2.4	THD (AC current 110V to 250V)	Not more than 10%
2.5	LED Drive Current	Not more than 500mA
2.6	Led Efficacy	≥110lm/watt
3	***Optical Management***	
3.1	Colour Temperature	2700˚K to 6500˚K
3.2	LED life with L70 criteria	Above 50,000 operating hours
3.3	CRI	More than 70
4	***Thermal Management***	
4.1	Jn. Temperature of LED at 25˚C	≤65˚C
4.2	Heat Sink temperature rise above ambient	≤30˚C
5	***General parameters***	

5.1	Mounting Arrangement	Mounting Angle Adjustment facility should be provided
5.2	IP Clause & Environment Protection	Minimum IP 20 for indoor, IP 44 for semi covered area and IP 65 for outdoor
5.3	Overall system efficiency	Not less than 75%

Successful Contractor has to submit test report of similar LED light fixture for following parameters from any Government Approved Test Laboratories for approval. However, test certificates of the lot to be supplied are required to be produced before supply of material at site.

For LED

- LM 80 report of the LED chip being used

For Fixtures

- Endurance Test
- Thermal Test
- IP rating test
- Power factor, efficiency
- Harmonic test
- Surge test
- Mechanical strength test
- Dielectric test
- IR test
- Goniophotometer Reading for the LED Light

Contractor have to give three year unconditional guarantee for replacement for each light fixture.

The electronic components used shall be as follows:-

a) IC (Integrated circuit) shall be of industrial grade or above.

b) Metallic film / Paper/Polyester Capacitor shall be rated for a sustained operating temperature of 105ºC.

c) The resistors should be preferably made of metal film where suitable, of adequate rating. The actual rating versus loading shall be by a factor of >2.

d) The junction temperature of the Switching devices such as transistors and MOSFETs etc. shall not exceed 125ºC (allowing thermal margin of 25 ºC).

e) The protective cum adhesive coating used on PCBs should be clear and transparent and should not affect color code of electronic components or the product code of the company.

f) The construction of PCBs and the assembly for components for PCBs should be as per relevant Indian / international standards.

g) The electronics covered for this equipment shall pass all the tests covered under relevant Indian / International standards specification.

h) The infrastructure for Quality Assurance facilities must be available at the manufacturing facility. In house testing facility for Quality Assurance should be present.

i) The connecting wires used inside the luminaries, shall be low smoke halogen free, fire retardant e-beam cable and fuse protection shall be provided in input side.

j) For outdoor fixtures, Care shall be taken in the design that there is no water stagnation anywhere. The entire housing shall be dust and water proof having IP66 or above protection and the light shall pass driving rain test/jet water test.

k) The LED Module(s), Driver gear, etc. shall be designed in such a way so that temperature of heat sink shall not exceed 30ºC above the ambient temperature.

l) All the material used in the luminaries shall be halogen free and fire retardant confirming to UL94.

m) The LED Luminaries shall have an input connector which shall be made of fire retardant material & its construction shall be water proof

n) The Contractor shall submit all the necessary support documents alongwith the compliance statement of all technical requirements w.r.t. Electrical, Optical, Thermal & environmental performance, including the Technical specification mentioned herewith.

o) Each LED should have necessary lens /reflector for better distribution of light at surface.

p) All the applicable test reports for complete fixtures and spare parts have to be submitted.

q) The manufacturer should have in house testing facilities within the India for the fixtures intending to supply.

1.3.5 Ceiling Fans :

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

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

E – 11 Earthing

1.0 SCOPE OF WORK :

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

1.1 copper/galvanized/aluminium/chemical or Electrode type Earthing station.

1.2 Earthing G.I./Aluminum/copper strips from earthing station to equi-potential bar.

1.3 Earthing G.I./ Aluminum/ copper strips/ wires from equi-potential bar to lay feeder mains and circuit to connect power panels, DBs, switchboards etc.

1.4 Bonding of Non-current carrying parts, and metallic parts of the electrical installation.

1.5 Provide inter connection between all earth pits of same type.

2.0 STANDARDS

2.1 The following standards and rules shall be applicable:

1) IS: 3043 - 2018 Code of practice for Earthing.

2) Indian Electricity Act and Rules

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

3.0 GENERAL

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

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

4.0 TYPE OF EARTHING STATION

4.1 PLATE EARTHING STATIONS

4.1.1 The earthing station shall be as shown on the drawing IS:3043.

4.1.2 The earth resistance shall be maintained with suitable soil treatment as shown in the drawing.

4.1.3 The resistance of each earth station should not exceed the limit specified in IS : 3043.

4.1.4 The earth lead shall be connected to the earth plate through copper/brass bolts in case of copper earth plate and shall be hot dip galvanized iron for G.I. plate earth plate as shown on the drawing.

4.1.5 The earthing grid and the earthing conductors shall be of copper strip in case of copper earth plate and hot dip galvanized iron strip in case of G.I. earth plate of size as mentioned on the drawing.

4.1.6 G.I. pipe with funnel with filter of approved quality shall be used for watering the earthing electrodes \ stations.

4.1.7 The block masonry chamber with Cast Iron hinged cover of 300 x 300 mm shall be provided for housing the funnel and the pipe for watering the earthing electrodes \ stations.

4.2 PIPE EARTHING STATIONS

4.2.1 The substation earthing shall be with GI Pipe earthing station and equipment earthing grid shall be with hot dip galvanized iron earthing station.

4.2.2 The Pipe electrode shall 38mm dia GI pipe for earthing

4.2.3 The earthing station shall be as shown on the drawing.

4.2.4 The earth resistance shall be maintained with suitable soil treatment as shown in the drawing.

4.2.5 The resistance of each earth station should not exceed 4 ohms.

4.2.6 The earth lead shall be connected to the earth plate through copper/brass bolts in case of copper earth plate and shall be hot dip galvanized iron for G.I. Pipe earth as shown on the drawing.

4.2.7 The earthing grid and the earthing conductors shall be of hot dip galvanized iron strip of size as mentioned on the drawing.

4.2.8 The block masonry chamber with Cast Iron hinged cover of 300 x 300 mm shall be provided for housing the funnel and the pipe for watering the earthing electrodes \ stations.

4.2.9 The hardware and other consumable for earthing installation shall be of copper/brass in case of copper earth plate and shall be hot dip galvanized iron material in case of G.I. Pipe , as per details shown in the drawing .

4.3 ELECTRODE / CHEMICAL TYPE EARTHING STATIONS:

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

4.3.2 The earthing station shall be as shown on the drawing.

4.3.3 The earth resistance shall be maintained with suitable soil treatment as shown in the drawing.

4.3.4 The resistance of each earth station should not exceed the limit specified in IS : 3043.

4.3.5 The earthing grid and the earthing conductors shall be of copper strip of size as mentioned on the drawing.

4.3.6 The block masonry chamber with Cast Iron hinged cover shall be provided for housing the termination block as shown in the drawing.

4.3.7 The hardware and other consumable for earthing installation shall be of copper/brass, as per details shown in the drawing.

4.3.8 GROUNDING: The grounding system shall incorporate the following individual components or a combination of the following:

- Deep driven copper bonded steel core ground rod/ Copper Plate / Copper Rod as central injection point for flow of fault current which is securely connected to the lower end of the down conductor.

- The use of ground resistance improvement material shall be applied in order to reduce the resistivity levels of the grounding system and maintain a constant low resistivity. The grounding system shall be maintenance free.

Maintenance Free Earthing System consist of following material:
- Copper Bonded Earth Rod- Length 1.5Mtr/3Mtr Dia. 5/8"
- Ground Rod Clamp – For Earth Termination.
- Ground Resistance Lowering Compound.

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

Description: Threaded Copper bonded Earth Rod

Material: Carbon steel rod bonded with Copper

Length: 1.5Mtr./3Mtr

Rod Diameter (Actual): 5/8"

Weight: 1.92kg / 4Kg.

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

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

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

U-Bolt Rod Clamp.

Suitable for clamping earth rods to tape or round conductor.

Description:
Suitable for
Rod Diam. : 5/8" & Copper Tape Size: 25mm x 3mm
Weight: 90 grm.

5.0 INSTALLATION AND CONNECTION :

5.1 The plate \ pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 2.5 M below finished ground level.

5.2 The plate \pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall \ column.

5.3 The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.

5.4 G.I. pipe for watering, shall run from top edge of the plate \ pipe electrode to the mid level of block masonry chamber.

5.5 Top of the pipe shall be provided with G.I. funnel and screen for watering the earth \ ground through the pipe.

5.6 The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing.

5.7 The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.

5.8 Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.

5.9 The earth conductors (Strips / Wires copper/ Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Mild Steel Zinc Passivated screws \ bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level.

5.10 The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.

5.11 Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.

5.12 The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

6.0 EARTH LEADS AND CONNECTIONS :

6.1 Earth lead shall be bare copper or galvanized steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. Galvanized steel buried in the ground shall be protected with bitumen and Hessian wrap or polytene faced Hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is at least 8 mm away from the wall surface.

6.2 The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

7.0 EQUIPMENT EARTHING :

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

8.0 POWER TRANSMISSION APPARATUS

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

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

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

8.2 Non metallic conduit shall have an insulated earth continuity conductor of the same size as for metallic conduit. All metal junction and switch boxes shall have an inside earth stud to which the earth conductor shall be connected. The earth conduct or shall be distinctly coloured (Green or Green/Yellow) for easy identification.

8.3 Armoured cable shall be earthed by two distinct earth connections to the armouring at both the ends and the size of connection being as for the metallic conduit.

8.4 In the case of Unarmoured cable, an earth continuity conductor shall either be run outside along with the cable or should form a separate insulated core of the cable.

8.5 Three phase power panel and distribution boards shall have two distinct earth connections of the size correlated to the incoming cable size. In case of single phase DB's a single earth connection is adequate.

9.0 UTILIZING EQUIPMENT :

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

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

9.2 For single phase motors and apparatus, the single earth connection shall be provided of the above size. For all light fittings and fans a single earth connection with 1.5 sqmm copper or equivalent size shall be provided.

9.3 All street light poles shall have an earth stud and shall be connected to the cable armouring using 6.5 sqmm copper or equivalent unless shown otherwise. For street lighting poles planted in ground, 2.4 M long 10 SWG bare copper wire shall be coiled and buried with every fourth pole in addition to connection to cable armouring.

9.4 An equipment earthing grid shall be established as shown in the drawing. All earth connections to all panels, DB's and equipment shall be connected to the nearest point of the earthing grid.

10.0 TEST :

10.1 The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS : 3043.

10.2 The following earth resistance values shall be measured with an approved earth meggar and recorded.

1) Each earthing station
2) Earthing system as a whole
3) Earth continuity conductors

10.3 Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 Ohm in each case. This is responsibility of contractor to get the final value for resistance.

10.4 Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

10.5 All tests shall be carried out in presence of the consultant..

11.0 METHOD OF MEASUREMENT :

11.1 Provision of earthing station complete with excavation, plate, earth lead upto chamber, earth link in the chamber, electrode, GI watering pipe, Salt, Charcoal, soil treatment to achieve the earth resistance less than 4 ohm, masonry chamber with cast iron cover etc. shall be treated as one unit of measurement.

11.2 The following items of work shall be measured and paid per unit length covering the cost of the earth wires/strips, clamps, labour etc.

a) main equipment earthing grid and connection to the earthing stations.
b) Connection to the power panels, DB etc.

11.3 The cost of earthing the following items shall become part of the cost of the item itself and no separate payment for earthing shall be made.

a) Light fittings - form part of installation of the light fitting.
b) Conduit wiring, cabling - should form part of the wiring or cabling.
c) Street lighting - should form part of the street light poles.

E-12 External Lighting

1.0 Scope :

1.1 The scope of work covers the supply, installation and testing of lighting poles, weather proof light fixtures, wiring to the fixtures, cable laying, earthing as specified and shown on drawings.

2.0 Standards :

As per Applicable standard

3.0 Light Fixtures :

3.1 The light fixture construction shall be of IP 65 die cast aluminium with a separate compartment for integral ballast equipment. The reflector shall be anodized polished aluminium. The glass refractor shall be heat-resistant.

3.2 Lamp holder shall be of porcelain and shall comprise of a terminal block of non-hygroscopic material. The luminaries shall have integral ballast housed in water tight and dust tight metal cases. Ballast shall be pre-wired to the Lamp socket and terminal block, requiring only power supply leads to the ballast primary terminals.

3.3 The Lamp & Laminar shall generally follow the specification under section `LIGHT FIXTURES'.

4.0 Lighting Poles : Lighting Poles for street lights /flood lights shall be swaged type GI pole construction

4.1 The lighting poles shall be fabricated from heavy duty cold-rolled steel tubes to IS:1239-1958 and hot dip galvanized or painted as specified. The pole shall have a base plate, a large access panel, and necessary fixture mounting bracket at top. The access panel shall provide easy access to a multi-way porcelain connector and fuse board, to be mounted inside the pole. The access shall be specially fabricated with adequate reinforcement and weather gasket to prevent ingress of moisture and vandal proof. Poles shall have large diameter entries for incoming and outgoing cable and two earth studs. The pole fabrication shall conform to the drawings and where such drawing is not available, the contractor shall make such drawing and have it approved before fabrication.

4.2 The pole shall house a multi-way porcelain terminal block and re-wirable fuse as shown on the drawings. Pole shall have a concrete coping.

5.0 Cable laying :

5.1 Cabling shall be generally as specified in the section `CABLING'.

5.2 Cables shall be terminated in a 4-way terminal block inside the pole or attached therewith as shown on drawings.

5.3 Cable route shall be as shown on the drawings or the contractor shall mark out the route and lay the cables only upon approval of the route.

6.0 Earthing :

6.1 All street lights fixtures and poles shall be earthed as specified under section `EARTHING'.

7.0 Mode of Measurement :

7.1 Each light fitting with lamp, control gear, earthing etc. shall be considered as one unit for measurement and payment.

7.2 Each lighting pole, concrete coping, base plate earthing etc. shall be considered as one unit for measurement and payment.

7.3 All cabling work shall be measured on the basis of unit length and the cost shall include, cost of cable ,cable termination in junction boxes or pole terminal box etc.

8.0 LT SECTION FEEDER PILLAR - SFP

8.1 SCOPE :

(i) This specification covers the scope of design, fabrication, assembling, inspection at vender's works and delivery in properly packed condition to project site of cubical pattern MV Metal Enclosed Switchgear.

(ii) The switchgear would comprise Main L.T.power distribution panel , Section pillar, sub-section pillar, power distribution board(PDB).

8.2. CODES AND STANDARDS :

(A) The equipment shall be designed to conform to the requirements of following Indian Standards :

IS : 8623 and IEC-439	:	Factory built assemblies of switchgear and control gear.
IS : 4237	:	General requirements for switchgear and control gear for voltage not exceeding 1000 volts.
IS : 2147	:	Degree of protection provided by enclosures for low voltage switchgear and control gear.
IS : 375	:	Marking and arrangement of busbars.

(B) Individual equipment housed in the Medium Voltage Switchgear shall conform to the following IS specifications.

1.	IS : 13947(part-3) & IEC: 947-3 :	:	Air break switches and fuses combination units for voltage not exceeding 1000 Volts (specific requirements for the direct switching of individual motors) i.e. suitable for AC 23 duty.
2.	IS : 1248	:	Direct acting electrical indicating instruments.
3.	IS : 694 (1990) and IS : 8130 (1994)	:	PVC insulated cables and aluminium conductors.
4.	IS : 13703 (PART 2)	:	Low voltage fuses.
5.	IS : 13947 (PART 2)	:	Air circuit breakers.
6.	IS : 2705	:	Current transformers
7.	IS:13947(PART-4/SEC-1) & IEC-60947-4-1	:	Contactors.
8.	IS:13947(PART-4/SEC-1) & IEC-60947-4-1	:	Thermal overload relay
9.	Indian Electricity Rules	:	As amended up to date
10.	Approval From T.A.C./F.I.A. OR C.P.R.I. Tested.		

8.3 DESIGN & CONSTRUCTION REQUIREMENTS :

(a) The switch board shall be for indoor application, metal enclosed, dust & vermin roof, free standing, floor mounting, compartmentalized, modular type & extensible on both sides.

(b) The switch board shall be fabricated from CRCA sheet steel having following minimum thickness :

- Frames, load bearing members & large doors : 2.5 mm(12 swg)
- Partitions & small doors : 2.03 mm(14 swg)
- Front, back & side covers : 2.03 mm(14 swg)
- Section pillar : outer side(Front, back & side covers) 12 SWG and inner side 14 SWG

(c) The board shall be divided in to distinct vertical sections, each comprising of :

- A completely metal enclosed bus bar chamber running horizontally throughout the length of the switchboard.
- Individual feeder modules.
- Vertical busbar chamber at the side of feeder modules or back of the feeder module.
- Cable alley shall be with 250 mm width for double front execution.

(d) The switchboard shall be provided with degree of protection of not less than IP 42 as per IS 2147 for indoor application and all section pillar /sub-section pillar shall be of not less than IP-55 as per IS outdoor application.

(e) Maximum height of the board including the height of the Base Channel shall be 2450 mm. Also, the minimum & maximum mounting height of the switches, relays & instruments etc. shall be 200 mm & 2000 mm respectively, above the bottom of the Base Channel.

(f) Suitable sized thick neoprene gaskets shall be provided all round the perimeter of doors, covers etc for making the construction dust & vermin proof.

(g) Power/control terminals in the cable alleys for each module & also the busbar chamber shall be covered with hinged & bolted type hylum shrouds respectively to prevent accidental contact when the door/cover is withdrawn. In each feeder module, the phase barrier of hylum sheet shall be provided between the adjacent phases.

(h) Suitable lifting hooks shall be provided on each shipping section of the board. **Each module shall be considered as separate shipping section.**

(i) In case of double front type design the vertical busbar chamber shall be common for the front sided feeders as well as for the rear sided feeders in each panel of the switchboard.

(j) Gland plate of 5 mm thickness shall be provided at the top or bottom of the board, and gland plate shall be of **non -magnetic type. (Where ever required)**

(k) All the feeder modules & the cable alleys are provided with hinged type doors and cam lock with key lock chromium plated, whereas all the busbar chambers are provided with bolted type .

(l) Main earth bus of aluminium flat shall be suitably placed running throughout the length of the switchboard.

(m) All the hardwares used in the construction of the switchboard shall be chromium /zinc plated passivated type with spring washers to avoid loosening of the fixed parts.

8.4 METAL TREATMENT AND PAINT FINISH :

(a) PRE TREATMENT CHEMICAL PROCESS :

All sheet steel work used in the construction of the switchboards shall be pre-treated with 7-tank chemical process as specified in the specific requirement sheet before applying the two coats of zinc cromate primer followed by synthetic enamel/epoxy paint as follows :

7-TANK PROCESS :-

1. DEGREASING :-

In this process the M.S. sheets shall be effectively cleaning by dipping in hot alkaline degreasing solution for the period of about 10-20 minutes.

2. WATER RINSING :-

After degreasing process the M.S. sheets shall be rinsed in to the water for the period of about 1-2 minutes to remove the loosened oil, grease and adhering alkali from the surface.

3. DERUSTING :-

In this process the M.S. sheets shall be pickled in dilute sulphuric acid to remove oxide scales and rust formation for the period of about 30 minutes.

4.WATER RINSING :-

After the derusting process the M.S. sheets shall be rinsed in to the water for the period of about 1-2 minutes to remove the traces of acidic solution from the surface.

5. PHOSPHATING :-

In this process the M.S. sheets shall be dipped in to the zinc phosphating solution for the period of about 30 minutes to facilitate durable coating of the paint on the metal surfaces.

6.WATER RINSING :-

After the phosphating process the M.S. sheets shall be rinsed in to the water for the period of about 1-2 minutes to remove the traces of phosphate solution from the surface.

7. PASSIVATION :-

In this process the M.S. sheets shall be dipped in to the de-oxalite solution for the period of about 1 minute to retain and augment the effects of phosphating on the surface.

After completion of 3-tank/7-tank process a fine grained, smooth and compact coating of iron/zinc phosphate shall be produced, which is an excellent base for paint and provide under film protection against corrosion. The coating shall meet the Indian Standard Specification IS:3618-1966 class C.

(b) DRYING :

After the above pre treatment chemical process, the M.S. sheets shall be dried either by means of hot air circulation oven (stoving) or by means of blast of compressed air (air drying).

(c) PRIMER COATING :

Primer coating with two coats of highly corrosion resistant zinc cromate primer shall be done before applying the final paint finish.

(d) PAINT FINISH :

The final finishing of synthetic enamel/epoxy paint of **RAL-7032** shall be matt finish powder coated.

8.5 MATERIAL/COMPONENT SPECIFICATIONS :

(A) BUSBAR :

(a) The busbar shall be air insulated with heat shrinkable coloured sleeves and made of high conductivity high strength Aluminium complying to the requirements of IS : 5082.

(b) The busbar shall be suitably braced with non-hygroscopic epoxy resin cast/SMC supports at regular distance to provide a through fault withstand capacity of 50 KA RMS symmetrical for one second and a peak short circuit withstand of 150 KA minimum. Ridges shall be provided on the busbar supports to prevent tracking between adjacent busbars.

(c) The main horizontal busbars shall be positioned at top portion running throughout the length of the switch board. The cross section of the busbar shall be uniform throughout the length of busbar. The busbars shall be insulated with coloured PVC heat shrinkable sleeves i.e. red coloured for R-phase, yellow coloured for Y-phase, blue coloured for B-phase and black coloured for Neutral. Also the sequence of R, Y & B phase busbars shall be from top to bottom/left to right/front to back respectively and Neutral busbar shall be fixed near to R or B phase busbar.

(d) The vertical busbars shall be provided in separate vertical busbar alley adjacent to individual feeder modules. Suitable barrier shall be provided in front of vertical busbar against accidental contact after the module has been withdrawn.

(e) Pre-drilled holes shall be provided on the vertical risers so that modules can be changed at site, for vacant feeders also.

(f) High tensile bolts and spring washers shall be provided at all busbar joints. Also, all busbar joints shall be protected by using hylum/plastic shrouds.

(g) The minimum clearance in air between phase to phase busbars as well as between phase to earth shall be 25 & 20 mm respectively or as per fault level requirement.

(h) Main busbars shall be adequately sized, so that, while carrying rated current continuously the maximum temperature of busbars, even at joints, does not exceed 85 degree centigrade.

(i) Danger caution plates shall be provided on each busbar chamber cover.

(j) Busbar shall be of sufficient cross section so that a current density of 160 A/ Sq.cm (1000 A/ sq. inch) is not exceeded at nominal current rating for copper bus bars.

(B) UNIT MODULE :

(a) Each module shall be suitable for mounting drawout type air circuit breakers/MCCB/MCB power fuses, control fuses, contactors, relays, push buttons, indicating lamps, terminal blocks etc. as may be required.

(b) Each module shall be provided with individual door and the door shall be mounted on the main structure. The doors shall be provided with concealed hinges. The module door with cromium plated locks / key operation.

(c) Unit doors shall be interlocked mechanically with breaker/switch/fuse switch to prevent unintentional opening of the door while the units is in energized condition. However, provision should be made to open the door in energized condition i.e. defeat facility, for testing purpose.

(d) Main HRC fuses shall be positioned before the isolator to eliminate any position hazards during a fault at the isolator terminals. The HRC fuses however, shall not be accessible when they are in live condition.

(C) CIRCUIT BREAKERS :-

(a) The circuit breaker shall be air break type, FOUR pole, Drawout type and electrically operated type as specified in the schematic drawing complying to the requirements of IS : 13947(PART 2)

(b) The circuit breaker shall be provided with shunt trip mechanism.

(c) The circuit breaker shall be provided with inbuilt over current, short circuit and earth fault releases or separate protection relays as may be specified in the schematic drawing. All release shall be micro processor based.

(d) The circuit breaker shall be provided with 6 NO + 6 NC auxiliary contacts rated 10 Amp, 240 Volt AC supply duly wired up to the terminal block for purchaser's use.

(e) The circuit breaker shall be provided with red, green, amber and white indicating lamps for indicating closed, open, auto trip and trip circuit healthy conditions of the breaker. all release shall be micro processor based.

(f) Automatic safety shutters shall be provided to completely cover the female primary contacts when the breaker is withdrawn from service position.

(g) Compartment door of breaker should not open unless the associated breaker is in open position. The interlock defeat also to be provided.

(h) Closing action of the breaker shall charge the tripping spring ready for tripping.

(i) Manually operated breaker shall be of the spring charging stored energy type.

(j) Electrically operated breaker shall be provided with following :-

(i) 1 no 240 V, 1-ph, 50 Hz AC universal motor for charging the breaker closing spring alongwith HRC fuse link with base and carrier or SP MCB of appropriate rating and of approved make. Motors shall be sized such that maximum spring charging time is less than 15 seconds.

(ii) Limit switches with 2 NO + 2 NC contacts for cutting off the power supply to spring charging motor when spring is under fully charged conditions.

(iii) Closing of breaker shall automatically initiate the recharging of closing spring ready for next closing.

(D) SWITCHES/FUSE SWITCHES : Not Applicable

(E) FUSES :

(i). Fuses shall be of HRC cartridge link type having rupturing capacity of not less than 80 KA at 440 Volt.
(ii). Fuses shall preferably be mounted in moulded plastic carriers and shall be complete with fuse bases.
(iii). Fuses shall be suitably rated to prevent damage of the switchgears incorporated in the respective circuit of the particular module in case of overloading or any other fault occuring in the circuit.

(F) CONTACTOR :

(i). All the motor starter feeders shall be provided with electro magnetic type tripple pole contactors suitably rated for uninterrupted AC-3 duty and shall comply with the requirements of IS : 13947 (PART 4 /SEC. 1)
(ii). Main contacts of the contactors shall be of silver plated copper.
(iii). Each contactor shall be provided with 2 NO + 2 NC auxiliary contacts.
(iv). Operating coils of contactors shall be suitable for operation from the control supply of 420V/240V/110V AC.

(G) TIMER WITH POWER RESERVE CAPACITY :

(i). Power reserve capacity of timer shall be minimum upto 150 HRS. And timer with 24 HRS. Programmer.
(ii). Timer shall be with High switching capacity and with inbuilt over-ride facility.
(iii). Modular construction, Flush\Base\Dinrail mounting

(H) THERMAL OVERLOAD RELAYS :

(i). All the motor starter feeders shall be provided with triple pole bimetal thermal overload relays with inbuilt single phasing protection to furnish protection against overload and single phasing and shall comply to all the requirements of IS : 13947 (PART 4 /SEC. 1)

(ii). Thermal overload relays shall be provided with adjustable settings. The setting range shall be properly selected in accordance with the rating of the motor.

(iii). Thermal overload relays shall be provided with at least 1NO + 1 NC auxiliary contacts.

(iv). Thermal overload relays shall be either self reset type or hand reset type. In case of hand reset type thermal overload relays, the reset push button shall be mounted flush on the compartment door separate from start/stop push button.

(I) CURRENT TRANSFORMERS :

Current transformers shall have adequate class of accuracy and VA burden to comply with all the requirements of IS : 2705.The design of current transformers shall be of ring tape wound type.Unless otherwise specified, the minimum performance requirement of current transformers are as follows :

- Measuring CT :- rated burden 15 VA, accuracy class 1.0
- Protective CT :- rated burden 15 VA, accuracy class 5P10

All current transformers shall be earthed through a separate earth link on the terminal block to permit easy measurement of the current transformer insulation resistance.Secondary windings of current transformers shall be rated for 1 Amp as specified in the schematic diagram of the switchboard.

(J) INDICATING INSTRUMENTS :

(i). Ammeters and Voltmeters shall be of moving iron spring controlled (MISC) industrial type suitable for flush mounting of size 144x144/96x96 sq.mm. of suitable range as specified in the schematic drawing of the switchboard.
(ii). Ammeters with suppressed scale current rating shall be provided for specific requirements.
(iii). Energy meter (KWH meter) of direct reading 3-phase 4 wire unbalance type shall be provided wherever specified in the schematic drawing of the switchboard. It should be mounted inside the compartment but can be read through cutout on the compartment door.
(iv). Power factor meter (PF meter), frequency meter (Hz meter), Watt meter (KW meter) etc. shall be provided if specified in the schematic drawing of the switchboard.

(K) INDICATING LAMPS :

(i). Indicating lamps shall be of LED. The lamps shall have translucent lenses to diffuse light.
(ii). Indicating lamps shall be provided in the respective colours i.e. Red, Yellow, Blue, Green, Amber, White etc. as required in the schematic drawing of the switchboard.

(L) PUSH BUTTONS :

(i). Push buttons shall be rated for 10 Amp at 240 Volt AC and provided with 1 NO + 1 NC auxiliary contacts.

(ii). On/start push button actuator shall be of Green colour, off/stop push button actuator shall be of Red colour and O/L relay reset push button actuator shall be of Black colour.

(M) INTERNAL WIRING :

(i). All power/control wiring of the switchboard shall be made with 1100/660 Volt grade Black/Gray FRLS-PVC insulated flexible/stranded copper wires.
(ii). The size of control wiring shall be 2.5 sq.mm. except for CT secondary circuit of 2.5 sq.mm. wire.
(iii). Pin type crimping lugs shall be provided for flexible wire terminations.
(iv). Power wiring shall be terminated preferably on stud/clamp type terminal blocks, whereas, control wiring shall be terminated on clip-on type terminal blocks.
(v). All electrical connections are made vibration proof by proper tightening by using plain washers and spring washers etc.

(N) TERMINAL BLOCK :

(i). Terminal blocks for power circuits shall be of 660 V grade with contacts of rating not less than 10 Amps.

They shall be of the stud type of Elmex/Connecwell make with insulated barriers between adjacent terminals.
(ii). Terminal blocks for control circuits shall be of clip on type of Elmex/Connectwell make complete with mounting channel.
(iii). The wire terminations to the blocks shall be screw type suitable for crimp type socket.
(iv). Suitable provision shall be made to terminate power/control connections in the respective module.

(J) SPACE HEATER :

Space heater with thermostate and switch shall be provided in each cable alley of the cubical switchboard if specified in the specific requirement sheet.

(O) LABLES :

Lables shall be of anodized aluminium or acrylic sheets with white engraving on black back-ground. The engraving shall provided at the back side of lable. They shall be properly secured by fastners at convenient location on each feeder module, busbar chamber and cable alley of the cubical switchboard.

8.6. TESTS :

The switchboards shall be tested for all the following routine tests in accordance with IS:8623 of specification for Factory Built Assembly (FBA) of switchgear & controlgear for voltage up to and including 1000 V AC and 1200 V DC.

a. Inspection of the switchboard including inspection of wiring and electrical operational test, where necessary.
b. High voltage test
c. Insulation resistance test (Megger test)

8.7 DRAWINGS AND DOCUMENATION :

(a) General Arrangement (GA) drawings indicating front, rear, side, sectional views, dimentions of the feeder modules and overall dimentions of the switchboards shall be furnished alongwith the offer.

(b) After getting the order, the supplier should submit two sets of the following drawings and technical data to us for our review and approval.

(i) General Arrangement (GA) drawings indicating front, rear, side, sectional views, dimensions of the feeder modules and overall dimensions of the switchboards.
(ii) Single line diagrams of the switchboards.

(iii) Control schematic drawings for various types of feeders.

(iv) Bills of quantity sheet indicating details of components (make,cat.no.,rating, type etc.) in each feeder of the switchboards.

(c) According to the changes/comments we have mentioned, the supplier should submit the final three sets of the above drawings/documents for our reference and record. One will remain with us, one with client and one will be return back to supplier duly signed & sealed.

E-13 Lightining Arrestor

1.1 General

Installation of Lightning Protection System shall be strictly in accordance with IS/IEC: 62305-2010.
Contractor to submit design drawing with calculation sheet for approval of consultant before execution.

1.2 Zone of Protection

The zone of protection of a lightning conductor define the space within which a lightning conductor provides protection against a direct lightning stroke by diverting the stroke to itself. For a single vertical conductor, this zone is described as a cone with its apex at the highest point of the conductor and with an angle called as protective angle. For the purpose of providing an acceptable degree of protection the protective angle of termination network shall be considered as 45°. Between two or more vertical conductors of equal height spaced at a distance not exceeding twice their height, the protective angle within the space bounded the air termination shall be taken as 60° to the vertical, while the protective angle away from the conductor will be taken as 45° to the verticals.

1.3 Material and Dimensions

The materials of lightning conductor, down conductors, earth termination etc. shall be copper / GI as per schedule of quantities and shall be protected against corrosion.

All air terminations and down conductors shall be of copper / GI as per schedule of quantities and shall conform to IS/IEC: 62305-2010.

1.4 Joints and Bonds

The lightning protective system shall have as few joints as far as possible. Wherever joints in the conductor are necessary they shall be mechanically and electrically effective, and shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner.

1.5 Earth Terminations

Each down conductor shall have an independent earth termination. All the earth termination shall be inter connected and shall be capable of isolation for testing.

1.6 Earth Electrode

Earth pits shall be installed in accordance with IS : 3043-2018.

The resistance of earthing system shall not exceed 1 ohm.

1.7 Air Terminations Mesh (On the Terrace)

As an alternative to vertical air termination, grid of horizontal air termination may also be provided as per IS 2309. Often combination of both may be provided when stucture to be **protected for high** ratio of length to height. Air termination mesh shall be provided not greater than 10mx20m. Down conductor shall be not more than 10 m apart where the building height in more than 20 m.

1.8 Fasteners

Conductors shall be securely fixed to the building to be protected by fasteners which shall be not more than 1.20 meter apart for horizontal run and 1.0 meters for vertical run.

E – 14 DIESEL GENERATOR SET

1.0 GENERAL:

1.1 **SCOPE:**

This general specification together with the equipment sheets and attachments defines the minimum requirements the design, performance, inspection, testing and supply diesel engines for general industrial purposes.

1.2 The construction, design and rating of the diesel engine shall meet fully, the requirements of the specified driven machine and the Vendor shall select and provide the requisite ancillaries and controls with the diesel engine for its safe and satisfactory operation.

1.3 No deviations or exceptions from this specification shall be permitted without the written approval of the purchaser. Intended deviations supported by reasons there of shall be separately listed by the vendor and submitted with the bid for the consideration of the Purchaser.

1.4 Compliance with this specification shall not relieve the vendor of the responsibility of furnishing equipment and accessories of proper design, materials and workmanship to meet the specified operating conditions.

1.5 This general specification supplements the specific requirements contained in the attached equipment data sheets. In the event of any contradiction between the two, the information contained in the latter shall govern.

1.6 Other attachments of the Material Requisition from a apart of this specification.

1.7 **TERMS AND DEFINITIONS:**

1.7.1 The Net Calorific value of fuel is defined as the heat resulting from the complete combustion of a unit quantity of fuel oil and air, without condensation of the water vapor. A net calorific value of 9,720 Kcal/Kg (As per IS : 1460 Rev.2) shall be considered while declaring the fuel consumption and for testing purposes.

1.7.2 The unit of horse power as defined in this specification is the metric horse power equivalent to 4,500 n-Kg/Min. The horse power in F.P.S. system is equal to 1.014 metric horse power.

1.7.3 Other terms used in this specification or in the equipment data sheets are as defined in the latest edition of British Standard-5514.

2.0 STANDARD OPERATING CONDITIONS:

2.1 The standard operating conditions shall be defined in the latest edition of B.S.-5514 unless otherwise mentioned specifically in the equipment data sheet.

3.0 RATED POWER OUTPUT AND SPEED:

3.1 The diesel engine rating shall be the net output in brake horse power, which the engine is capable of delivering continuously at the stated crank shaft speed under the conditions specified under Clause 2.0 above, provided the engine is maintained in good operating condition and is serviced / overhauled regularly as per the schedules laid down by the Manufacturer.

3.2 No negative tolerance shall be allowed on the diesel engine rating specified by the Vendor in the equipment data sheets.

3.3 The engine shall be capable of satisfactorily providing an output 10 percent in excess of the continuous rating defined as per IS 8582.

3.4 The normal power requirement of the engine driven radiator fan or the coolant pump and the battery charging dynamo shall be clearly stated for the engine which is so equipped.

3.5 Unless otherwise specified in the equipment data sheets, the site rating of the engine shall be worked out considering the duration's specified under the latest edition of B.S.-5514 and the power absorb by all the engine driven ancillaries shall also be deducted.

4.0 DESIGN & CONSTRUCTION:

4.1 GENERAL:

4.1.1 The Diesel engine offered shall be of the regular production models of the manufacturer for industrial applications and already type tested either at the manufacturer's works or outside. The type test report shall be furnished to the purchaser for his review if so desired.

The diesel engine with less number of cylinders viz **inline 6 / 8 cylinder arrangement** will be preferred . The diesel engine should be latest design , without any PT pump , and it should be digital governing system to manage the fuel . The fuel system should be equip with unit injectors for better fuel automiztion .

4.1.2 Unless otherwise specified in the equipment data sheets, the diesel engine shall be provided with class A1 governing as per the latest edition of B.S. 5514.

4.1.3 The "Cyclic irregularity" of the diesel engine for direct coupling to an electric generator, "angular deviation of p73 A.C. generators " driven by diesel engine for parallel operation, and the "engine governor speed droop characteristics ", shall be restricted to the values specified under the latest edition of B.S.-5514.

4.1.4 In case diesel engines are required to drive generators in parallel, the governor fuel injection pumps provided should have identical characteristics and the speed-load curves shall be made available to the purchaser's inspector for his scrutiny and approval prior to load testing. The vendor shall maintain proper record for such curves to ensure additional diesel engines if required in future with identical characteristics, could be made available to the purchaser. A set of the said curves shall also be furnished to the purchaser.

4.1.5 The vendor shall be responsible for carrying out torsion analysis of the dynamic system as specified in the latest edition of British Standard-5514. The results in the fork of a report shall be submitted to the purchaser for scrutiny and reference, if desired.

4.1.6 Vendor shall provide the flexible exhaust connection /s to connect the engine exhaust to the exhaust piping. The required size of the exhaust piping should be clearly specified by the Vendor.

4.1.7 If specified, the common base plate for mounting the diesel engine and the driven equipment through single bearing alternator shall be supplied by the vendor.

4.1.8 Vendor shall indicate in the bid, the ISO Noise Level rating of the diesel engine with the offered exhaust silencer/s.

4.2 **ENGINE STARTING**:

4.2.1 Diesel engines shall be capable of starting without the use of cold starting aids so long the ambient temperature at the site is not below 4 ^{o}C. The vendor shall provide suitable cold starting aids with diesel engine for quick starting below 4^{o}C of ambient and such aids shall be clearly detailed out along with the offer.

4.2.2 Where the diesel engine is specified / offered with battery starting arrangement, the starter motor shall be capable of starting the engine without having to disengage the driven machine with the help of a clutch.

In case of diesel engines driving fire water pumps, besides the engine mounted dynamo and voltage regulator, the Vendor shall also provide automatic battery charging equipment suitable for taking power from an alternating current power source and mounted on a free standing type of a panel.

The battery charger if specified in the equipment data sheet, shall be SMPS type.

4.2.3 Where the diesel engine is specified / offered with 24V Electric Start system.

4.2.4 If as specified in the data sheets, the diesel engine is required to start / stop automatically, the vendor shall provide the necessary controls (automatic-cum-manual) in the engine panel and the interconnecting wiring and piping from the panel to the engine and starting equipment. A pilot lamp shall be provided in the line side of the starting equipment circuit to indicate that the controller is in the automatic position. In the event the engine does not start after three attempts have been made, the controller shall stop all further cranking and operate the audiovisual alarm.

4.3 **ENGINE COOLING :**

4.3.1 Radiator cooled engines are offered, the diesel engine shall be provided with a radiator for mounting on the common base plate, complete with the suction / blower fan, temperature control valve and a radiator guard.

4.4 **ENGINE FUEL SYSTEM :**

4.4.1 The daily service fuel tank shall be equipped with as air breather, shielded level gauge, strainer and a hand hole, besides the required fuel connections and a drain plug. The capacity of tank shall be as specified in the equipment data sheets.

4.4.2 The inside surfaces of the fuel tank and the float tank shall be coated with Enamel Red or Black of I.C.I. or its equivalent and the outside surface to be given two coats of the oil resistant primer paint. Both the fuel tank and the float tank, shall be hydrostatic tested at a pressure not less than 0.35 kg /Cm^2.

5.0 INSPECTION & TESTING:

5.1 The inspector representing Purchaser shall have entry to the plant while and wherever work for the equipment is being performed.

5.2 The vendor shall have the responsibility of providing purchaser's inspector with all requisite facilities / equipment for carrying out satisfactory testing.

5.3 The diesel engines shall be tested in the presence of purchaser's inspector in accordance with the latest edition of B.S. -5514 or any other equivalent standard as agreed to with the purchaser before the finalization of order.

5.4 Unless otherwise specified, 10% overload provision shall be kept while setting the fuel stop for the site running.

5.5 The hydrostatic test certificates for the heat exchanger / intercoler , fuel tanks and other pressure vessels shall be furnished to the purchaser's inspector for his review and approval at the time of load testing of the diesel engine.

5.6 The engine control panel/s after assembly and wiring, shall be functionally tested in the presence of the purchaser's inspector.

5.7 Following tests has to be perform

PERFORMANCE TESTS

The schedule of tests to be performed in the Factory Acceptance Test shall include the following:

On each of three separate days and before any other operation of the diesel-alternator on that day three successful manual start-up operations to be accomplished.

Three separate manual start-up operations each within one minute of the diesel-alternator being shut down after running continuously for not less than one hour and attaining normal engine running temperatures.

Three separate automatic start-up operations with simulation of “mains failure”. In all or any of these tests the diesel-alternator may be out on load by the automatic closing of the emergency power supply circuit breaker.

Three separate automatic shutdown operations, each initiated by mechanical simulation of a “low pressure” condition.

Three separate automatic shutdown operations, each initiated by manual instigation of an “over-speed” condition.

Three separate abortive start-up operations, each inducing “failure to start” shut-down.

The load tests shall be carried out at manufacturer’s works as follows before dispatch:

Idle Run	-	05 mins
25% Load	-	15 mins
50% Load	-	30 mins
75% Load	-	30 mins
100% Load	-	60 mins
110% Load	-	60 mins

At the completion of the test, readings shall be taken of Voltage, Frequency, Current, Temperature, Vibration, Fuel ratio to Unit produced, Flue analysis and the following:

Insulation resistance – rotor, stator, exciter – to earth;

Insulation resistance – between stator windings;

Alternator rotor and exciter armature temperature

Noise level measurement of DG set in acoustic enclosure as per specification
Vadild Test certificates of alternator manufacturer to be offered .

Site Test

Upon the delivery to the site and if the generator set is required to re-assemble on site, similar tests shall be carried out by the Contractor to ensure that the performance is not degraded.

The tests, but not limited to are:

Diesel engine-Generator coupling and shafts alignment.

On load ‘mains failure’ simulation test

Safety devices test

Remote monitoring

Auxiliary contacts etc.

Load tests.

BMS interface test

Load tests shall be carried out through building load (minimum 50%).

Additional Load test at any load other than building load or 100% load at site shall be optional which shall be quoted separately and will be decided by the Client. Cost to arrange the load bank for purpose of testing at site shall be included in the this separately quoted rate. Please delete this paragraph

6.0 PREPARATION FOR SHIPMENT:

6.1 Immediately upon completion of all tests and inspections, all exposed machined surfaces shall be cleaned and coated with suitable rust preventive by the vendor and the unmachined surface shall be painted by at least two coats of red oxide primer.

6.2 Diesel engines shall be transported assembled as far as possible.

6.3 All untapped opening shall be provided with 4mm thick metal closures with full rubber gaskets and bolted by not less than 4 bolts. All connections including those for instruments, instrument leads, lubricating oil and the like shall be identified with securely attached tags indicating the type of connection, the instrument or the line description as applicable.

6.4 The equipment shall be crated for domestic / export shipment as specified in the data sheets considering for storage at job site for at least 6 months if specified at the time of placing order. Lifting load-out, and handling instructions shall be securely attached to the exterior of the largest packing in a well marked weather proof container. Upright position lifting points, weight (including packing and dimensions shall be clearly identified with item no., serial no., package no., and the names of the equipment.)

7.0 PROPOSAL :

7.1 Proposals shall be accompanied with completely filled in Data Sheets. The vendor shall not use his own data sheets.

7.2 The proposals must include either a specified statement that all equipment is in accordance with the purchaser's specifications or exceptions, if any, to this general specification including attachments shall be clearly brought out by the vendor on separate sheets, supported with suitable reasons thereof for the consideration of the purchaser.

7.3 Additions or exclusions from the scope of supply shall be clearly brought out on separate sheets giving reasons for such deviations for the purchaser's approval.

7.4 The drawings and data as listed under "prints with Quote" on the vendor data requirement sheet attached with this specification, shall be provided.

7.5 The vendor shall also submit a separate proposal for carrying out supervision of the installation and commissioning of diesel engine/s offered indicating per item rates, no. of specialists proposed to be deputed, completion time and a list indicating nature and quantity of consumable/ tools required and any other terms.

8.0 SCOPE :

8.1 This specification define the requirements of design, manufacture, testing and supply of self excited emergency generator complete with automatic voltage regulator, control panel, generator breaker and other accessories as specified in the material requisition.

8.2 Unless otherwise specified the emergency generator shall be supplied complete with

a) Brushless excitation system complete with AVR.

b) Air inlet and outlet for generator cooling (inlet shall be oriented to suit local plant layout).

c) Lifting arrangement for the machine.

d) Foundation frame complete with foundation bolts and base frame.

e) Lube oil system integral with the prime mover lube oil system.

f) Spares for commissioning - recommendation

g) List of Spares for 4 years / 1010 hours of operation and maintenance.

h) Any other part / accessories not specifically mentioned above but considered necessary for safe and reliable operation.

9.0 CODES AND STANDARDS:

Unless they are in variance with the clause of this specification the diesel engine driven generator and their components shall comply with the latest edition of the applicable standards listed below:

IS : 22534 Designation for type of construction and mounting arrangement of rotating electrical machines.

IS : 46914 Degree of protection providing by enclosures of rotating electrical machinery.

IS : 47284 Terminal marking of rotating electrical machines.

IS : 71324 Guide for testing 3 Ph. sysn. Machines.
IS : 54224 Turbine type generators.

IS : 48894 Methods of determination of efficiency of rotating electrical machines.

IS : 12714 Insulating materials for Electric machinery and apparatus in relation to their thermal stability service, classification of

IS : 47224 Specification for rotating electrical machines.

IS : 25164 A.C. Circuit breakers.

10.0 PERFORMANCE REQUIREMENTS :

10.1 Operative Conditions :

Generators shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in pump house. Service conditions shall be as specified in the data sheet. The generator shall operate satisfactorily under sudden load application. Generator rating indicated in the data sheet shall be the net output of the set after accounting for all auxiliaries for the prime mover and generator.

10.2 Transistant Voltage performance
The dip or rise in system voltage load variations is dependent on the leakage voltage drop of the machine, which shall be kept to the minimum.

In case of sudden application of minimum 60% Block load at rated power factor the voltage drop shall not exceed 15% of the rated voltage. The rated voltage shall be restored within 0.5 to 0.8 second depending on the size of the machine.

10.3 Voltage Regulation

The voltage regulation of the machine shall be within +/- 1 % of the nominal voltage under following conditions :

a). Between no load and nominal load with p.f. of 0.8 lag to unity.
b). With the machine cold or warm.
c).At a speed drop of approximately 3% of the nominal speed.

10.4 Voltage setting range :
The generator terminal voltage shall be adjustable with a continuously variable potentiometer. The adjustment range shall be +/- 5%.

10.5 Harmonic Content

The maximum permissible deviation from the sine wave shall be 5%. The harmonic content of the voltage shall be less than 3% measured between phases off load and up to nominal rating for a power factor of 0.8 lag to unity and with symmetrical distortion free consumers in circuit.

10.6 Frequency limits

The Generator shall be suitable for continuous operation at rated load for frequency variation of +/- 3% of rated value in addition the vendor shall furnish the short time under-frequency operating limits.

10.7 Overloads:

The generator shall be capable of withstanding without injury the effect of a 10% overload for one hour.

10.8 Short Circuit Conditions:

The generator shall be capable of withstanding without damage, a three phase, a line to line, line to earth or two line to earth short circuit for a period of 3 seconds when operating at rated speed and with an excitation corresponding to 5% over voltage at no load.

10.9 Excitation support system

Excitation system shall be provided with short circuit support equipment (Series compounding) to maintain three times the rated current for three seconds in case of short circuit to ensure proper fault clearance in outgoing feeders.

11.0 DESIGN AND CONSTRUCTION:

11.1 The generator design shall meet the requirement specified in data sheet and shall be suitable for the site conditions specified therein.

11.2 The generator shall be mounted on a common base frame together with the prime mover unless otherwise agreed. The generator shall be provided with necessary lifting hooks and two earth terminals for connection to main earth grid.

11.3 The generator winding shall be class "H" insulation with temperature limitation for class "H" the windings and overhangs shall be braced to withstand the short circuit forces.

11.4 The stators windings shall be brought out to suitable terminals in terminal boxes. The terminal box for control cables shall contain properly marked terminals for all internal equipment e.g. embedded temperature detectors etc. All terminals shall be stud type. The terminal boxes shall be complete with lugs and double compression cable glands. Current transformers shall be as specified in data sheet.

11.5 All parts and accessories shall be suitable to withstand stresses due to over speed / overload / short circuit conditions specified.

11.6 Bearings shall be single shielded and relubricated. Grease in the bearing enclosure shall provide additional lubrication to bearing as well as provide sealing against dust and moisture.

11.7 The generator shall be air cooled unless otherwise agreed generator enclosure shall be as specified in data sheet.

11.8 The direction of rotation of the rotor of the machine shall be compatible with that of the prime mover. A clear indication of the direction of rotation shall be given on either end of the machine.

11.9 Space heaters shall be installed within the enclosure, location and max. surface temperature of the heaters shall be such that no damage can be caused to any insulation. Heaters shall suitable for operation on a single-phase 240V AC supply unless otherwise specified.

A suitable double pole switch shall be mounted on or adjacent to the stators frame or enclosure for the manual switching off of the heaters.

11.10 Field winding shall have class "H" insulation with excellent electrical and mechanical properties. The field winding shall be capable of operating at a field voltage of 125% of rated load field voltage for at least one minute starting from stabilized temperatures at rated conditions.

11.11 All cabling on the generator set skid shall be in GI cable trays/ conduits. All cables shall be identified close to their termination point. Double compression type cable glands shall be used for cable termination.

11.12 A rating plate of corrosion resistant material shall be fixed on the generator frame and shall give the following information:

a) Manufacturer's name.
b) Serial Number, Type and frame reference
c) Rated output in KVA & KW.
d) Rated power factor, frequency and voltage
e) Rated stators current and speed in Rev. / Min.
f) Class of insulation
g) Phase rotation (CW or CCW)

12.0 EXCITATION SYSTEM :

The generator shall be provided with brushless type solid state excitation system with automatic voltage regulator. The excitation system shall include the automatic voltage regulator, AC exciter and rotary rectifier. The field of the exciter shall be fed from the stators winding through a suitable transformer and AVR. AC Voltage generated in the AC exciter shall be rectified by the rotary rectifier assembly and fed to the main field circuits. The rotor windings of the AC exciter, the rectifier assemble, main field winding of the generator and other accessories on rotor part shall be rigidly fastened to the shaft and the connection with different items shall be anti-loosening type.

The exciter capacity shall be at least 20% more than the maximum requirement at any time. The exciter winding shall be insulated with class "H" insulation.

Automatic solid state voltage shall be provided with the following features as a minimum.

- Under frequency protection.
- short circuit protection.
- Cross current compensation for parallel operation.
- Voltage build up circuitry.
- Stators current limited.
- Field current limited.

The Current and potential transformers required to feed the AVR from the generator terminal shall be adequately rated.

13.0 SYSTEM OPERATION

The emergency generator set shall normally be in an unattended area. The Control system shall operate in fail safe mode and shall include all controls and protection necessary for the safe operation of the package. The generator set shall function as per one of the following schemes:

- Auto main failure scheme (AMF).
- Manual start in service mode.

14.0 GENERATOR CONTROL PANEL :

14.0 <u>DG Controller Based Synchronizing and Automatic Mains Failure / Aux. Panels.</u>

14.1 Scope

The scope of this section comprised of fabrication, supply, earthing, testing & commissioning of Synchronizing, and AMF/Aux. panels. These panels shall be suitable for operation on 3 Phase 415 volts, 50 cycles. The degree of protection for enclosure shall be IP-52. All panels shall be CPRI approved.

Synchronizing panels and AMF/Aux. panels shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1993.

14.2 Construction Features

Synchronizing and AMF panels shall be 2 mm thick sheet steel cabinet for indoor installation, dead front, floor / wall mounting type and shall be form 3b construction. The Synchronizing / AMF panels shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket and padlocking arrangement. Panels shall be suitable for the climatic conditions as specified in Special Conditions. Steel sheets used in the construction of Synchronizing / AMF panels shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. 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 confirm to IS-8623-1993 (Part-1) for factory built assembled switchgear & control gear for voltage upto 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 Synchronizing / AMF panels. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels. Minimum clearance of 275 mm shall be provided between the floor of AMF panels and the lowest unit.

Synchronizing / AMF panels shall be of adequate size with a provision of spare switchgear as indicated on the Single Line Diagram. Switches shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the AMF panels in conformity with the location of cable/conduit connections.

Synchronizing / AMF panels shall be suitable for top cable duct connection for incoming from alternator and bus duct connection for outgoing to LT panel. Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram engraved on PVC sheet. All live accessible connections shall be shrouded and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

All panels shall have provision of pad locking of breaker handles in OFF position.
Panel must be future expandanble type.

14.3 Bus Bar Connections

Bus bar and interconnections shall be of high conductivity electrolytic copper and of rectangular cross section suitable for carrying the rated full load current and short circuit current without overheating of phase and neutral bus bars and shall be extendable on either side. Bus bars and interconnections shall be insulated with heat shrinkable sleeve and shall be colour coded. Bus bars shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bars shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area to be added to the bus bar to compensate for the holes. All connections between bus bars and breakers shall be through solid strips of proper size to carry full rated current and insulated with insulating sleeves.

14.4 Temperature - Rise Limit

Unless otherwise specified, in the case of external surface of enclosures of bus bar chamber and trunking system which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per IS 8623(Part-2) 1993.

AMF / Synchronizing panels shall be provided with ACB's / MCCB's of appropriate capacity as per Single Line Diagram. AMF / Synchronizing Panels shall be completely factory wired, ready for connection. All the terminals shall be of proper current rating and sized to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

14.5 Cable Compartments

Cable compartment of adequate size shall be provided in the AMF / Synchronizing panels for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables.

14.6 Air Circuit Breakers (ACB)

14.6.1 The ACB shall conform to the requirements of IEC 60947-2 / IS 13947. The circuit breaker shall be suitable for 415 ± 10% 50 Hz supply system. Air Circuit Breakers shall be moulded housing, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" "TRIP" indications.

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

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

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

The ACB shall be provided with a door interlock. The contacts shall be of silver plated copper with a feature of contact wear inspection, indicating the life of the contacts. The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and in accessibility to live parts. All electrical closing breaker shall be with electrical motor wound stored energy spring closing mechanism with mechanical indicator to provide ON/OFF status to the ACB.

14.6.2 Cradle

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on steel balls/rollers and not on flat surfaces.

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

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

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

Isolated Position : Both main isolating and control contacts are isolated.

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

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

14.6.3 Safety Features

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

II. It shall not be possible to interchange two circuit breakers of two different thermal ratings.

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

IV. Arc Chute covers wherever necessary shall be provided.

V. The AMF panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, electronic type meter of accuracy class 1..0 with suitable ratio CT's to measure and display various electrical quantities as mentioned in Schedule of Quantities with built-in selector switches, MCB for protection circuit and current transformers.

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

14.7 Moulded Case Circuit Breaker (MCCB)

MCCB shall be Current Limiting and comprise of Quick Make - break switching mechanism, preferably Double Break Contact system, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCB's shall be capable of defined Variable overload adjustment. All MCCB's upto 250 Amps shall have thermal magnetic releases and above 250 amps shall have microprocessor based release with adjustable magnetic short circuit pickup. Wherever MCCB with earth fault protection mentioned in BOQ, the protection shall be an integral part of the release with adjustable magnetic short circuit and earth fault protection with time delay.

The trip command shall override all other commands. MCCB shall employ maintenance free double break contact system to minimize the let thru' energies and capable of achieving discrimination upto full short circuit capacity of downstream MCCB. The manufacturer shall provide both discrimination tables and let thru energy curves.

The breaking capacity of MCCB's shall be as asked for in the schedule of quantities. The breaking capacities specified shall be ICU=ICS i.e type-2. Co-ordination as per IEC-60947-2, 1989/IS 13947-2, 1993.

The MCCB's shall be provided with rotary handle operating mechanism. The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to Disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

14.8 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.

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.

14.9 Earthing

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

14.10 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 RAL-7032 of IS Code No.5.

14.11 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.

14.12 Meters

i. All voltmeters and indicating lamps shall be through MCB's.

ii. Meters and indicating instruments shall be digital electronic type.

iii. All CT's connection for meters shall be through Test Terminal Block (TTB).

iv. CT ratio and burdens shall be as specified on the Single line diagram.

14.13 Current Transformers

Current transformers shall be provided for Synchronizing / AMF / AUX panels. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.

The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast/ Flame Retardent resin filled Nylon type robust to withstand thermal and dynamic stresses during short circuits. Metering CTs, shall have inbuilt busbar mounting arrangement. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The secondary terminal should be covered with insulation cap/cover so that there should not be any possibility of touching the live terminal. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

14.14 Selector Switch

Where called for selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

14.15 Contactor

Contactor shall be built into a high strength thermoplastic body and shall be provided with an are shield for quick are extinguishing. Silver alloy tips shall be provided to ensure a high degree of reliability and endurance under continuous operation. The magnet system shall consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starters contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta Starters. The insulation for contactor coils shall be of Class "E".

Coil shall be tape wound vacuum impregnated and shall be housed in a thermostatic bobbin, suitable for tropical conditions and shall withstand voltage fluctuations. Coil shall be suitable for 240 / 415 + 10% volts, 50 cycles AC supply.

14.16 Thermal Overload Relay

Thermal overload relay shall have built in phase failure sensitive tripping mechanism to prevent against single phasing. The relay shall operate on the differential system of protection to safeguard against three phase overload, single phasing and unbalanced voltage conditions.

Auto-manual conversion facility shall be provided to convert from auto-reset mode to manual reset mode and vice-versa at site. Ambient temperature compensation shall be provided for variation in ambient temperature from –5deg C + 55 deg C.

All overload relays shall be of three element, positive acting ambient temperature compensated time logged thermal over load relays with adjustable setting. Relays shall be directly connected for motors upto 35 HP capacity. C.T. operated relays shall be provided for motors above 35 HP capacity.

14.17 Time Delay Relays

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

14.18 Toggle Switch

Toggle switches, where called for in Schedule of Quantities, shall be in conformity with relevant IS codes an shall be of 5 amps rating.

14.19 Push Button Stations

Push button shall be provided for manual starting and stopping of motors / equipment "Green" and "Red" colour push buttons shall be provided for 'Starting' and 'Stopping' operations. 'Start' or 'Stop' indicating flaps shall be provided for push buttons. Push buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for 'Stop' push buttons. The push button contacts shall be suitable for 6 amps current capacity.

14.20 Indicating Panel

All meters and indicating instruments shall be in accordance with relevant Indian Standards. The meters shall be flush mounted type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB.

14.21 Testing

Testing of panels shall be as per following codes:

I. IS: 8623 (Part -I) 1993 for factory built assemblies of switch gear for voltages upto and including 1010 VAC.
II. IS: 13947 : 1993 Degree of protection
III. IS: 5578 & 11353:1985 Arrangement of bus bars.

14.22. Anti-Condensation Space Heaters

1 No. 100 W, 240 Volts single phase, 50 Hz AC Anti Condensation space heaters controlled by thermostat and protected by 6 amps MCB's or MPCB's as per fault level at the panel shall be provided in each vertical section of AMP / Synchronizing panel and 1 No. 60 watt Anti Condensation space heater shall be provided in each cable alley of DG Auxiliaries panel and sub distribution boards. Supply and control equipment for the above shall be provided by the vendors.

14.23. DG Controller Function

14.23.1 General

The auto synchronizing cum LT panel shall have DG controller with following general requirements for AMF start, Auto synchronizing and Auto Load sharing functions.

14.23.2 **AMF function**

In the case of failure of normal power supply of individual substations

1. Generator to start after a prefixed time of three second on any of the following conditions :

   a. Total absence of voltage.
   b. Failure of one or two phases.
   c. Under voltage below 375 volts.
   d. Overvoltage of more than 6%.

2. After a lapse of 10-12 seconds normal power supply breaker to open and Generator supply breaker to close.

In the case of Resumption of Normal Power supply :

1. Generator breaker to open and normal power supply breaker to close after three seconds on resumption of normal power on the following conditions.

   a. All the three phases available at the normal supply breaker.

   b. 380-415 volts available at the normal supply breaker.

2. Generator to over run for the three minutes and stop automatically.

3. All auxiliaries to stop automatically.

4. Generator to be ready for the next operation automatically.

14.23.3 **Auto Synchronising & Auto Load sharing function**

A. <u>Sequence of Operation in Auto Mode.</u>

In auto mode Master GENERATOR set (Selected by DG controller) shall start through cranking relay & close its ACB / NIC after verifying frequency and voltage. However, the transfer of load shall take place only when the generator output reaches 90% of its rated voltage and frequency.

As load increases beyond 90% (settable from 80 to 100%) of ratings of DG set which is running, other generator will start and synchronize on the same bus. Required no of DG sets as per demand shall run, synchronized automatically and shall feed the loads accordingly

As the load increases or decreases, accordingly switching ON and OFF of the generator on the synchronizing bus shall continue with the help of DG controller. If any time only one Generator coming and the load is increased suddenly more than the available capacity then non critical load shall drop out from the bus automatically through DG controller and same shall come on automatically if other Generator shall start and synchronize on the same bus.

Auto Synchronizing system shall verify the phase angle of all the sets and also compensate for ACB closing time by initiating closing of the breaker ahead of the actual predictable synchronism hereby ensuring a phase difference of zero degree. The breaker closing command shall not be given at a phase angle difference of $\pm$ 4% in any circumstances.

The synchronizing system shall operate the generator ISOCHRONOUS mode by setting Droop to Zero. The system shall have a direct analogue interface with the AVR & Governor for direct bias control. No motorized potentiometers shall be acceptable.

- Failure of any synchronizing module shall not disturb the synchronizing of other generator.
- Failure of any one DG controller shall not affect the synchronizing system which shall be independent of each other.

System shall also monitor the slip frequency and the Beat Voltage of the machine or system.

NIC of First generator shall remain in Ckt. In the event of shutting OFF of First Set, NIC of any other generator shall close first before tripping NIC of first set. It shall be possible to alter sequence of generator starting through, manual selection or through, Man Machine interface.

Active and reactive power shall be made equal on all the machines automatically with the help of ACTIVE LOAD BALANCING System through Governor Control.

In event of set failing to Synchronize, Alarm from annunciator shall invite attention of OPERATOR for manual intervention.

LOAD MANAGEMENT SYSTEM shall have 64 output contacts for tripping various loads by field wiring and also trip the ACB of different generator and give ALARM for shutting OFF generator in accordance with predefined parameters to avoid underloading, overloading, cascading effect of tripping and unnecessary FUEL WASTAGE.

On the removal of load, generator ACB's & Bus Coupler ACB's shall be switched OFF in preset sequence with time delays to cover DIPS. Generator shall continue to run for 3 Minutes at reduced speed after generator ACB has been switched OFF.

DG controller System shall have compatibility for interface with PC (for Graphic Displays / Report Generation).

All auxillaries (Cooling tower fan, pumps supply air fans etc) to come on Automatically.

Engine start stop control system shall be mounted on the generator panel.

B. Sequence of Operation in Manual Mode
(Through DG controller)

- In the manual mode master generator set shall be started by pressing 'Engine Start' Push Button (PB)
- When Engine starting push button is pressed cranking relay shall be energized and give starting signal to the engine.
- After full voltage is build up, breaker of the Master generator shall close manually with the help of breaker control switch.
- When breaker Control switch is turned to 'CLOSE' position, breaker as per following sequence:
  a. DG controller /Main Selector Switch shall be in Manual Mode.
  b. Solo/Parallel Selector Switch being in 'Solo' mode.
  c. With the conditions mentioned above fulfilled and breaker control switch in 'Close' position, Neutral contactor shall be energized.
  d. Closing command to the generator breaker shall be given.
- IN manual mode care shall be taken, to synchronize the follower generator sets with the 'Master' before closing its breaker.
- For synchronizing the generator in manual mode, voltage/frequency raise/low commands shall be given to Alternator/Engine with the help of 'Joy sticks' provided in the Relay/Synchronizing Panel.

  While synchronizing the generator, manually, all the parameters viz. voltage, frequency and phase rotation shall be monitored with the help of Double voltmeter, Double Frequency Meter and Synchronoscope provided in the Relay/Synchronizing Panel and breaker shall be closed only when all the three parameters are matched properly.
- Active/Reactive load sharing between all the running sets in manual mode shall be managed by raising/lowering voltage/frequency with the help of joy sticks.
- During the parallel operation of Power Generating sets in 'Manual Mode', Neutral contact of only master generator shall close. This shall be assured by inter locking the neutral contactors of all the generator.

14.23.4 Summary Of Functions

The following functions shall be performed by the controller for Synchronizing the generating sets.

- Automatic starting of generating sets.
- Automatic Synchronization of all available generating sets.
- Automatic load sharing between generators, active as well as reactive load sharing.
- Starting & stopping of generators as per load requirement.
- Monitoring of engine & alternator condition and protections.
- Complete load management as per requirement.

The control functions shall be as follows :

Engine Control

- Speed monitoring
- Over-speed protection
- Oil pressure monitoring
- Water temperature monitoring
- Battery voltage monitoring.

Engine Protective Features

- High / Low coolant temperature
- High / Low oil pressure
- Over-speed

- Start Failure

Generator Protective Features

- Over / Under voltage.
- Over / Under Frequency
- Reverse Power (Inverse time delay)
- Loss of Excitation
- Over Current (Inverse time delay)
- Current Unbalance
- Voltage Unbalance

Reactive (KVAR) Control

- VAR sharing on isolated busses using %age base reactive load sharing.
- Power factor or VAR control when base loaded
- Externally adjustable VAR of PF set point levels.

Control System

- All the electrical parameters are monitored centrally through DG controller. All the electrical data is brought to the DG controller & then DG controller controls the complete Synchronizing, Load Control & Management system.
- No motorized potentioners are used. AVR & Governor are given direct bias control (Analog / Plum Commands).

14.23.5 Synchronising Logic

The system shall be capable of a dynamic synchronization as described above, where the generator frequency is controlled to be slightly higher than the bus bar frequency, when the breaker closes. This shall ensure that the generator will start to take load the moment the generator breaker is closed. The frequency difference between generator & bus bar at the moment of synchronization shall be programmed. Breaker time shall be adjusted to ensure breaker closure at the exact point of synchronization. System shall control the voltage under synchronization if necessary.

During synchronization system shall supervising the frequency of the generator voltage to make sure that the genset is not unstable due to a cold fuel / genset or an uneven fuel supply. The two frequencies must be within the accepted slip-frequency in 200 mili sec before synchronization.

The system shall synchronize the generator to the bus, when all below conditions are fulfilled :

- A control order is given by setting the input “start synchronizing / regulating”
- Feedback signal from breaker “GCB open” is present.
- Bus bar voltage is present
- Generator voltage is present

The voltage regulator in the system shall start when the frequency is within 90% of nominal frequency.

System shall close the breaker without synchronization, when all the following conditions are fulfilled :

- Display setting “Black busbar operation is ON.
- A control order is given by setting the input “start synchronizing / regulating”
- Feedback signal from breaker “GCB open” is present.
- Bus bar voltage is not present (Black bus bar)
- Generator voltage is present.

Monitoring

Following electrical parameters shall be monitored by DG controller based system, which shall be connected through set of CT / PT’s & shall indicate the following:

i. Voltage – all phases (Line & Phase both)
ii. Current – all phases.
iii. Frequency
iv. Power factor
v. KVAR
vi. KVARH
vii. KW
viii. KWH

All these parameters shall be displayed & shall be used for Load Management & Safety functions. Limits can be assigned to each parameter in the PLC for alarm & recording / logging purposes.

System shall include the following features:

- The system shall work on **Isochronous** principle thus avoiding the problem of **Droop** adjustment. The frequency shall remain constant at all loads.
- Automatic dead bus closing.
- Active & reactive load sharing.
- Modular system & each module shall be independent of the other. The breakdown of one section shall not effect the other.
- The synchronizing module shall directly communicates with the electronic governors and shall connect to the load control lines of governor directly.

14.23.6 **Solid State Annunciator For Auto Synchronizing Panel (Typical For Two DG With Bus Coupler)**

Channel No.	**Inscription**
01	G-1 Fails to Synchronize
02	G-1 Fails to Start
03	G-1 Neutral Discrepancy
04	G-1 ACB Fails to Close
05	G-2 Fails to Synchronize
06	G-2 Fails to Start
07	G-2 Neutral Discrepancy
08	G-2 ACB Fails to Close
09	Bus Coupler ACB-1 Fails to close

14.23.7 INDICATION

:1 No. Spring charged Indicating Light.
:1 No. Neutral ON Indicating Light.
:1 No. Neutral OFF Indicating Light
:1 No. Trip Indicating Light
:3 Nos. Ph. Indicating Light
:1 No. ACB ON Indicating Light
:1 No. ACB OFF Indicating Light
:1 Set Control MCB.
:1 set push buttons for generator start / stop, master changing, speed decrease / speed increase, voltage decrease / voltage increase.

14.24 PROTECTION THROUGH RELAYS
(Applicable for both synchronizing and AMF panel)

14.24.1 Following protection shall be provided through relay both for the stator side and the rotor side:

ii) Restricted Earth fault Relay : Relay shall have REF protection element (64R), which shall monitor the generator for internal earth faults. It has a built-in O/C protection, as a back up.

iii) Over voltage and under voltage protection.

14.24.2 In addition to above, following relays to be provided

- Master Trip Relay
- Trip Circuit Supervision Relay
- Engine Cranking Relay

14.25 METERING FOR EACH GENERATOR

As mentioned in the Schedule of Quantities.

14.26 ANNUNCIATION

Annunciation with Hooter, Test, Accept and Reset P.B. and Annunciator.

14 Window Solid State Annunciator for each DG sets.

Channel No.	Inscription
01	Set fails to start (only alarm)
02	Over current (breaker trip)
03	Earth Fault (Breaker trip)
04	Excitation Failure (Engine should be stop with breaker trip)
05	Reverse Power (Breaker trip)
06	Emergency Shutdown (Breaker will trip with engine stop command)
07	Over speed (Breaker will trip with engine stop command)
08	Low Lube Oil pressure (Breaker will trip with engine stop command)
09	High Water Temperature (Breaker will trip with engine stop command
10	Under Voltage (Breaker trip)
11.	Over Voltage (Breaker trip)
12	Bearing Temperature high (breaker will trip with engine stop command)
13.	Under Frequency (Breaker trip)
14	Over Frequency (Breaker trip)
15.	Winding Temperature High Breaker with trip with engine stop command)
16.	Low fuel oil level (only alarm at preset level.

14.27 The Local generator control panel for the generator set shall comprise of the following unless otherwise specified in the attached data sheet & Technical specification in 17.

(a) Protection and metering equipment's.

(b) Indicating instruments.

(c) Control gear for generator set auxiliaries.

Any other accessory require to make the generator set operational as a package shall be included in scope of supply . If required the generator control panel shall be split into various functional sections vi. protection, metering and control, regulation etc.

All motor starters for generator set auxiliaries shall be DOL type.

15.0 PAINTING, PACKING AND TRANSPORT:

15.1 All metal surfaces shall be thoroughly cleaned of scale, rust and grease etc. prior to painting. Cleaned surfaces shall be given two coats of primer and prepared for final painting. Final finish shall be free from all sorts of blemishes.

15.2 The equipment shall be shipped to site suitably packed to prevent any damage. Each package shall have labels to show purchaser's name, purchase order and equipment no. suitable lifting lugs etc. shall be provided and lifting points shall be clearly marked on the package. Packing shall be suitable for storage at site for a minimum period of 6 months.

16.0 TESTS AND INSPECTION :

16.1 The owner or his authorized representative may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.

16.2 Detailed test procedure along with the facilities available at vendors works shall be furnished along with the bid Owner's representative shall be given minimum four weeks advance notice for witnessing the final testing. Test certificates including test records and performances curves etc. shall be furnished by the vendor.

16.3 Tests

Equipment shall be tested to confirm to the appropriate standards and the following tests shall be conducted in the presence of purchaser's:

16.3.1 Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification.

16.3.2 Power frequency voltage test on switch gear and mechanical / electrical operational check.

16.3.3 Routine tests for alternator as per IS: 4722.

16.3.4 over speed test (to be provided by way of engine test certificate)

16.3.5 Transient response tests for sudden application and rejection of loads of 0 to 60 %

16.3.6 Wave form test (type test results are acceptable)

16.3.7 Phase sequence test.

16.3.8 Vibration test

16.3.9 Noise level test.

16.3.10 Dimensional and alignment test.

16.3.11 Test certificate of engine / alternator / breaker manufacturer is acceptable

17.0 Technical Specifications of Diesel Engine Generator Sets rating

Diesel Engine

The diesel engine shall be of the 4 stroke cycle, prime rated continuous, multi-cylinder direct injection, compression ignition type operating at a speed of 1500 rpm and shall be silent, vibration free while in operation and comply Center / State Pollution Control Board and shall conform to BS:649/5514.

The engine shall be complete with radiator cooled type engine, fan, lubricating oil pump, lubrication oil pressure gauge (or microprocess built-in display), tachometer, digital integrated hours-run recorder, over-speed trip and all other necessary auxiliaries.

The brake horse power of the engine with all attached accessories as specified shall not be less than that which is required by the full load rating of the alternator at site operating conditions taking into consideration losses, plus a reserve factor of at least 10%.

Standard Equipment:

- Radiator with blower fan & Fan Guard.
- Corrosion inhibitor coolant
- Paper element filters – fuel, lubricating oil and by-pass
- Flywheel to suit single/double bearing alternator & Flexble Coupling with starter ring.
- Flywheel housing
- Dry type air cleaner with vacuum indicator
- Residential Silencer
- Stainless steel exhaust flexible bellow
- Electric Starter
- 24V Electric starting system
- Battery charging alternator
- Safety Controls (trip) : High water temperature (HWT)
  Low lubricating oil pressure (LLOP)
  Engine overspeed

- Exhaust Gas Turbocharger with after cooler
- Bypass thermostat

Brief Technical Particulars : (To be Given By Bidder)

- Nos. of cylinders
- Bore x Stroke (mm)
- Compression Ratio
- Voltage
- Voltage regulation
- Voltage adjustment
- Coolant capacity (engine only)
- Specific fuel consumption at rated load (As per ISO: 3046/BS 5514)
- Rated Output(Prime Rating)

The above fuel consumption datas are based on engine operating with diesel fuel corresponding to Grade no. 2D as per ASTM D975/IS 1460:1995

This engine should be meets latest CPCB emission norms

Exhaust System

Adequate sized piping and fittings shall be installed to carry the engine exhaust discharge into the atmosphere at a height as indicated in the drawings & as per the requirement of Center / State Pollution Control Board or Pollution Control Committee as the case may be.

M.S. epoxy painted structural support and vibration arrestors for D.G. set chimney to specify along with drawing for statutory clearance..

Mufflers shall be installed to reduce the engine exhaust noise at the outlet of muffler to noise level as permitted at site as per CPCB requirements. Flexible connection shall be provided between the engine and the fixed piping.

Engine instrument panel

An instrument panel mounted on the engine shall be provided and shall comprise the following flush-mounted instruments and gauges:

Lubricating oil pressure gauge

Tachometer, positive driven

Hour counter with hour totalizer.

Protection Devices

Warning indication and automatic shut-down shall be provided for the following:

Low oil pressure shutdown and alarm

high coolant temperature alarm

High coolant temperature shutdown

Fail to crank shutdown

Overcranking shutdown

Overspeed shutdown

Low & high DC voltage alarm

Low battery alarm

Low fuel-day tank alarm

High and Low AC voltage shutdown

Under frequency shutdown

Over current and alarm and shutdown

Short circuit shutdown

Earth fault alarm

Overload alarm

Emergency stop

Failure indication lights and alarm for all fault conditions shall be provided on control panel for restoring the operation to normal.

The starting circuit shall be disconnected in the event of any of the above shutdowns.

18.0 VIBRATION CONTROL

The complete generator assembly shall be isolated on static deflection unhoused spring-neoprene in series isolator with non-skid neoprene pads. Start-up and shut down rocking restraint snuffers shall be provided at four corners of base frame.

All fuel line pipes shall be cushioned with a layer of harnesss and neoprene pad at attached points.

All pipe work and engine silencers shall be suspended on static deflection spring-neoprene in-series hangers.

Detail calculation and proposal for justifying the size and provision shall be provided for Project Manager review prior to the installation.

18.1 Emission standards for Diesel Engines (Engine rating more than 800 KW) for generating sets

Parameter		**Area Category**	**Total engine rating of the plant (includes existing as well as new generator sets)**	**Generator sets commissioning date**
				On or after 1.7.2005
NO_x (as NO_2) (at 15% O_2), dry basis, in ppmv		A	Upto 75 MW	710
		B	Upto 150 MW	
NMHC (as C) (at 15% O_2), $mgNm^3$		Both A and B		100
PM (at 15% O_2), $mgNm^3$	Diesel Fuels HSD & LDO	Both A and B		75
	Furnace Oils – LSHS & FO	Both A and B		100
CO (at 15% O_2), $mgNm^3$		Both A and B		150
Sulphur Content in fuel		A		<2%
		B		<4%
Fuel specification		For A only	Upto 5 MW	Only diesel fuels (HSD, LDO) shall be used.
Stack height (for generator sets commissioned after 1.7.2003)		Stack height shall be maximum of the following in meter : i. $14\ Q^{0.3}$, Q=Total SO_2 emission from the plant in Kg / hr ii. Minimum 6 m above the building where generator in installed. iii. 30 m.		

Acronyms Used

MW	:	Mega (10^6) Watt
NO_x	:	Oxides of Nitrogen
NO_2	:	Nitrogen Dioxide
O_2	:	Oxygen
NMHC	:	Non-Methane Hydrocarbon
C	:	Carbon
PM	:	Particulate Matter
CO	:	Carbon Monoxide

SO_2	:	Sulphur Dioxide
ppmv	:	Part per million (10^6) by volume
FO	:	Furnace Oil
HSD	:	High speed diesel
LDO	:	Light Diesel Oil
LSHS	:	Low Sulphur Heavy Stock
kPa	:	Kilo Pascal
mm	:	Milli (10^3) meter
kg/hr	:	Kilo (10^3) gram per hour
mg / Nm^3	:	Milli (10^3) gram per Normal metre cubic

Area Categories A & B are defined as follows:

Category A : Areas within the municipal limits of towns / cities having population more than 10 lakhs and also upto 5 km beyond the municipal limits of such towns / cities.

Category B : Areas not covered by Category A

The standards shall be regulated by the State Pollution Control Boards or Pollution Control Committees, as the case may be.

LIMITS OF NOISE FOR POWER GENERATING SETS (UPTO 1010 KVA) MANUFACTURED ON OR AFTER THE 1ST JULY, 2003

Applicability

These rules apply to Generator sets upto 1010 KVA rated output, installed on or after 1st July, 2003.

Requirement of Certification

Every manufacturer or importer of Power Generating set must have valid certificates of Type Approval and also valid certificates of conformity of production for each year, for all the product models being manufactured or imported after 1st July, 2003 with the specified noise limit.

All Power Generators shall have a valid Type Approval certificate and conformity of production certificate.

All Power Generator shall have conformance label meeting the requirements.

The conformance label shall contain the following information :

- Name and address of the supplier (if the address is described in the Owner's manual, it may not be included in the label).
- Statement "This product conforms to the Environment (Protection) Rules, 1986"
- Noise limit viz. 75 dB(A) at 1 meter under free field condition
- Type approval certificate number.(for less than 1010 kva DG set)
- Date of manufacturer of the product. (for less than 1010 kva DG set)

Authorized agencies for certification

The following agencies are authorized to carry out such tests as they deem necessary for giving certificates for Type Approval and Conformity of production testing of Generator and to give such certificates :

- Automotive Research Association of India, Pune.
- National Physical Laboratory, New Delhi.
- Naval Science & Technology Laboratory, Palghat
- National Acrospace Laboratory, Bangalore

Alternator:

The above diesel engine will be coupled with the brushless type Alternator of **1000 KVA / 800 KW.** The make of Alternator shall be as specified. The alternator shall be with salient features like self excited, self regulated through AVR, three phase, 415 Volts, 50 Hz, 1500 RPM, screen protected, drip proof. The alternator shall generally confirm to IS: 4722/BS: 2613 standards. The alternators shall be with class H insulation & temperature rise limited to class "H". The alternator shall be suitable for 45°C Ambient Temperature. The alternator shall be single bearing type.
The alternator shall be generally confirming to IS: 4722/BS: 5000 standards & shall be suitable for 10%overload for 1 hours in continuous 12 hours duration.

Automatic Voltage Regulator

a. An automatic high speed, dead band type voltage regulator shall be provided, complete with all accessories. The regulation system shall be provided with equipment for automatic and manual control.

b. The regulator shall regulate the output voltage from generator current and potential signals. Series compounding transformer shall be provided to enable maintaining adequate terminal voltage in the event of terminal faults. Alternatively excitation system shall be provided with arrangement for field forcing. Contractor shall coordinate suitability of protection relays for generator with the operational characteristics of automatic voltage regulator, specially under short circuit conditions.

c. Voltage regulation and steady state modulation shall be within ± 1% of the line voltage.

d. Necessary equipment for field suppression and surge protection shall be provided.

e. The response time of exciter and the generator shall be properly matched to avoid hunting.

f. AVR system shall be provided with equipment for automatic and remote operation / control.

g. Necessary equipment shall be furnished for the following.

- To prevent automatic rise of field voltage in case of failure of potential supply.

To initiate transfer from automatic to manual control of excitation on fuse failure on the generator potential signal.

Syncronisation / AMF control panel for 2 nos. of 1000 KVA :

The Control panel shall be fabricated out of 14 SWG M. S. sheet. The panel shall be suitable for floor mounting, indoor type, cubicle design, dust & vermin proof. The panel shall be painted with paint shade Siemens Grey. The sheet steel shall be treated for degreasing, rinsing, degreasing, pickling, phosphating & passivation through 7-tank process.

- Microprocessor based Engine generator Control package with built in AMF with Protection like Over Current, Reverse Power, Under/Over Voltage, Under / Over Frequency, etc.. with inbuilt key features as under:
  - 8 Relay Outputs, 8 Static Outputs & 3 Programmable Digital Inputs
  - 3 Programmable Static Outputs, configurable to one of over 10 function types
  - 13 Digital Inputs, 1 Pick Up Input for RPM monitoring
  - D+/W.L. control & 3 Channel Analogue Sender Interface
  - 3-phase Generator & Mains Voltage Monitoring upto 500 V ac
  - External Adaptor to monitor upto 1010 V ac-3-phase
  - 3-phase Generator Current monitoring upto 9900 A
  - Digital Metering for Amp. Voltage, Frequency,Power Factor, KW, KVA, KVAR, KWH, EngineRun Hour, Battery Voltage etc…
  - Announciation for Various Faults.
  - Serial Interface RS 232 or RS 485 for Grid Parrareling, Import / Export Facility, remote control & monitoring
  - Aac, Vac, Hz, Vdc, kVA, kW, kVAr & PF monitoring
  - Oil pressure, Engine Temperature & Fuel Level measurements
  - Manual, Automatic, Remote & Off operating modes
  - Event & Data Logging Memory & Hour Counter
  - Automatic Scheduled Testing & Service/Maintenance
  - 6 Point Relationship for analogue senders upto 1010 Ohm
  - Cycle Lube Interval, Automatic Transfer Fuel Pump Control
  - Extended Temperature Range/Humidity -30ºC to +70ºC/95% HR

- Incomer : 2 nos. TPN type, 1600 Amps. 50 KA EDO ACB of specified make – Adjustable Thermal magnetic release for overcurrent, short circuit & earth fault release complete with 3 CT's of Class 1, 15 VA, 1600/5 Amp. With following asscesories.
  1. 1 no. digital type Ampere meter with inbuilt selector switch

2. 1 no. digital type Voltmeter with inbuilt selector switch
3. 1 no. digital type KW/PF meter
4. 1 no. digital type Frequency meter
5. 1 no. 3 phase, 4 wire, Panel mounted Digital Type KWH meter
6. Neccessary set of instrument fuses, HRC type
7. 3 nos. 1600/5 Amps ratio current transformers for metering, class 1.0, 15 VA burden
8. 3 nos. 1600/5 Amps ratio current transformers for relay, class 1.0, 15 VA burden
9. 1 no. F-Thyrsitor (Primary) Controlled Constant Voltage Constant Current Automatic Battery Charger
10. 1 no. 96 sq.mm Analogue type DC Ampere meter
11. 1 no. 96 sq.mm Analogue type DC Voltmeter
12. 2 set (12 nos.) of indicating lamps, LED type
    Load on Genset
    Load on Mains
    Mains R, Y, B
    Genset R, Y, B
13. 1 no. 4-point annunciator with inbuilt hooter, Test, Accept & Reset push buttons for the following,
    Low lubricating oil pressure
    High water temperature
    Engine overspeed
    Relay operated
14. Auto/Manual Selector Switch for MCCB ON/OFF
15. 1 no. TNC type Breaker Control Switch for Genset MCCB / DG

- Outgoing : 2 no. FP type, 2000 Amps. 50 KA ACB of specified make – Adjustable Thermal magnetic release for overcurrent, short circuit & earth fault release complete with 3 CT's of Class 1, 15 VA, 2000/5 Amp. With 1 no. of Load manager equivalent to Conserve make EM6400 per DG of standard rating.

- 1 no. digital type Ampere meter with inbuilt selector switch
- 1 no. digital type Voltmeter with inbuilt selector switch
- 1 no. digital type KW/PF meter
- 1 no. digital type Frequency meter
- 1 no. 3 phase, 4 wire, Panel mounted Digital Type KWH meter
- Neccessary set of instrument fuses, HRC type
- 3 nos. 2000/5 Amps ratio current transformers for metering, class 1.0, 15 VA burden
- 3 nos. 2000/5 Amps ratio current transformers for relay, class 1.0, 15 VA burden

Base Frame:

Suitable and recommended base frame of sturdy design made out of M. S. channel with necessary reinforcement & pri-drilled holes. The base frame shall be made out of reputed steel company. The diesel engine and alternator will be coupled on this base frame. skid mounted type providing common bed for engine and alternator. Provision is made in Base Frame for lifting arrangement of DG set.

Discription mentioned in above panel is indicative supplier has to provide all components as per specifications.

Acoustic Enclosure:

The Generating sets should be housed inside a high quality acoustic enclosure having salient features & constructional features such as:

1. Compact, modular construction & sleek design **with low noise level 75dBA @ 1 mtr distance in free field condition.**
2. Soundproof, weatherproof & environment-friendly **silent set with top lifting facility, preffered 6 sided enclosure**
3. Ready-to-use silent set, eliminates need for foundation or grouting.
4. The acoustic enclosure is manufactured & powder coated & lined with Fireproof Acoustic Material light resin rock wool as per IS: 8518. The material shall be of 48-kg/m^3 density & the layer shall be 75-mm thick.
5. It is made of compact sleek design confirming to international standards to provide insertion loss of 25 dBA meeting CPCB norms. **(1.6 / 2 mm thick CRCA sheet)**
6. Steel outer construction with heavy-duty fabricated base frame & inbuilt fuel tank.
7. Attenuators are placed in the hot air outlet & cooling air inlet.
8. Exhaust silencer – Residential type mounted on the enclosure, exhausting to atmosphere.
9. All joints are sealed with fireproof neoprene gaskets, which withstand high temperature & pressure.
10. All high temperature exposed surfaces are insulated by glasswool with aluminium cladding.
11. Painted with weatherproof, acidproof, heat-resistant, powder-coated after pretreatment for degreasing, derusting, pickling, phosphating & passivation for durability & better look.

Fuel Tank :

Silent Gensets have a unique **"Built in fuel tank"** which provides absolute safety and protection from any mishap unlike conventional systems.

The daily fuel tank should be suitably designed so as to provide long hours of uninterrupted and continuous power. For ease of monitoring the fuel level in the fuel tank, a sophisticated fuel level gauge should be provided in the control panel. For ease of operation, there is a provision for fuel inlet, which has accessibility from outside the acoustic enclosure, and designed so that the refueling is possible even when the generating set is in operation. The tank should be fabricated from M.S. Sheet, duly painted and fitted with inlet-outlet connections, air-vent, drain valve & level indicatiors suitable for 8 Hrs running.

Batteries :

2 nos. of Batteries will **be required with** each Genset. Each battery shall be of 12 Volts and of EXIDE / EQUIVALENT make with leads & Battery Cable.

Vendor to submit battery calculation.

BATTERY CHARGER

General

The battery charger shall be SMPS type. The charger shall have selector switch for Auto Float – Boost / Manual Float / Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost mode and Vice-Versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to trickle charge.

Construction Feature

The battery charger shall be housed in sheet steel cubicle of Angle Iron frame work with sheet steel panels of 1.6 mm thickness. Louvers shall be provided in the cabinet for the ventilation. The cubicle shall be painted in Siemens Grey shade RAL7032 of IS-5. Four wheels shall be provided at the base.

Performance

The D.C output voltage of Float / Boost charger shall be stabilized within ± 2% for AC input variation of 230 V ± 10%, frequency variation of 50 Hz ± 5% and DC load variation of 0-100%. The voltage regulation shall be achieved by a constant voltage regulator having fast response SCR control. The ripple content will be within 3% of DC output nominal voltage.

There shall be provision to select Auto Float / Manual Float / Manual Boost modes. During Auto Float Mode the battery charging shall automatically changeover from Boost Mode to Float Mode and Vice Versa. During Manual Float / Boost modes it shall be possible to set the output volts by separate potentiometers.

The battery charger shall have automatic output current limiting feature.

Rating

AC Input	:	230 V + 10% AC 50 Hz single phase.
DC Output	:	To float / boost charge 180 AH batteries and also supply a continuous load.
Current Rating	:	30.0 Amps
Float Mode	:	27.0 V nominal (Adjustable) between 24-28.0 V.
Boost Mode	:	29.0 V nominal (Adjustable) between 24-32.0 V.
Voltage Regulation	:	± 2% for AC input variation of 230 V ± 10%. Frequency Variation of 50 Hz ± 5% and DC load variation 0-100%

DATA SHEET

PRIME MOVER FOR D.G. SET

1.	Prime mover	Diesel Engine
2.	Qty required	One No. for each alternator.
3.	Service	Prime mover for generating set.
4.	Horse power	As specified in BOQ
5.	RPM	1500 RPM
6.	Type	Water cooled
7.	Flywheel	Require
8.	Vibration damper	Require
9.	Fuel pump air cleaner	Require
10.	Fuel pump	Require
11.	Radiator	Require
12.	Oil filter, fuel Filter etc.	Require
13.	Lub oil pump	Require
14.	24 DC V electrical System	Require
15.	Safety controls	1.LLOP, 2.HWT, 3. OS . 4.Cooldown timer 5. Low cool out level.
16.	Silencer	Required – Residencial Type
17.	Coupling	Require
18.	Instrument panel consist of	As specified in Panel.
a)	Meter	1.Voltage,2.Current,3 frequency,4.Engine hours.
19	Fuel tank	suitable for 8Hrs Running
20	Battery charger	Require
20A	Battery charging Alternator	24V DC, 35 Amp.
21.	Engine testing	
a)	At shop	Require
b)	At site	Require
22.	Tool kits	list of tools req. to be maintain at site.
23.	**Engine Design temp**	**45 deg C**
24.	Literature	Require
a)	Operation & maintenance manual a) Parts catalogue/list	

Note:

1. The engine HP. should be selected so as to achieve required KW rating to be generated considering darating of engine due to altitude, **temp. @ 45 deg. C**, humidity etc.

2. D.G. set should be able to start by AMF panel.

3. The engine test shall be witnessed by the client's representative if required.

ALTERNATOR

DATA SHEET - A

1.	Make	:	As per Make list
2.	Rating	:	As per schedule of quantities.
3.	Power factor	:	0.8
4.	Rated voltage	:	415 V
5.	Voltage regulation	:	5 %
6.	Rated current	:	As per SOQ
7.	Speed	:	1500 RPM.
8.	Frequency	:	50 Hz.
9.	Method of excitation and Regulation	:	Self
10.	Class of insulation	:	A) Stator - H with temp.rise of H B) Rotor - H --- do ------
11.	Degree of protection	:	Screen protected, drip proof.
12.	Base plate	:	The Engine & alternator shall be mounted and alignedon a Common base plate fabricated from steel.
13.	AMF Panel	:	As per specification
14.	PMG exitation / Auxiliary winding	:	Required.

DATA SHEET- B (To be furnished by the bidder)

I. ENGINE

1. Make :
2. Model :
3. No. of cylinders :
4. Arrangement of cylinders :
5. No. of stroke :
6. Speed RPM :
7. B.H.P Standard rating :
8. S.H.P. Standard rating :
9. Max. BHP at site (Over load) :
10. Engine over load operations hrs. :
11. Recommended fuel oil :
12. Compression ratio :
13. Firing order :
14. Sp. fuel oil consumption (LTR / HR) @ 0.85 spec.gravity.
15. Recommended Lub-oil :
16. Method of starting :

    a) Battery details :
    b) Charger details :
    c) Make of battery & charger. :
17. Silencer type :
18. Cooling system :
19. Fuel system :

    1. Filters :
    a) Type :
    b) Nos. :
    2. Injection pump :
    a) Type :
    b) Nos. :

    3. Injector :
    a) Type :
    b) Cooling :

    4. Day tank :
    a) Capacity :
    b) Location :
20. Lubricating system :
    1. Type :

    2. Filters :
    a) Type :
    b) Nos :

3. Lub oil pump :
a) Type :
b) Rating :

21. Governing system :

22. Instrument panel : Consist of:

23. Safety control :

24. Max. period for which engine can operate without raw cooling water supply. :

25. Other accessories :

26. Exhaust system :

27. Literature :

28. Diesel engine auxiliary (Materials of Construction)

1. Base plate

2. Fuel oil tank :

Note : All data to be supplied by the contractor.

E-15 UPS & INVERTER

A : UPS SYSTEM

1.0 Scope:

The scope covers supply, installation, testing & commissioning of UPS system given in BOQ, complete with batteries & all accessories.

UPS:-
"True Online-Double conversion type single module UPS.
Input 415V Nominal; 50Hz; 3Phase 4wire system. (single phase input up to 7.5 kva)
Output 415V Nominal; 50Hz; 3Phase 4 Wire system (single phase output up to 7.5 kva)
with Battery each UPS comprising of the following Major components

IGBT based Rectifier cum charger
IGBT based Inverter
Sealed maintenance free battery with back up time of 10Mins
Inter connecting cables; Links; Racks and standard accessories
(Attach Battery Sizing calculation for back up)
Built in SNMP card

The Client will only give the connection to the Incoming terminals and take the load from Outgoing terminals of the UPS.
All other equipment necessary to operate the UPS is in the scope of the Vendor. Any deviation from this scope has to be intimated to the client well in advance.

.

2.0 GENERAL

1.1 SUMMARY

A. This specification describes the operation and functionality of a continuous duty, dual input feed with configurable single-phase or three-phase output power (3:1 or 3:3), solid-state, static Uninterruptible Power System (UPS) hereafter referred to as the UPS.

B. The UPS shall utilize double conversion online topology designed to protect electronic equipment by supplying reliable, network-grade power with extremely tight voltage and frequency regulation. The UPS shall feature an internal static bypass and input power factor correction.

C. Configuration Specifics:

1. The system power train shall comprise of, input disconnect and filter stage, input PFC power stage, energy storage stage (DC bus capacitor bank), output power stage (inverters), static bypass switch for connecting bypass line to the output, and battery charger.

2. The system shall also include, field-replaceable fan module, removable input/output wiring trays, battery disconnects, an LCD interface display, EPO, and an integrated UPS network management card with temperature monitoring.

D. The UPS and associated equipment shall operate in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for mission critical, electronic equipment load.

E. All programming and miscellaneous components for a fully operational system as described in this specification shall be available as part of the UPS.

1.2 STANDARDS

A. EN50091-1/ EN/IEC62040-1-1

B. EN50091-2 / IEC62040-2

C. EN55022 Class A

D. EN55024

E. EN61000-4-2, 4-3, 4-4, 4-5, 4-6, 4-11

F. EN60950

G. IEC 60950

H. CE

I. VDE

J. C-tick

K. ISO 9001

L. ISO 14001

1.3 MODES OF OPERATION

A. Normal: The input Power Factor Corrector (PFC) stage and output inverter stage shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

B. Battery: Upon failure of the AC input source, the critical load shall continue being supplied by the output inverters, which shall derive their power from the battery system. There shall be no interruption in power to the critical load during either transfer to or from battery operation back to normal operation.

C. During the re transfer from battery to on-line operation, the load shall be softly transferred from battery back on-line within 10 seconds, to avoid step load changes on the mains supply.

D. Recharge: Upon restoration of the AC input source, the input converters and output inverters shall simultaneously provide regulated power to the critical load and recharge the battery.

E. Bypass operation: Bypass mode shall be reached either as a user selection or automatically.

1. Bypass mode can be selected through the Control menu screen on the PowerView display

2. The UPS will automatically switch into bypass mode if:

   a. Both normal and battery operation modes are unavailable
   b. An output overload condition occurs
   c. The UPS has an internal fault

During bypass operation the utility power is connected to the load, bypassing the internal converters. If the bypass mode becomes unavailable the UPS will automatically switch to mains power. In the event that mains power is unavailable the system will switch to battery power.

With the UPS supplied from dual feeds and operating on battery, due to a mains failure, it shall be possible to request the unit to go to bypass, in addition to automatically transfer to bypass when the batteries are depleted. In this bypass mode the inverter shall become a PFC and back-feed the DC busses. This allows the charger to continue charging the batteries.

1.4 SUBMITTALS

A. Proposal Submittals:

1. As bid system bill of materials.

2. Product catalog sheets or equipment brochures.

3. Product guide specifications.

4. System single-line operation diagram.

5. Installation information, including weights and dimensions.

6. Information about terminal locations for power and control connections.

B. Delivery Submittals:

1. Installation manual, which includes instructions for storage, handling, examination, preparation, installation, and start-up of UPS.

2. User manual, which includes operating instructions.

PART 2 - PRODUCT

2.1 MECHANICAL DESIGN

A. The UPS shall be contained in two rugged steel cabinets one containing the power electronics and the other containing the batteries and single phase distribution outlets;

B. The UPS and battery cabinets shall be capable of conversion between Tower / Stack and Rack-Mount configurations;

C. The power electronics cabinet dimensions including terminations shall be

Rack configuration 263 x 432 x 773mm (10.35 x 17 x 30.43 in.) (Height x Width x Depth), requires 6U of rack space and the side rack mounting brackets shall increase the overall width to 482mm (19 in);

Tower configuration 432 x 263 x 773mm (17 x 10.35 x 30.43 in.) (Height x Width x Depth);

2.2 SYSTEM CHARACTERISTICS

A. System Capacity:

1. The system shall be rated for .8 Pf output:

60,000VA or 48,000W whichever limit is reached first (60kVA model).
100,000VA or 80,000W whichever limit is reached first (100kVA model).

B. Input:

1. AC input nominal voltage:

a. 220/230/240VAC, single phase, 3 wire (L + N + G) Up to7.5 KVA
b. 380/400/415VAC, three phase, 5 wire (L1+L2+L3+N+G); for above 10 KVA

2. AC input voltage window:

a. Full Load, 160 -275V (Line-Neutral) for single phase input or 277 -476V (Line-Line) for three phase input;
b. Half Load, 100 -275V (Line-Neutral) for single phase input or 173 -476V (Line-Line) for three phase input;

3. Input frequency range: 40-70Hz;

4. Input Power Factor; > 0.98 at 100% load

5. Input Current Distortion: < 4% at 100% load, 230VAC (<7% for 3 phase output)

6. Crest factor: 3:1.

C. UPS Output:

1. AC Output Nominal Output: (Customer configurable)
a. 220VAC, 230VAC or 240VAC, Single Phase three wire, 50/60Hz; up to 10 KVA
b. 380VAC, 400VAC or 415VAC, Three phase five wire, 50/60Hz; above 10 KVA

2. AC output voltage distortion: Max. 2% @ 100% linear load; Max. 5% @ 100% non-linear Load;

3. AC output voltage regulation (Static): +/-1%;

4. Voltage Transient Response : +/- 8% maximum for 100% load step

5. Voltage Transient Recovery within < 10ms recovery time;

6. Output Voltage Harmonic Distortion:

a. <2% THD maximum for a 100% linear load
b. <5% THD maximum for a 100% non-linear load

7. Overload Rating:

a. Online: 105% - infinite; 125% - 1 minute; 150% - 30 seconds;

b. In bypass: Overload is limited by the external input circuit breaker feeding the UPS.

8. System AC-AC Efficiency:
   a. > 91 % for 6, 10kva
   b. > 94% for 15 and 20 kva
   c. > 96 % for 30 kva

9. Output Power Factor Rating: 0.2 –1.0 lagging, nominal: 0.8 lagging.

10. Output frequency: 50/60 +/- 3Hz tracking or 50/60 +/- 0.1Hz tracking (user selectable);

11. Output connectors:

    a. Single phase: Hardwire 3-wire (Phase + N + G),
    b. Three phase: Hardwire 5-wire (3 Phase + N + G)

12. Output frequency Slew rate : 1.0Hz/Sec, 0.5Hz/Sec 0.25Hz/Sec

2.3 ENVIRONMENTAL

1. Storage Ambient Temperature:

   a. -15° to +45° C (+5° to +113° F) charge the UPS battery every 6 months.
   b. +30° to +70° C (+86° to +158° F) charge the UPS battery every 3 months.

2. Operating Ambient Temperature: 0°C to +40°C (+32°F to +104°F). (+25°C (+77°F) is ideal for most battery types).

3. Relative Humidity: 0 to 95% non-condensing

4. Storage altitude: 15,240m (50,000 feet) above sea level

5. Operating altitude: 3,000m (10,000 feet) above sea level. At an altitude of 3,000 m the UPS shall be capable of supporting a load of up to 90% of its nominal capacity.

6. Audible noise:

   a. <50dBA at <70 % load at 1m,
   b. <60dBA at >75 % load at 1m

2.4 INPUT PFC POWER STAGE

A. The input PFC power stage of the UPS shall constantly rectify the power imported from the mains input of the system, converting the input mains AC power to DC power for precise regulation of the DC bus voltage, battery charging, and output power stage (inverter) regulated output power.

B. Input Current Total Harmonic Distortion: The input current THD_I shall be held to 6% or less at full system load, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting loads of both a linear or non-linear type. This shall be accomplished with no additional filters, magnetic devices, or other components.

C. Input Current Limit:

1. The input converter shall control and limit the input current drawn from the utility supply

2. Overloads at low line input voltages shall draw power from the battery, (battery assist mode) in order to support the load and maintain the input current below the set current limit points.

D. Charging:

1. The battery charging shall maintain the DC bus float voltage of +/-219V, +/-1% at the nominal temperature of 20°C (68°F)

2. The battery charging circuit shall contain a temperature monitoring circuit, which will regulate the battery charging current to optimize battery life.

3. The battery charging circuit shall remain active when in automatic Bypass and in Normal Operation.

4. The battery charging system shall adjust the charging current by automatically sensing the number of battery modules and by monitoring the individual battery current. Maximum charger power shall be 3kW.

2.5 OUTPUT POWER STAGE (INVERTER)

A. The UPS output power stage (inverter) shall constantly recreate the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT switches. In both online operation and battery operation, the output power stage (inverter) shall create an output voltage waveform independent of the mains input voltage waveform. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter).

B. Overload Capability: The output power stage (inverter) shall be capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for an indefinite length of time. The system shall transfer to bypass if the overload persist and then return back on-line when the overload is removed.

C. Battery Protection: The UPS shall have monitoring and control circuits to limit the level of discharge on the battery system.

2.6 AUTOMATIC BYPASS

A. As part of the UPS, a system automatic bypass switch shall be provided. The system automatic bypass shall provide a transfer of the critical load from the Inverter output to the automatic bypass input source during times when the inverter cannot support the load. Such times may be due to prolonged or severe overloads, or UPS failure. The UPS shall constantly monitor the output current, as well as the bypass source voltage, and inhibit potentially unsuccessful transfers to automatic bypass from taking place.

B. The design of the automatic bypass switch power path shall consist of an electromechanical bypass contactor and series SCR's.

C. Automatic Transfers: An automatic transfer of load to bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from bypass back to normal operation takes place when the overload condition is removed from the critical bus output of the system. Automatic transfers of load to bypass shall also take place if for any reason the UPS cannot support the critical bus.

D. Manual Transfers: Manually initiated transfers to and from bypass shall be initiated through the UPS interface display or via the serial communications port.

2.7 DISPLAY AND CONTROLS

A. Control Logic: The UPS shall be controlled by an embedded microcontroller which performs the following functions:

1. Monitoring quality of input, bypass and output voltages;

2. Monitoring vital parameters of the UPS;

3. Executing the state machine;

4. Intelligent battery management;

5. Remaining runtime calculation;

6. Self-diagnostics, self-test and proactive fault detection;

7. Communication to the host server via serial port;

8. Communication to the Network Interface Card or another SmartSlot accessory card if equipped.

B. Display Unit: A microprocessor controlled display unit shall be located at the front of the system. The display shall consist of an alphanumeric display with backlight, providing system status, LED alarm indicators and a keypad consisting of pushbutton switches for control and status reading selection.

C. Metered Data: The following metered data, shall be available on the alphanumeric display:

1. Year, Month, Day, Hour, Minute, Second of occurring events
2. Source and Bypass Input Voltages
3. Output AC voltage
4. Input, Bypass and Output AC currents
5. Input, Bypass and Output Frequency
6. Battery voltages and currents
7. Internal and battery pack temperature

D. Event log: The display unit shall allow the user to display a time and date stamped log of the 100 most recent status and alarm events.

E. Alarms: The display unit shall allow the user to display a log of all active alarms. The following minimum set of alarm conditions shall be available:

1. Input Frequency outside configured range
2. AC adequate for UPS but not for Bypass
3. Low/No AC input, startup on battery
4. Number of Batteries changed since last ON*
5. Number of Batteries increased*
6. Number of Batteries decreased*
7. Need Battery Replacement*
8. UPS Fault
9. On Battery
10. Shutdown or unable to transfer to battery due to overload
11. Load Shutdown from Bypass. Input Frequency Volts outside limits
12. Fault, Internal Temp exceeded system normal limits
13. System level fan failed
14. Runtime is below alarm threshold
15. Load is above alarm threshold
16. Load is no longer above alarm Threshold
17. Minimum Runtime restored
18. Bypass is not in range (either frequency or voltage)
19. UPS in Bypass due to Internal Fault
20. UPS in Bypass due to overload
21. Low Battery Shutdown
22. Low Battery Warning

F. Controls: The following controls or programming functions shall be accomplished by use of the display unit. Pushbutton switches shall facilitate these operations.

1. Silence audible Alarm
2. Display or set the date and time
3. Transfer critical load to and from bypass
4. Test battery condition on demand
5. Set intervals for automatic battery tests
6. Adjust set points for different alarms

G. Communication Interface Board: A communication interface shall provide the following communication ports which can be used simultaneously:

1. RS232 Serial Port #1
2. RJ-45 Interface port for PowerView Display
3. RJ-45 Ethernet connection, on installed Network Management Card

2.8 BATTERY

A. External SMF Battery

1. The UPS battery system shall comprise of user replaceable external batteries providing 192VDC nominal for the positive DC bus rail and 192VDC nominal for the negative DC bus rail.
2. The battery blocks shall be of the Valve Regulated Lead Acid (VRLA) type.
3. The UPS shall incorporate an Intelligent Battery Management system to continuously monitor the health of the battery system and notify the user if that system is weak or needs replacing.

B. General description for Batteries

1. Batteries shall be of the Sealed Lead-Acid type.
2. Two separate, isolated 192 V battery systems shall be provided. One cable shall be wired to each 192 V battery system. Two cable assemblies shall be included with the UPS, one for each 192 V battery system.
3. Each battery system shall have identical Amp-hrs capacity.
4. Ground wires shall be supplied for connection from the UPS to each battery enclosure grounding point.

C. Charging:

1. The intelligent battery management system shall contain a temperature monitoring circuit and compensation algorithm that regulates the battery charging current so as to optimize battery life. The UPS shall monitor the temperature of all proprietary battery packs and use the highest one as a reference to adjust the battery float voltage.
2. The battery charging circuit shall remain active when in bypass or on-line.
3. Charging system shall automatically adjust the maximum charger power, up to 3kW, based on the installed proprietary battery capacity and current through each battery string to avoid excessive charging that could result in bloated batteries. Each proprietary battery pack shall report its battery currents and temperature to UPS through CAN communication

PART 3 - ACCESSORIES

3.1 REMOVABLE INPUT/OUPUT ELECTRICAL TERMINAL

A. The input and output terminal connections shall be designed to be removable trays for easy electrical connection and unit removal.

B. The removable input and output trays shall contain a means of configuring the system for 1 or 3 phase input and output as well as for single or dual feed input.

3.2 SOFTWARE AND CONNECTIVITY

A. Network Adaptor: Built in SmartSlot Network Management Card shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments.

B. Unattended Shutdown

1. The UPS, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems when the UPS is operating in the battery mode. Network Shutdown software shall be available with the UPS.

2. The UPS shall also be capable of using an RS232 port to communicate with the host computer by means of serial communications so as to gracefully shut down one or more operating systems during an on battery situation.

3.3 REMOTE UPS MONITORING, CONFIGURATION AND CONTROL

A. The following three methods of remote UPS control, configuration and monitoring are available:

1. Web Monitoring: Remote monitoring shall be available via a web browser such as Internet Explorer.

2. RS232 Monitoring: Remote UPS monitoring shall be possible via either RS232 or contact closure signals from the UPS.

3. Simple Network Management Protocol (SNMP): Remote UPS Monitoring shall be possible through a standard MIB II compliant platform.

3.4 SOFTWARE COMPATIBILITY

A. The UPS manufacturer shall have available software to support graceful shutdown and remote monitoring for the systems detailed on the following web link:

PART 4 - EXECUTION

4.1 START-UP

Start-up is requested, factory trained service personnel shall perform the following inspections, test procedures, and on-site training:

A. Visual Inspection:

1. Inspect equipment for signs of damage.

2. Verify installation per manufacturer's instructions.

3. Inspect cabinets for foreign objects.

4. Inspect battery chassis and modules.

5. Inspect power chassis

B. Mechanical Inspection

1. Check all UPS and internal power wiring connections.

2. Check all UPS and nuts, and/or spade lugs for tightness.

C. Electrical Inspection:

1. Verify correct input and bypass voltage.

2. Verify correct UPS control wiring and terminations.

3. Verify voltage of all battery modules.

4. Verify neutral and ground conductors are properly landed.

5. Inspect external service bypass panel for proper terminations.

D. Site Testing:

1. Ensure proper system start-up.
2. Verify proper control functions.
3. Verify proper bypass operation.
4. Verify system set points.
5. Verify proper inverter operation and regulation circuits.
6. Simulate utility power failure.
7. Verify proper charger operation.
8. Document, sign, and date all test results.

E. On-Site Operational Training: During the factory assisted start-up, operational training for site personnel shall include key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

4.2 MANUFACTURER FIELD SERVICE

A. Worldwide service: The UPS manufacturer shall have a worldwide service organization available, consisting of factory trained field service personnel to perform start-up, preventative maintenance, and service of the UPS system and power equipment. The service organization shall offer 24 hours a day, 7 days a week, 365 days a year service support.

B. Replacement parts: Parts shall be available through the worldwide service organization 24 hours a day, 7 days a week, 365 days a year. The worldwide service organization shall be capable of shipping parts within 4 working hours or on the next available flight, so that the parts may be shipped to the customer site within 24 hours.

4.3 MAINTENANCE CONTRACTS

A. A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available from the vendor. All contract work shall be performed by the vendor's factory trained service personnel.

4.4 TRAINING

A. UPS service training workshop: A UPS service training workshop shall be available from APC. The service training workshop shall include a combination of lecture and practical instruction with hands-on laboratory sessions. The service training workshop shall include instruction about safety procedures, UPS operational theory, sub-assembly identification and operation, system controls and adjustment, preventative maintenance, and troubleshooting.

E-16 Miscellaneous (Fire Stop system Material)

1.0 Scope :

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

2.0 Standards :

As per Applicable standard Specification of Fire stopper material suppler.

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

3.0 Material :

a) Fire Resistant Mortar
fire resistant, cement based mortar with thermal insulating properties from admixed perlite CP 636 of HILTI India Pvt Ltd or Equvalrent .The product shall be tested for withstanding Zone 4 earthquake when tested in accordance with acceleration time history waveform VERTEQII as per IEC 60068 and Telcordia Technologies GR-63-Core 2006-03. The product shall be age tested for 30 years as per Dafstb and DIBT standards. The product shall be tested and

approved by third party agencies such as UL, FM and LPCB. The product shall bear the UL and FM approval logo on the packing.

b) Fire Stop System

Providing & Supplying Passive Firestop system using HILTI Mineral wool board along with CP 670 coating of 1 mm DFT and CP 606 Firestop filler or Equivalent system. Fire barrier coating of 1 mm thickness should be apply on Mineral wood board (density min. 150 kg/cu. meter) and fill the remaining gap around entrants with suitable filler of depth same as mineral wool panel thickness to provide 2 hour fire rating on solid structure (wall- min. 80 mm, floor-min. 150 mm thickness) when subject to test conditions of BS 476: part 20:1987 and after age testing to DafStb guidelines. Cables and cable tray should be coated with above same coating up to minimum length of 300 mm to prevent spread of fire. Fire barrier coating and filler should be approved to international test standard like BS 476 and tested by FM, LPC, BRE, and WFRC. For wall opening the Board system should be used on both sides of the wall and for floor opening it should be used only on one side.

c) Fire Stop System

Providing and supplying versatile intumescent expanding foam CP 620 of HILTI India Pvt Ltd.The product shall be tested for withstanding Zone 4 earthquake when tested in accordance with acceleration time history waveform VERTEQII as per IEC 60068 and Telcordia Technologies GR-63-Core 2006-03. The product shall be age tested for 30 years as per Dafstb and DIBT standards. The product shall provide water tightness when tested for W rating as per UL standards and shall be tested for providing a sound insulation of 50 when tested in accordance with ASTM E 90. The product shall be tested and approved by third party agencies such as UL, FM and LPCB. The product shall bear the UL and FM approval logo on the packing.

4.0 Mode of measurement :

As specified in BOQ.

APPLICABLE STANDARDS

Sr. No.	IS No.		Description
1)	IS: 2026-1977 1981 -1994	:	Power transformers & fittings.
2)	IS 3639-1966	:	Fittings and acc. For P.T.
3)	IS10028-Part III 1981	:	Installation of Transformer.
4)	IS: 13118-1991	:	Specification for High voltage AC circuit breakers.
5)	IS: 335-1993	:	Insulating oil for Transformers & switch gear.
6)	IS: 2705-1992	:	CT for measuring and protection.
7)	IS: 3156-1992	:	Voltage (Potential) Transformers.
8)	IS: 3156-1992	:	Voltage Transformer.
9)	IS: 8623-Part II 1993	:	Bus-bar arrangement and marking.
10)	IS: 2099-1986	:	Bushing
11)	IS: 5621-1980	:	Large Hollow Porcelains Insulator
12)	IS: 2544-1973	:	Insulators greater than 1000V
13)	IS: 2629-1985 IS: 2633-1986	:	Hot Dip Galvanizing
14)	IS: 3842-1967	:	Relays for AC system
15)	IS: 1248-2003	:	Meters (measuring).
16)	IS: 10118-1982	:	Installation of Switch gears.
17)	IS: 692-1994	:	HV Cable Paper Insulated Lead Sheathed Cables for Rated Voltage up to and Including 33 kV – Specification
18)	IS: 1255 -1983	:	Installation of HV cables and jointing.
19)	IS: 3043-1987	:	Code of practice for earthing.
20)	IS: 13947-Part III -1993	:	HD Air breaker, Switch gears and fuses for Voltage not exceeding 1000 Volts.
21)	IS: 13703-Part IV -1993	:	Selection, installation and maintenance of fuses up to 650 Volts.
22)	IS: 13947-Part I -1993	:	General requirements for switch gear and control gear for voltage not exceeding 1000 Volts.
23)	IS: 13947-Part III	:	Air-break isolators for Voltage

	-1993		not exceeding 1000 Volts.
24)	IS:8623-1993	:	Factory built assemblies of switch gears and control gears for voltage up to and including 1000 Volts A.C. and 1200 Volts D.C.
25)	IS: 11353-1985	:	Marking and arrangement of switch gear bus bars main connectors and auxiliary wiring.
26)	IS: 13947 PART-1	:	Cubical Boards.
27)	IS: 8084-1976	:	Insulated Busbar rating.
28)	IS: 2675-1983	:	Enclosed distribution fuse boards and cutouts for Voltage not exceeding 1000 Volts.
29)	IS: 8828-1995	:	Miniature Circuit Breaker.
30)	IS: 9926-1981	:	Fuse wire used in rewirable type electric fuses up to 650 Volts.
31)	IS: 1554-Part I -1988	:	PVC insulated electric cables Heavy duty.
32)	IS: 3961-Part II & IV -1967	:	Recommended current rating for cables.
33)	IS: 8130-1984	:	Copper conductor in insulated cables and cores.
34)	IS: 8130-1984	:	Conductor for insulated electric cables and flexible cords.
35)	IS: 3975-1999	:	Low Carbon Galvanized Steel Wires, FormedWires and Tapes for Armouring of Cables - Specification
36)	IS: 5831-1984	:	PVC insulation and sheath of electric cables.
37)	IS: 8130-1984	:	Aluminum conductor for insulated cables.
38)	IS: 11955-1987	:	Recommended current rating for Cable.
39)	IS: 732-1989	:	Code of practice for electrical wiring installation system Voltage not exceeding 650 Volts.
40)	IS: 1646-1997	:	Code of practice for fire safety of Buildings (general) electrical installation.
41)	IS: 9537-1981	:	Rigid steel conduits for electrical wiring.
42)	IS: 2667-1988	:	Fittings for rigid steel conduits for electrical wiring.
43)	IS: 3480-1966	:	Flexible steel conduit for electrical wiring.
44)	IS: 3837-1976	:	Accessories for rigid steel conduits for electrical wiring.
45)	IS: 694-1990	:	PVC insulated cables (wires).
46)	IS: 9537-Part III -1983	:	Installation of Rigid non-metallic conduits for electrical wiring.
47)	IS: 6946-1973	:	Flexible (playable) nonmetallic conduits for electrical installation.

48)	IS: 1293-2005	:	Plugs and sockets upto 250V.
49)	IS: 8130-1984	:	Conductors for insulated electrical cables and flexible codes.
50)	IS: 9537-1980	:	Specification for conduit for electrical installation.
51)	IS: 3419-1988	:	Accessories for non-metallic conduits for electrical wiring.
52)	IS: 3854-1997	:	Switches.
53)	IS: 6538-1971	:	Plugs.
54)	IS: 13585-Part I -1998	:	Shunt Capacitors for power systems upto 650V.
55)	IS: 13703	:	Low voltage fuse and links up to 1000 volts.
56)	IS: 1913-1978	:	General and safety requirement for lighting fittings.
57)	IS: 1944-1981	:	Code of practice for lighting public thorough fares.
58)	IS: 3528-1966	:	Waterproof electric lighting fittings.
59)	IS: 3553-1966	:	Water tight electric lighting fitting.
60)	IS: 1239-Part I -2004	:	Mild Steel tubular and other wrought steel pipe fitting.
61)	IS: 10322-Part V -1987	:	Luminaries for street light.
62)	IS: 13703-Part III -1993	:	HRC fuses having rupturing capacity voltage upto 1000V.
63)	IS: 2312-1967	:	Exhaust Fan.
64)	IS: 374-1979	:	Class I Ceiling Fan.
65)	IS: 7098 (Part I, II, III) -1988	:	XLPE armoured Cables upto 1000V.

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

PLEASE FOLLOW:

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

LIST OF APPROVED MAKE / MANUFACTURER FOR ELECTRICAL WORK MATERIALS

1)	Rigid PVC Conduit	:	ISI & FIA approved & manufactured from virgin material. **Astral, Precision PPI.**
2)	Accessories for conduit	:	Same make as of pipe.
3)	Flexible Copper Wires	:	**FRLS type : KEI, Avocab, Finolex, RR Kabel**
4)	Switches	:	**MK(blenze),Legrand(Arteor), Havell's(carabtree-Verona), Hager**
5)	Light Fixture	:	**lighting ways, Phillips, Wipro, Havell's, Regent, Bajaj** (As suggested by Consultant - Sample to be approved)
6)	FTL/CFL/Lamps or any kind of light source	:	**Osram, Philips, GE**
7)	Ceiling Fans	:	**Bajaj, Havell's**
8)	Fan box	:	**Cast Iron Type Only**
9)	Exhaust Fan	:	**Crompton, Almonard, Bajaj, Havell's**
10)	Call bell	:	**Anchor Ding Dong type.**
11)	PVC tape	:	**Steel grip, Anchor**
12)	Distribution boards	:	**Legrand (MDS-lexic), Schneider (MG) , L&T, Hager** Factory fabricated. Double door type
13)	MCB/ELMCB & Acc	:	**Legrand (MDS-lexic), Schneider (MG) , L&T, Hager**
14)	LT Cables	:	**KEI, Avocab, Finolex, Havell's, Polycab**
15)	Panel Fabricators	:	**CPRI & ISO(A.D. ENTERPRISE, Themis Automation private limited, GMDT Engineering private limited) Approved panel builders only**
16)	Load Manager / Energy Meter: (Suitable for PC Connected and LAN with open protocol, Sample to be approved)		**Conzerve, Secure, Elmeasure, L&T**
17)	Meters(Digital : V,A,PF etc)	:	**Conzerve, Secure, Elmeasure, L&T**
18)	Timer	:	**Theban (Indoasain), Legrand, L&T**
19)	RTPFC Panel	:	**Datar, Epcos, Power Matrix, Shreem, Neptune ducati,L&T**
20)	RTPFC Relay	:	**Beluk (Germani), Conzerve, Neptune ducati, L&T, Secure**
20)	Capacitor (APP type)	:	**L&T, Conzerv, Shreem, Legrand**
21)	Relay	:	**Areva, Siemens, L&T, ABB,CSPC, Schnieder**
22)	MCCB	:	**Legrand, Schneider (MG) , L&T,Hager**
23)	A.C.B.	:	**Legrand, Schneider (MG) , L&T**
24)	On Load Changeover	:	**C&S, HPL, Havell's**

25) Connectors	:	**ELMEX, Wago**
26) SFU - Switch Fuse Unit 60 Amps - AC 23 duty	:	**Schneider MG, Siemens, L&T, Havell's (AC 23duty only)**
27) HRC Fuses & Fuse-Base	:	**Schneider MG, Siemens, L&T, Havell's**
28) Glands	:	Compression type, Heavy duty and deep threding with rubber-ring and double washers. (Sample tobe approved) **HMI, Comet**
29) Cable Lugs	:	**Dowells, 3-D (Copper long nack)**
30) Metal Clad and Wheather proof Plug-socket	:	**Legrand, Indoasain, RR PCE, BCH, Schnieder**
31) Button holder, Angle holder, ceiling rose	:	**Anchor, CPL**
32) M.S. Conduit ISI	:	**BEC, Steel Craft, AKG**
33) M.S. Boxes	:	Fabricated out of CRCA sheets / Angle / Strip continuously welded (sample to be approved) with Powder coating / Colour coating.
34) Oil cool type Transformer	:	**Voltamp, Crompton, ABB, Vidhyut**
35) HT Joint Kit	:	**Raychem, 3M.**
36) HT Cable	:	**KEI, Avocab, Havell's, Polycab**
37) Cable Tray	:	**Indiana, Dudhat , Neel Enterprise**
38) Raceway	:	**MK (Ega), Legrand, OBO**
39) Chemical Type Earthing	:	**OBO, ASHLOK, JSR, AXIS**
40) Lightening Surge Protector	:	**OBO, ASHLOK, JSR, AXIS**
41) DB Surge Protector	:	**Legrand, Hager,Schnieder,OBO, L&T**
42) Anchor Fastener	:	**Hilti,3M**
43) Fire Stopper / Mortar	:	**Hilti, OBO**
44) Fire Stop Sealant / Foam	:	**Hilti, OBO**
45) Fire Resi Cable Coating	:	**Hilti, OBO**
46) Power Generating Engine a. Diesel Operated	:	**Caterpillar, Cummins India, MTU Friedrichshaten, Perkins, Volvo Penta**
48) System Intregrator (OEM) for DG sets authorized by Engine Manufacturer	:	**Gmmco** (For Caterpillar), **Powerica** (For Cummins) **GMDT**, **Sudhir Gendet** (for Cummins), **Supernova**
49) Synchronisation Panel Relay:		**Woodward, Power Guard, EMCP-2, GC 500**

50) HT VCB	:	**ABB, Siemens, Schneider, C&S, L&T**
51) Current Transformer	:	**AE, Virat, Narmada**
52) Indication Lamp	:	**LED Type : Schneider, Sumo, L&T, RASS**
53) Voltage Selecter Switch	:	**L&T, Salzer**
54) Ameter Selecter Switch	:	**L&T, Salzer**
55) Power Pack	:	Gogate / Eq.
56) Thermoplastic Boxes	:	Hensel, Spelsberg
57) UPS	:	APC, HIREL, ETON, EMERSON
58) Battery	:	Global (Rocket),HBL (Life), Exide, Amarraja,Hitachi
59) Isolation Transformers	:	Automatic Electric, Servomax, Aplab
60) LT Busbar Trunking	:	**C&S, Schneider, Godrej, L&T**
61) Gas based Fire Suppression System	:	Ceasefire,
62) Ligtning Protection System	:	ASHLOK, JSR, AXIS, OBO

Special Notes :

- The successful tenderer will have to supply the makes from above in consultation with the Client/Architect/Consultant without any extra cost.
- tender, in covering letter of separate letter enclosure. However, the final decision for accepting make specified by tenderer would be of client/Architect/Consultants.
- As far as possible, the successful tenderer will have to place order directly to the manufacturer OR it's authorized dealer.
- The Client/Architect/Consultants have right to check the challans of supplier.
- The MCB and MCB DBs must be of same make.
- Make of components reuired to be used by contractor to complet the installation, if not mentioned any where, shall be required to GOT IT APPROVED by Client/Architect/Consultant before installation in writing manner.
- Within a week of work order, the contractor shall submit the sample of each item / component of above mentioned approved make for the approval of the Client/Architect/Consultant.
- The make for CAT6 and OFC should be the same.

B. ELV Work Specification

MATERIAL SPECIFICATION

MATERIAL SPECIFICATION

SUMMARY PAGE FOR LOW VOLTAGE (LV) SYSTEMS WORKS

S/No	ITEM
(A)	MATERIAL SPECIFICATIONS
1	DATA &TELECOM – TELECOM COMPONENTS, FIBER OPTICS CABLE & COMPONENTS
2	ACTIVE COMPONENTS - NETWORKING SWITCH SPECIFICATIONS
3	VIDEO SURVEILLANCE / CCTV SYSTEM
4	FIRE DETECTION & ALARM SYSTEM
5	DIGITAL EVACUATION AND PUBLIC ADDRESS SYSTEM
6	ACCESS CONTROL SYSTEM
7	CABLE TELEVISION SYSTEM
(B)	SPECIAL CONDITIONS
(C)	LIST OF APPROVED MAKE / BRANDS / MANUFACTURERS

1. TELEPHONE AND DATA DISTRIBUTION

1.1. SCOPE OF WORK:

a) Complete installation shall be done in accordance with installation practices for a well structured cabling system, using components from a single vendor to ensure consistent and assured performance. The structured cabling distribution network shall serve as a vehicle for transport of data, video and voice telephony signals throughout the network.

b) Installation, termination and identification of wiring between station outlets, Telecom Rooms and the Equipment Room shall be considered part of the contractors work.

c) Wiring utilized for data and voice communications shall originate at owner provided hubs and concentrators either wall mounted, in vertical free standing equipment racks, and/or enclosed wall mounted vertical equipment racks located at the Telecommunications Equipment Room (ER), the Main Cross-connect (MC) , the Intermediate cross-connect (IC), and/or the Telecommunications Room (TR) location(s). Wiring, terminations and patch bays between these designated demarcation points and outlet locations designated on the plans shall be considered part of the contract. Telecommunication Outlets (TO) shall be furnished, wired and installed by the structured cabling distribution network system contractor.

d) The system shall utilize a network of unshielded twisted pair, riser, tie and station cables. Cables and terminations shall be provided and located as shown and, in the quantities, indicated on the drawings.

e) All cables and terminations shall be identified at all locations.

f) All cables shall terminate in an alphanumeric sequence at all termination locations.

g) All balanced twisted pair cable terminations shall comply with, and be tested to TIA/EIA568-B standards for Category 3, Category 5e, Category 6 & Category 6 installations.

h) The contractor carrying out the SITC shall make the system entirely operational for its intended use, by addition of components specific to its make/model even if not specifically mentioned in the BoQ. Also most current versions of software and applications shall be provided by the contractor, as applicable at the time of execution and commissioning.

i) The Contractor has to furnish working drawings and as-built drawings, which shall be an essential component of commissioning.

Supported Applications, but not limited to:

a) Ethernet Applications

b) IEEE 802.3af Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)

c) Fiber Channel Applications

d) IEEE 802.11a/b/g Wireless LAN Applications

e) Digital Subscriber Loop (DSL) Applications

f) Voice, Video and ISDN Applications

g) Building Automation Systems (BAS) Applications

References & Standards, but not limited to:

a) TIA / EIA

b) International Electro technical Commission (IEC)

c) European Committee for Electro technical Standardization (CENELEC)

d) National Fire Protection Association (NFPA) / UL Listed

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

a) The Passive Components of structured cabling distribution network will be free from manufacturing defects in material and workmanship under normal and proper use;

b) All Passive Components in the structured cabling distribution network meet or exceed the relevant component specification of the TIA 568-B series and ISO/IEC 11801: 2002 standards;

c) The structured cabling distribution network compliant channels will meet or exceed the Guaranteed Channel Performance as per relevant standards in the structured cabling distribution network Performance Specifications in effect at the time of installation.

d) The Application Assurance covers the structured cabling distribution network compliant channels to support operations of the application(s) that the system was designed to support.

e) The site will be duly certified by OEM for a period of Twenty years from the date of issuance of the registration certificate or installation, whichever is earlier.

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

a) Jelly Filled Armoured Telephone Cable

b) Category 6 Data Networking UTP Cable and associated components such as CAT6 patch panels – 16/24/48 ports, IOs/RJ45 jacks, CAT6 patch cords, Face plates & SMBs

c) Single mode / Multimode Outdoor/Indoor Optic Fiber Cable and accessories such as – Light Guide Interface Unit (LIU), wall mount and rack mount, pigtail, splices, couplers, patch cords, splicing kit and splice trays

d) Networking Racks – for termination of networking cables

e) GPON/FTTX Racks - for termination of GPON/FTTX Cables

f) Equipment Racks – for servers and hardware

g) Wire-Less Access Point

h) Networking Switches – Simple Manageable, Layer 2 & Layer 3 inclusive of their options such as uplinks, transceivers for fiber transmission

Installation:

a) The installation of conduits shall generally be as specified under section `CONDUIT WIRING'.

b) All cables shall be on cable racks and neatly stitched together.

c) The connection at the tag blocks shall be silver soldered of IDC type so as to achieve minimum contact resistance gas tight connection.

d) The final branch connections with single pair cables in conduits and the maximum number of cables in each conduit shall be as follows :

Conduit Diameter	Inch/mm.	Max. No. of cables
1"	25	3 Nos. Of CAT6 UTP Cable
1"	25	Single cable par loop for FAS, PA Services
1½"	40	6 Nos. Of CAT6 UTP Cables & Single run for Fiber Cable

Mode of measurement:

a) The main telephone/data cables shall include supply and laying of multi pair cables on ceiling/wall/on cable trays/racks including all supports and shall be measured and paid on running length basis. Cable trays/racks shall be paid for separately.

b) The multi pair tag blocks shall consist of two telephone connector's strips, jumper interconnections silver IDC terminated soldered enclosure etc. and shall be measured and paid as one unit.

c) The conduit wiring for telephone/data shall include single pair 0.6 diameter cable in heavy duty rigid, PVC conduits and shall include junction boxes, pull boxes, 2 pair 2 A connector in GI box, Perspex cover etc. and shall from one point.

1.2. CONDUITS

a) Conduits shall be as given below :

b) The conduit shall generally be as specified under section `Telephone and Data Distribution'.

1.3. JELLY FILLED ARMORED TELEPHONE CABLES – 20/ 50/100/200 PAIRS

a) All multi core cables and wires shall be of tinned copper conductor of not less than 0.5 mm diameter and shall be color coded twisted pairs with rip cord.

b) The conductor resistance shall be less than 150 ohms per KM and the insulation resistance between the conductors shall be not less than 50 mega ohms and the nominal capacitance measuring about 0.1 microfarad per kilometer.

c) Cables which are laid underground or locations subject to dampness and flooding shall be filled with polyethylene compound and shall have sufficient protection against moisture and water ingress.

d) All armoring shall be of galvanized steel wires and protected against corrosion by an outer sheath of PVC in the case of indoor cables and polyethylene in the case of outdoor cables. Outer sheathing must be fire retarding and anti-termite.

e) The Jelly Filled armored cable (JFA) shall be of 50 pairs capacity as required and suitable for direct burial application.

f) Physical Specifications:

- Gauge of Conductor: 23/24 AWG
- Material: Annealed soft electrolytic copper wire monolithic
- Operating Temperature: -20 Deg. C to + 80 Deg. C
- Current Resistance: Minimum 90 ohm/mile

1.4. TAG BLOCKS OR KRONE (50 TO 500 PAIRS) BLOCKS

a) The telephone tag blocks shall be suitable for the multi core telephone cables and shall have two terminal blocks, cross connect type. All incoming and outgoing cables shall be terminated on separate terminal blocks and termination shall be of insulation displacement type (IDC) to provide silver soldered gas tight connection. The cross connecting jumpers shall be insulated wires of same diameter and terminated using impact tool for gas tight connection. Screw connected.

b) The tag blocks shall be mounted inside fabricated sheet steel boxes with removable hinged over's and shall be fully accessible. The enclosure shall be painted with 2 coats of red oxide and stove enamelled.

1.5. TELEPHONE/DATA NETWORKING

1.5.1. CATEGORY 6 UTP CABLE

SR. No	Minimum Specifications / Functionalities / Capabilities	
1	Type	Unshielded twisted pair cabling system, TIA / EIA 568-C.2 Category 6 Cabling system
2	Network support	Supports ultrahigh speed data networks such as Gigabit Ethernet (1000 Base-T and 1000 Base-TX) and beyond.
3	TIA / EIA 568-B.1	ETL Verified, UL Listed and UL channel verified- All three Certificates are mandatory
4	IEEE 802.3ab	Zero-bit Error, ETL verified

5	Warranty	25-year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs. Site certificate must be issued by OEM
6	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	Manufacturer	All passive cabling must be from same OEM
8	Conductors	23 AWG solid bare copper
9	Insulation	Polyethylene
10	Jacket	LSZH
11	Filler	PE
10	Approvals	UL Listed and UL Channel verified
		ETL verified to TIA / EIA Cat 6
11	Frequency tested up to	600 MHz minimum
12	Outer dia	6.2 mm
13	Packing	Box of 305 meters
14	shipping weight	305m reel in a box 24kg
15	Impedance	100 Ohms + / - 15 ohms
16	Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR
17	Delay Skew:	45ns Max
18	Impedance:	100 ± 15 Ohms
19	Current Rating:	1.5 A Max
20	Conductor DC Resistance:	66.5Ω/km
21	Voltage:	150VAC
22	NVP	67%
23	Propagation delay:	535ns/100m @250MHz
24	Mutual Capacitance:	5.6nF/100m Nominal
25	Insulation Resistance:	500 MΩ Minimum
26	Dielectric Strength:	1000 V RMS
27	Contact Resistance:	10 mΩ Max
28	Fire Propagation Test	UL 1581 VW1, IEC 60332.1, EN0256-2-1

1.5.2. CATEGORY 6 MODULAR PATCH PANEL, (24 PORTS – 1U)

SR. No	Minimum Specifications / Functionalities / Capabilities
	UTP Straight Jack Panel UL listed, loaded with 24 nos. UTP ports for PCB based IO Jacks (RJ45, TIA-568C Category-6, Installation and Termination of all 24 nos. Catergory-6 UTP Cable
1	Minimum Specifications
1.1	Shall be unloaded with individually replaceable 24 nos. Category-6 I/O Jacks complying with TIA-568.C.2
1.2	Shall be 19" rack mountable , angled and of 1U height & complete with all mounting accessories, UL listed
1.3	Shall have labels for identification of ports
1.4	Should have integrated bonding bar for grounding individual jacks
1.5	Shall be RoHS Compliant
1.6	Shall have minimum 25-Year Extended Product Warranty and System Warranty
1.7	Shall be having a 6 port module construction for better cable dressing at the rear
1.8	Shall have Comprehensive port numbering on front
1.9	Shall be suitable for loading unshielded & shielded jacks for different category systems (CAT 6 & CAT 6A)
1.10	Shall be certified by independent labs like ETL/UL etc.

1.5.3. CATEGORY 6 INFORMATION OUTLET (I/O)

SR.No	Minimum Specifications / Functionalities / Capabilities
	PCB based Information Outlet (I/O) RJ45, TIA-568C Category-6, Termination of Catergory-6 UTP Cable, UL listed
1	Minimum Specifications
1.1	Shall conform to Category-6 as per the EIA/TIA-568C.2
1.2	Shall support network line speeds up to 1 Gbps
1.3	Shall have RJ-45 type connector with strain relief for securing IDC contacts from external forces. Shall have a feature to maintain the bend radius of the cable while entering the jack.
1.4	Shall have minimum durability of 750 mating cycles and 200 termination cycles
1.5	Shall Snap into standard faceplates, surface-mount boxes, consolidation point boxes, and Modular Panels.
1.6	Shall be mountable either at 90 degrees (straight) or 45 degrees (angled) in any faceplate.
1.7	Shall be certified by independent labs like ETL/GHMT for compliance to EIA/TIA-568C.2, (Report required).
1.8	Shall be RoHS Compliant.

1.9	Shall have minimum 25-Year Extended Product Warranty and system warranty

1.5.4. FACE PLATE FOR INFORMATION OUTLET (SINGLE / DUAL)

SR. No	Minimum Specifications / Functionalities / Capabilities
	Faceplate Single/ Dual/ Quad Port (Work Area End)
1	Minimum Specifications
1.1	Shall be Single/ Dual/ Quad Port (RJ45) square plate, dimension as per commercially available modular office furniture.
1.2	Shall have spring shuttered front access for preventing ingress of dust
1.3	Shall be supplied with Gang Box of the same size by System Integrator or OEM
1.4	Shall have Write on labels in transparent plastic window along with the plate
1.5	Shall have Screw hole covers along with the plate
1.6	Shall be able to support variety of jacks – UTP and STP Information outlets

1.5.5. CATEGORY 6 PATCH CORD (3 FEET / 7 FEET)

SR. No	Minimum Specifications / Functionalities / Capabilities
	Cat 6 UTP LSZH Patch Cable (Patch cord) , TIA-568C Category-6, UL-listed
1	Minimum Specifications
1.1	Length shall be available in 1/2/3/5 meters or equivalent length in feet as per requirement considered in Estimate Proposal
1.2	All patch cords shall conform to Category 6 & conductor shall be stranded for better flexibility
1.3	Shall support network line speeds up to 1 Gbps
1.4	Shall have RJ-45 jacks with transparent plugs at both the ends
1.5	All patch cords shall be factory crimped and packed
1.6	Shall be RoHS Compliant
1.7	Shall have LSZH jacket for safety measures
1.8	Shall have a transparent / clear boot
1.9	Shall support applications such as 155 Mbps ATM, token ring & VOIP.
1.10	Shall have minimum 25-Year Extended Product Warranty and system warranty

1.5.6. FIBER OPTIC CABLE & COMPONENTS

SR. No	Generalize Specification for Single Mode Fiber Cable:
1	All Passive Components should be from the same OEM.
2	The cabling should be certified to have application support warranty for next 25 years.
3	The entire fiber component must support standard applications like 10BASE-X, 100BASE-X, 1000BASE-X, and 10GBASE-X.
4	Passive components should adhere to Standard and references like International Electro technical commission (IEC): 60793-1/60794-1-2 and ISO/IEC 11801:2002.
5	Fiber Optic Cable Single Mode 6 Core Outdoor Use
5.1	General Features
	Fiber cable should be Single Mode. Suitable for Outdoor area
	Should have excellent Water Proof Layer & Good Moisture Resistance.
	Central Unitube with jelly compound.
	Glass yarns in between Steel tape & Unitube.
	Fiber cable should support standard ITU-T: REC G.652D and Telecordia
5.2	Mechanical Characteristics
	Fiber cable outer diameter should be 4F to 12F 9 mm +- 0.3, 24F 15 mm +- 0.3
	Thickness of the Jacket should be 1.8mm +- 0.2.
	Should have 3000N/100mm Crush Load (IEC 60794-1-2-E3).
	Bend Radius (IEC 60794-1-2-E11 & E6) should be Short Term 20D in mm and Long Term 10D in mm.
	Proof Test - The entire fiber length is subjected to a tensile stress of 100Kpsi (0.7Gpa). This is equivalent to 1% strain.
5.3	Geometrical Properties
	Mode field diameter 9.2um ±0.4
	Clad Diameter 125um ±0.7
	Cladding Non-Circularity <=1.0%
	Mode field Concentricity Error <=0.8 um
	Coating Diameter 245 ±10 um
	Coating / Cladding Concentricity Error <=12.0 um
5.4	Chromatic Dispersion
	At 1285 - 1330nm should be <=3.5 ps/nm.km
	At 1270 - 1340nm should be <=5.3 ps/nm.km
	At 1550nm should be <=18.0 ps/nm.km
	Zero Dispersion Wavelength should be 1302nm to 1322nm
	Zero Dispersion Slope should be <=0.092 ps/nm2.km
5.5	Other Characteristics
	Maximum Attenuation at 1310nm should be <=0.36 dB/km.
	Maximum Attenuation at 1550nm should be <=0.22 dB/km.

	Maximum Attenuation between 1285-1330nm should be <=0.38 dB/km.
	Point discontinuity at 1310nm and 1550nm should be <=0.1dB.
	Maximum PMD at 1310nm and 1550 nm should be <=0.2 ps/sqrt km.
	Fiber cutoff wavelength should be 1160nm to 1320nm.
	Cabled Cutoff Wavelength should be <=1260 nm.
	Fiber curl should be at >=4.0 m.
	Macro bend loss should be <=0.5 dB at 32mm Mandrel Diameter, 1 turn and 1550nm wavelength.
	Macro bend loss should be <=0.05 dB at 50mm Mandrel Diameter, 100 turn and 1310nm wavelength.
	Coating Strip Force should be 1.3N to 5.0N.
	Dynamic Fatigue Typical should be >=20nd.
5.6	Environmental Characteristics
	Operating Temperature should be -20 dec C to +60 deg C.
	Storage Temperature should be -40 dec C to +60 deg C.
	Water Immersion (23 ± 2 deg C) Induced Attenuation should be <=0.05 dB/km.
	Heat Aging (85 ± 2 deg C) Induced Attenuation should be <=0.05 dB/km.

Fiber Optic Cable Single Mode 12 & 24 Core Outdoor Use - OS2	
Cable Type	12 & 24 core, Single Mode, Armored, Loose-tube, Gel filled (Multi tube construction - Minimum 6 Tubes Cable)
Fiber Type	Single Mode, 9 / 125, 250 micron primary coated buffers. UL Listed fiber
Fiber core must be	As per Telecordia GR20, ITU-T G652D, IEC- 60793-2-50, TIA/EIA 492-CAAB
No of cores	24 core - Raw fiber core make must be Corning - ISO 11801 - OS2
Armor	Corrugated Steel Tape Armor
Cable Construction Type	BELLCORE GR 20 / IEC 794-1 - Loose tube Corrugated steel tape (0.155mm Min)CSTA provided with FRP Rod as strength members
Outer Jacket Construction	High density polyethylene, anti - termite, anti - rodent suitable for direct burial application. Jacket must be UV Stabilized.
@ 1310nm	< = 0.35 dB/Km
@1500nm	< = 0.20 dB/Km
Max Tensile Load	>= 2670 N
Maximum Crush resistance	3000N
Operating Temperature	-40 deg C to +60 deg C
Test Parameters	Must pass the following : - IEC794-1-E1, IEC794-1-E2, IEC794-1-E3, IEC794-1-E4, EIA-455-104, IEC794-1-E7, IEC794-1-E10, IEC794-1-E11, IEC794-1-F5
Marking:	The cable has identification marking at regular intervals of 1 meter which will be of permanent nature. The accuracy of the sequential marking will be within +/- 0.5%.
Multi Channel requirement	The fiber cable must have been designed to provide optimum performance from 1265nm to 1625nm making it suitable for 16 – channel Course Wavelength Division Multiplexing (CDDM) applications.
Cable / Component	All fiber cables and components must be from one OEM/

12/24/48 PORT SINGLE MODE FIBER LIU

SR. No.	Fiber Optic Light Interface Unit 12/24/48 Port Rack Mount
1	LIU Features
	Fiber optic LIU should include with LIU Box itself, Adapter Panel and Adapters as per requirement.
	Have sufficient slots for accommodate Simplex/duplex 12/24/48 number LC adapters individually.
	Should be 1U 19 inch rack mountable.
	Aluminium base material for light mounting.
	Should have Splice Tray & Cable Spool provision inside LIU.
	Accessory kit consists of cable ties; mounting ear screw earthling and spiral wrap tube.
	Panel cover should be slide out for easy maintenance.
	Removable Rear & Front cover for better access to interior of LIU.
	Should have Rubber fiber slotted bracket built-in, metal splice shelf to protect the fibers.
	Should capable of storing up to 3 meters of 900 µm tight buffered fiber per adapter.
2	Adapter Plate Features
	Plate made from Cold rolled steel materials.
	Suitable for LC adapters
3	Adapter Features
	All LC adaptors should be Simplex/Duplex type. Adapters should have compact design & high precision, which perform well under various circumstances & maintain good plug retention strength.
	Should have Telcordia, TIA/EIA and IEC compliance.
	The sleeves are basically recommended zirconia split type, the phosphor bronze split
	Insertion Loss should be ≤ 0.20dB for Zirconia Sleeve
	Sleeve/Ferrule Withdrawal Force should be 2.0N ~ 5.9N for SC/1.0N ~ 2.5N

FIBER OPTIC PATCH CABLE (LC-LC)

SR. No.	Fiber Optic Duplex Patch Cord LC-LC with 3 Meter Length
1	Features
	Fiber optic patch cord with two core fiber cable terminated with SC/LC connector at one end and LC connector at other end.
	The terminated connectors in assemblies are designed to and are compatible with industry standards (EIA/TIA, IEC, ANSI, NTT and Telcordia).
	Should have good geometrical characteristics of apex offset & radius of curvature & fiber height.

	Should be 100% inspected for optical characteristics & fiber end face finish.
	Patch cord length requires – 3 meters Duplex.
2	Performance Characteristics
	Should have Corning single-mode G652D, G657A, G657B optic fiber.
	Typical Insertion Loss should be ≤0.2dB, Max. 0.3dB.
	Return Loss should be PC≥45dB, UPC≥50 dB, APC≥60dB
3	Mechanical Characteristics
	Should have Ceramic Connector Ferrule.
	Apex Offset should be <50um.
	Fiber height should be ±100nm.
	Repeatability should be ≤0.2dB, 1,000 times mating cycles.
	Working Temperature should be -40 degree Celsius to + 85degree Celsius.

Fiber Optic Simplex Pigtail LC with 1.5/ 2 Meter Length

SR. No.	Pigtail LC with 1.5/ 2 Meter Length
	Fiber Optic Simplex Pigtail LC With 1.5/ 2 Meter Length
1	Features
	Fiber optic patch cord with one core fiber cable terminated with LC connector at one end and open at other end.
	The terminated connectors in assemblies are designed to and are compatible with industry standards (EIA/TIA, IEC, ANSI, NTT and Telcordia).
	Should have good geometrical characteristics of apex offset & radius of curvature & fiber height.
	Should be 100% inspected for optical characteristics & fiber end face finish.
	Pigtail length requires – 2 meter Simplex.
2	Performance Characteristics
	Should have Corning single-mode G652D, G657A, G657B optic fiber.
	Typical Insertion Loss should be ≤0.2dB, Max. 0.3dB.
	Return Loss should be PC≥45dB, UPC≥50 dB, APC≥60dB
3	Mechanical Characteristics
	Should have Ceramic Connector Ferrule.
	Apex Offset should be <50um.
	Fiber height should be ±100nm.
	Repeatability should be ≤0.2dB, 1,000 times mating cycles.
	Working Temperature should be -40 degree celcius to + 85degree celcius.

ALL FIBER NETWORKING COMPONENTS MUST BE FROM A SINGLE MANUFACTURER.

MANUFACTURER SHALL WARRANT THE COMPONENTS AND INSTALLATION FOR A PERIOD OF 15 YEARS WITH TEST RESULTS.

THE MANUFACTURER SHALL HAVE ELABORATE PRODUCT & INSTALLATION SUPPORT SYSTEM WITH TOLL-FREE TELEPHONE CONTACT NUMBERS AVAILABLE 24 X 7.

1.5.7 19" FLOOR STANDING NETWORKING ENCLOSURES (22U TO 42U USABLE HEIGHTS)

- Construction shall be high strength robust aluminium extruded frame structure with ventilation slots on the sides and top & bottom covers with provision to mount 4 fans on top cover (The Vertical Profiles which forms the frame of the racks are extruded Aluminium type).
- The Other parts / components except the Vertical Profiles are made of CRCA Steel.
- CRCA steel used is "IS 513 Gr D" standard
- The Thickness of the CRCA sheets used for Doors is 1.2mm and foe Side Panels is 1mm.
- Fully adjustable 19" equipment mounting angles
- The cabinet shall be made of high impact CRCA steel as per IS 513 Gr D standard and design confirming to DIN 41494 or EIA 310D standards.
- Top/ Bottom Covers and Side panels shall be of sheet steel and powder coated
- Vertical 19" metric panel mounts and door trims shall be of sheet steel and powder coated
- The top and bottom covers shall be provided with number of 50mm and 75mm round cable knockouts for cable entry and cable knockouts shall be edge protected with rubber grommets.
- Perforation - for full / split perforated doors the style should be " Honeycomb" type of perforation for maximum air circulation and stiffness .The perforation area should be 70% of the total door area.
- Cabinet can be capable of dismantling and reassemble at the site.
- Locks Options – options shall be available such as slam lock - common key or unique key, Swing handle lock, Digital Keypad operated locks, Biometric locks.
- Side Panels – must contain slam latches for locking purpose and option of providing slam locks, if required.
- Two pairs of 19" Equipment mounting angles with mounting holes conforming to IEC 2973
- Front Glass door made of toughened glass, tinted with easily detachable hinges.
- Two Pair of slotted vertical cable channel shall be provided at front and back for managing cables
- Lockable industrial grade castors with foot brakes
- Rack shall be supplied with 4 x 90 CFM fans at top, or optionally 250cfm
- Rack shall be supplied with equipment mounting hardware in pack of 100s such as mounting nuts and screws either 12-24 or M6 type as applicable

- Minimum 2 nos. of 8 x 5/15 Amps power supply sockets, 2 nos. of vertical cable managers and 2 no. of 19" 1U size horizontal cable managers.
- Finish – cabinet shall be black or grey epoxy powder-coated of durable quality. The Powder coating of the racks is as per Nano Technology process with "Zirconium Coating".
- Load carrying capacity – between 500 – 750 kg
- Product must be UL listed and certified for use in Information Technology or Communication Equipment
- Manufacturer must be at ISO standard plants/facility.
- Environmental safety – the rack must be RoHS compliant.
- EIA standard pattern design with 12-24 tapped holes (EIA-310-E compliant) or EIA standard pattern design with 3/8' (9.5mm) square punches for Cage Nuts for mounting
- Dimensions – at least 42U usable height, 800mmW x 1000mmD or 1000mmW x 1000mmD
- Powder Coating –
  - Powder Coating min 80 Microns with scratch resistance properties.
  - Rack to be powder coated with Nano ceramic pre-treatment process using a zirconium coat
  - The Powder coating process should be ROHS compliant
  - Powder coating thickness shall be 80 to 100 microns
- The Metal Enclosures/Racks must have unit prices for its individual knocked down items such as - 42U x 800mmW x 1000mmD main frame, glass front door, perforated/vented steel rear door, vented side panels (2), 4 x 90cfm fans tray and fans, 8x5A/15A power strip, 1U Cable Manager, Sliding Shelf, Rotating Shelf, Cantilever Shelf, Heavy Duty Stationery Shelf, Castors, Vertical manager/runner, hardware and any other such accessory. It must be possible to configure the enclosure as per specific needs for a customized installation for every rack.

1.5.8 19" FLOOR STANDING NETWORKING ENCLOSURES (15U USABLE HEIGHTS)

- Floor/Pole /Wall Mount single section 15U 600W*600D
- Should have Minimum 2 Nos. 230v AC Fans 90 CFM
- Should have Minimum 1 Nos. A/C Box 6 Socket 5/15-amp metal
- Should have Minimum 1 Nos. Cable Manager Metal (1U)
- Should have Carbon steel base material for housing.
- Should have Housing with hinged door, Flange plate with brush strip for cable entry in the enclosure base, Profile rails, 482.6 mm (19"), fully depth adjustable, C rail, for cable clamping on the rear panel, Minimum 2nos. of Cam lock with minimum 3 mm double-bit insert
- Should have Protection category IP55 to IEC 60 529

1. ACTIVE COMPONENTS - NETWORKING SWITCH SPECIFICATIONS

DESCRIPTION & DESIGN

- It is a high-performance networking design keeping in mind real time applications and reliability.
- Key considerations for network are - gigabit connectivity to each user from the server room to various users/departments/devices in a topology consisting of a central switch followed by the distribution and edge/access switches.
- The network shall have a mix of components for supporting PoE+ as well as non-PoE devices.
- A robust fiber optics-based backbone is being provided. It shall be based on ring topology using single mode fiber optics cable. The vendor shall ensure that the networking switches shall be populated with the necessary transceivers for achieving this design objective.
- Several applications are proposed to run on this network – IP-based voice communications supporting voice-data-video, network-based cameras and storage, integrated audio-video, video conferencing, interactive learning, integrated building management systems and important services integration such as fire detection.
- All Switches and Wireless Access Points be from same OEM.
- All Wireless Access Points asked in RFP should be fully compatible to existing Wireless LAN Controllers.
- All Switches asked in RFP should be fully compatible with existing switches.
- All Switches, Wireless Access Points and Existing Wireless LAN Controllers should have capability to manage, configure and troubleshoot from existing Network management system with a single pane of glass.
- All SFP and SFP+ should be from same OEM as of switches.
- OEM for equipment like Switches and Wireless Access Points should be listed in the leader's quadrant of the Gartner Magic Quadrant.

1.1. TYPE-1 SWITCH (DISTRIBUTION SWITCH)

LAYER 3- 24 Ports SFP+

1	Type	Enterprise Grade, Fully Manageable, Layer-3, Gigabit Ethernet Stackable Switch
2	Application	Core Switch- Primarily providing network connectivity to Aggregation Switches (Layer 3), Servers and Storage Devices etc.for IP CCTV system. The connectivity between aggregation switch and core switches will be done using 10Gbps single mode fiber modules
3	Power	The switches should have dual AC power supply input for redundancy
4	Port Density	Each Layer 3 switch should have 24 No. SFP+ slots loaded with required number of 1Gbps or 10Gbps Copper/ Fiber modules to connect servers, storage, workstation and Aggregation switches. Each Core switch will be connected to the Aggregation stack switch via 10G single mode fiber modules In addition to the above indicated 24 ports, each Layer 3 switch should have minimum160Gbps or higher stacking bandwidth
		SFP+ slots should support any combination of 10BASE-T,10GBASE-SR,10GBASE-LR SFP+ modules and 1000BASE-T,1000SX, 1000LX SFP modules.
		Should support Active - Active connection of 2 or more switches or equivalent technology for high availability and quick resiliency. The proposed Active-Active Connection or Equivalent technology should support high availability for IP Multicasting optimised for Real time applications like Voice and Video IP traffic
		The proposed Active - Active technology shall support Link Aggregation between connected members such as Servers,Switches for high reliability
5	Software Requirement	The switches should be loaded with required operating system software and any other software to comply with the functional requirement of the offered Video management system
6	SDN Support	Should support Open flow v1.3 or better
7	Performance Features	All the interfaces ports should be wire speed and non-blocking
		Supports 9KB Jumbo frame size
		Up to 64K MAC addresses
		Should support IPv4 and IPv6 routes
		VLAN support
		IEEE 802.1Q Virtual LANs
		IEEE 802.3ac VLAN tagging
8	Resiliency	Link Aggregation (802.3ad LACP)
		IEEE 802.1D Spanning Tree Protocol (STP) - MAC Bridges
		IEEE 802.1s Multiple Spanning Tree Protocol (MSTP)
		IEEE 802.1w - 2001 Rapid Spanning Tree Protocol (RSTP)

9	Security	The system should be secured in such a manner that only authorized user shall be able to access the system. The following minimum features should be provided. The additional security features shall be provided at no extra cost whenever required in future to protect the system from unauthorized access etc. and also the rate shall include for up gradation of security features.
		Private VLANs providing security and port isolation
		Dynamic VLAN assignment
		802.1x support
		ACLs -Access Control Lists to specify which users or system processes are granted access to objects, as well as what operations are allowed on given objects
		Bridge Protocol Data Unit (BPDU) Protection to detect loops in a network topology
		IEEE 802.1x Port Based Network Access Control
		IEEE 802.1x Authentication protocols
		IEEE 802.1x Multi Supplicant authentication
		MAC-based authentication
		Port Security
		Secure Shell (SSH) Remote Login to securely log onto remote systems
		Secure Socket Layer (SSLv3) to provide communication security over the Internet
		Web-based Authentication for authorized access
		RFC 2246 TLS Protocol v1.0
		RFC 2865 RADIUS
		RFC 2866 RADIUS Accounting
		RFC 3546 Transport Layer Security (TLS) Extensions
		RFC 3748 PPP Extensible Authentication Protocol (EAP)
		The switch should have DHCP snooping feature
		The switch should have security against Denial of Service (DoS) attack
10	Quality of Service	Highly configurable traffic classification
		IEEE 802.1p- Priority Tagging
		TCP-IP bandwidth limiting performance and bandwidth resolution down to 64Kbps
		DiffServ Code Point field (DSCP) classification via marking and reclassification on a per packet basis using source/destination IP address, source/destination MAC address, or Layer 4 TCP/UDP port number.
11	IPv6 Features	IPv4 and IPv6 Dual Stack
		IPv6 routing support in hardware for maximum performance.
12	General Routing	ECMP Equal Cost Multi Path routing
		RFC 768 User Datagram Protocol (UDP)
		RFC 791 Internet Protocol (IP)
		RFC 792 Internet Control Message Protocol (ICMP)
		RFC 793 Transmission Control Protocol (TCP)
		Route Maps
		RFC 1058 Routing Information Protocol (RIP)
		RFC 2082 RIP-2 MD5 Authentication

		RFC 2453 RIPv2
13	Multicast Support	IGMP query solicitation
		IGMP snooping (IGMPv1, v2 and v3)
		IGMP snooping fast-leave
		MLD snooping (MLDv1 and v2)
14	Management Features	Management using Network Management Server
		Console management port
		Auto-configuration of new stack units
		Dynamic Host Configuration Protocol (DHCP)
		Simple Network Management Protocol (SNMP) Version 1 and Version 2c and ver3 with Telnet support
		Provide configuration of end-to-end QoS policies through GUI tool
		Should provide for IGMP snooping for fast client joins and leaves of multicast streams
		Built in Web based management support
		An External memory card like SD/USB or network-based arrangement, allowing switch firmware, configurations to be stored for backup and distribution to other switches
		Port mirroring
		SSH and SNMPv3 for secure management
		RADIUS Authentication
		RMON (4 groups)
		SNMP Traps
		RFC 1157 Simple Network Management Protocol (SNMP)
		RFC 1212 Concise MIB definitions
		RFC 2574 User-based Security Model (USM) for SNMPv3
		RFC 2575 View-based Access Control Model (VACM) for SNMP
		RFC 2741 Agent Extensibility (AgentX) Protocol
		RFC 3164 Syslog Protocol
15	Diagnostic Tools	BIST (Built-In Self-test)
		SSH (secure Shell)
		RFC 3176 sFlow
		Port Mirroring
		Telnet
		User Interface & administrator Features
		Industry-standard CLI with built-in Help
		Built-in text editor
16	Standards to comply	IEEE 802.3, IEEE802.3u,IEEE 802.3AB,IEEE 802.3z,IEEE 802.3x,IEEE 802.3ad,IEEE 802.1d,IEEE 802.1p,IEEE 802.1Q,IEEE 802.1x
17	Operating Temperature/ humidity	0°C to 45°C 5% to 95% non-condensing
18	Safety	UL60950-1, CAN/CSA-C22.2 No.
		60950-1-03, EN60950-1, EN60825-1,
		AS/NZS 60950-1
1	Electro	EN55022 Class A

9	Magnetic Certificates	FCC class A, VCCI class A,
		ICES003 class A
		EN55024
		EN61000-3-levels 2 and 3
20	Test reports	All Ethernet switches shall be based on IEEE protocols. Optical modules (part of ethernet switch) shall be of same make as ethernet switch. Test reports for the Ethernet switches, uplink/optical modules shall be provided at the time of delivery.

1.2. TYPE-2 EDGE SWITCH (ACCESS SWITCH)

Fully Managed L2- 24 Ports PoE/PoE+ with 2xSFP+ Uplinks Ports

S/N	Performance Specification / Parameter
1	General Hardware and Interface requirements
1.1	Switch shall have minimum 24 nos. 10/100/1000 Base-T ports with PoE+ capability and minimum 370W of PoE Power and additional 2 nos. SFP + uplink ports.
1.2	Switch shall dedicated slots/ports for minimum 48 Gbps of stacking bandwidth with dedicated stacking ports and cables with minimum 8 switch in stack.
1.3	Switch should support internal/external redundant power supply.
2	Performance Requirements
2.1	Shall have minimum 88 Gbps of switching fabric and 65 Mpps of forwarding rate.
2.2	Shall have minimum 12K MAC Addresses.
2.3	Shall have minimum 1K Active VLANs.
2.4	Shall have minimum 1K IPv4 and IPv6 multicast groups.
2.5	Shall have minimum 1K IPv4 and IPv6 QoS and Security ACLs.
3	IEEE Standards
3.1	Should support IEEE Standards of Ethernet: IEEE 802.1D, 802.1s, 802.1w, 802.1x, 802.3ad, 802.3x, 802.1p, 802.1Q, 802.3, 802.3u, 802.3ab, 802.3z, 802.3az, 802.3af, 802.3at.
4	Quality of Service (QoS) requirements
4.1	Switch shall have 802.1p class of service, IP differentiated service code point (DSCP) and cross stack QoS.
4.2	Switch shall have committed information rate, rate limiting and flow based rate limiting.
4.3	Switch shall have minimum 8 egress queues per port and strict priority queuing.
5.	System Management and Administration
5.1	Switch should support SSHv2, SNMPv2c, SNMPv3, NTPv3 and NTPv4.
5.2	Switch should support AAA using RADIUS and TACACS+.

5.3	Switch should support port security, DHCP snooping, Dynamic ARP inspection, IP Source guard, BPDU Guard, Spanning tree root guard and IPv6 First Hop Security.
5.4	Switch should support software upgrades via TFTP or FTP.
5.5	Should support 802.1x authentication and accounting with Dynamic VLAN assignment.
5.6	Switch should support IPv4 and IPv6 ACLs, VLAN , Port and Time based access list with time ranges.
5.7	Switch Shall have Switch Port Analyzer (SPAN) and Remote Switch Port Analyzer (RSPAN) .
5.8	Switch shall have secure VTP with MD5 protocol or equivalent secure protocol to reduce administrative burden of configuring VLANs on multiple switches in turn eliminating the configuration errors & troubleshooting in secure manner.
5.9	Switch shall have Layer 2 trace route for ease of troubleshooting by identifying the physical path that a packet takes from source to destination.
5.10	Switch shall have Internet Group Management Protocol (IGMP) Snooping for Ipv4 and Ipv6, MLD v1 and v2 Snooping and Multicast VLAN Registration protocol.
5.11	Swich shall have per port broadcast, multicast and unicast storm control.
5.12	Switch shall have Unidirectional Link Detection Protocol (UDLD), Aggressive UDLD, Link Aggregation Control Protocol (LACP), Port Aggregation Protocol (PagP) and Dynamic Trunking Protocol (DTP).
5.13	Switch shall have Time Domain Reflector (TDR) feature to diagnose and resolve cabling problems.
5.14	Switch should be Software Defined Networking Ready with Openflow protocol support.
6	**Regulatory Compliance**
6.1	Switch shall conform to UL 60950 or IEC 60950 or CSA 60950 or EN 60950 Standards for Safety requirements of Information Technology Equipment.
6.2	Switch shall conform to EN 55022 Class A/B or CISPR22 Class A/B or CE Class A/B or FCC Class A/B Standards for EMC (Electro Magnetic Compatibility) requirements.
7	**Evaluation Compliance**
7.1	Switch / Switch's Operating System should be tested and certified for EAL 2/NDPP or above under Common Criteria Certification.
7.2	Switch should be IPv6 Certified/IPv6 logo ready.

1.3. TYPE-3 EDGE SWITCH (ACCESS SWITCH)

Fully Managed L2- 24 Ports with 2xSFP+ Uplinks Ports

S/N	Performance Specification / Parameter
1	General Hardware and Interface requirements
1.1	Switch shall have minimum 24 nos. 10/100/1000 Base-T ports and additional 2 nos. SFP + uplink ports.
1.2	Switch shall dedicated slots/ports for minimum 48 Gbps of stacking bandwidth with dedicated stacking ports and cables with minimum 8 switch in stack.
1.3	Switch should support internal/external redundant power supply.
2	
2.1	Shall have minimum 88 Gbps of switching fabric and 65 Mpps of forwarding rate.
2.2	Shall have minimum 12K MAC Addresses.
2.3	Shall have minimum 1K Active VLANs.
2.4	Shall have minimum 1K IPv4 and IPv6 multicast groups.
2.5	Shall have minimum 1K IPv4 and IPv6 QoS and Security ACLs.
3	
3.1	Should support IEEE Standards of Ethernet: IEEE 802.1D, 802.1s, 802.1w, 802.1x, 802.3ad, 802.3x, 802.1p, 802.1Q, 802.3, 802.3u, 802.3ab, 802.3z, 802.3az.
4	
4.1	Switch shall have 802.1p class of service, IP differentiated service code point (DSCP) and cross stack QoS.
4.2	Switch shall have committed information rate, rate limiting and flow based rate limiting.
4.3	Switch shall have minimum 8 egress queues per port and strict priority queuing.
5.	n
5.1	Switch should support SSHv2, SNMPv2c, SNMPv3, NTPv3 and NTPv4.
5.2	Switch should support AAA using RADIUS and TACACS+.
5.3	Switch should support port security, DHCP snooping, Dynamic ARP inspection, IP Source guard, BPDU Guard, Spanning tree root guard and IPv6 First Hop Security.
5.4	Switch should support software upgrades via TFTP or FTP.
5.5	Should support 802.1x authentication and accounting with Dynamic VLAN assignment.
5.6	Switch should support IPv4 and IPv6 ACLs, VLAN , Port and Time based access list with time ranges.
5.7	Switch Shall have Switch Port Analyzer (SPAN) and Remote Switch Port Analyzer (RSPAN) .
5.8	Switch shall have secure VTP with MD5 protocol or equivalent secure protocol to reduce administrative burden of configuring VLANs on multiple switches in turn eliminating the configuration errors & troubleshooting in secure manner.

5.9	Switch shall have Layer 2 trace route for ease of troubleshooting by identifying the physical path that a packet takes from source to destination.
5.10	Switch shall have Internet Group Management Protocol (IGMP) Snooping for Ipv4 and Ipv6, MLD v1 and v2 Snooping and Multicast VLAN Registration protocol.
5.11	Swich shall have per port broadcast, multicast and unicast storm control.
5.12	Switch shall have Unidirectional Link Detection Protocol (UDLD), Aggressive UDLD, Link Aggregation Control Protocol (LACP), Port Aggregation Protocol (PagP) and Dynamic Trunking Protocol (DTP).
5.13	Switch shall have Time Domain Reflector (TDR) feature to diagnose and resolve cabling problems.
5.14	Switch should be Software Defined Networking Ready with Openflow protocol support.
6	**Regulatory Compliance**
6.1	Switch shall conform to UL 60950 or IEC 60950 or CSA 60950 or EN 60950 Standards for Safety requirements of Information Technology Equipment.
6.2	Switch shall conform to EN 55022 Class A/B or CISPR22 Class A/B or CE Class A/B or FCC Class A/B Standards for EMC (Electro Magnetic Compatibility) requirements.
7	**Evaluation Compliance**
7.1	Switch / Switch's Operating System should be tested and certified for EAL 2/NDPP or above under Common Criteria Certification.
7.2	Switch should be IPv6 Certified/IPv6 logo ready.

1.4. TYPE-4 EDGE SWITCH (ACCESS SWITCH)

L2 48 Port 1000base-Tx, PoE+, 2 SFP+ Ports

Switch Architecture

- Switch should be standard 19" width rack mountable switch
- The Switch shall be designed for continuous operations. The bidder shall furnish the MTBF (Mean Time Between Failures) values along with calculations by the manufacturer.
- In case of full system failure, Switch shall maintain a trace area in the NVRAM / Flash which would be used for analysis / diagnosis of the problem.
- Switch shall have built in power-on diagnostics system to detect hardware failures
- Switch shall have suitable Visual Indicators for diagnostics and healthy / unhealthy status of Ports & modules.
- The switch should have 48 X 10/100/1000 Base-T ports and all ports shall be PoE+ capable of minimum 740W power budget.
- The switch ports should also be 802.3af-compliant PoE ports.
- Switch should have 48 Nos. 10 Base-T/100Base-Tx/1000Base-T auto-sensing ports complying to IEEE 802.3, IEEE 802.3at, IEEE 802.3u and 802.3ab standard, supporting half duplex mode, full duplex mode and auto-negotiation on each port.
- Switch should have minimum 2 SFP+ uplinks ports complying to IEEE standards which should support 10GBase-SR, LRM, LR/LW& Base-X SFP+ cables.
- The switching fabric for all the LAN ports shall be non-blocking and each port shall run at wire-speed / line-rate. Switching fabric capacity of the switch should be capable to run all the ports at line-rate.
- Switch should be provided with dedicated stacking ports with minimum of 40Gbps of stacking bandwidth, no additional hardware should be required to use stacking.
- Switch should be provided with stacking cable.

- Switch should support auto switch replacement in an existing stack with the new switch without any configuration for joining the stack.
- Switch should support link aggregation across multiple switches in a stack.
- Switch should support both IPv4 and IPv6 – Switch should support features like Neighbour Discovery, Syslog, Telnet, SSH, Web GUI, SNMP, NTP, DNS, RADIUS overIPv6.
- Switch should have non-blocking switching fabric of minimum 88 Gbps or more.
- Switch should have Forwarding rate of minimum 65 million packets per second.
- Type-1, Type-2, Type-3 and Type-4 switches must be stackable together.
- Switch should be IPv6 Ready from day 1.

Layer 2 Features

- IEEE 802.1Q VLAN tagging
- 802. 1Q VLAN on all ports with support for minimum 1024 VLANs.
- Support for minimum 8k MAC addresses.
- Spanning Tree Protocol as per IEEE 802.1d.
- Multiple Spanning-Tree Protocol as per IEEE 802.1s.
- Rapid Spanning-Tree Protocol as per IEEE 802.1w.
- Self-learning of unicast & multicast MAC addresses per switch port.
- Jumbo frames up to 9000 bytes.
- Link Aggregation Control Protocol (LACP) as per IEEE 802.3ad.

Quality of Service (QOS) Features

- Switch should support classification and scheduling as per IEEE 802.1P on all ports.
- Switch should support DiffServ as per RFC 2474/RFC 2475.
- Switch should support eight hardware queues per port.
- Switch should support QoS configuration on per switch port basis.
- Switch should support classification and marking based on IP Type of Service (TOS)and DSCP.
- Switch should provide traffic shaping and rate limiting features (for egress as well as ingress traffic) for specified Host and network etc.

Security Features

- Switch should support MAC Address based Filters / Access Control Lists (ACLs) on all switch ports.
- Switch should support Port based Filters / ACLs.
- Switch should support RADIUS and TACACS+ for access restriction and authentication.
- Secure Shell (SSH) Protocol, HTTP and DoS protection.
- ARP spoofing, DHCP snooping etc.
- Switch should support static ARP, Proxy ARP, UDP forwarding and IP source guard.

Management Features

- The switch should support Web-based Management
- Switch should be SNMP manageable with support for SNMP Version 1, 2 and 3.
- Switch should support all the standard MIBs (MIB-I & II).
- Switch should support TELNET and SSH Version-2 for Command Line Management.
- Switch should support 4 groups of embedded RMON (history, statistics, alarm and events).
- Switch should support System & Event logging functions as well as forwarding of these logs to multiple syslog servers.
- Switch should support online software reconfiguration to implement changes without rebooting. Any changes in the configuration of switches related to Layer 2 and 3 functions, VLAN, STP, Security and QoS should not require rebooting of the switch.

- Switch should have comprehensive debugging features required for software & hardware fault diagnosis.
- Switch should support multiple privilege levels to provide different levels of access.
- Switch should support SNTP (Network Time Protocol)
- Switch should support FTP/TFTP for software upgrade
- Switch support multiple configuration file & backup configuration file

Environmental Ranges

- Operating temperature: 0° to 40° C
- Storage temperature: -25° to 70° C)
- Relative humidity operating: 10% to 85% (non-condensing).

Certifications

- CISPR22 International EMC Emissions.
- EN55022:2006 European EMC Emissions (CE).
- EN61000
- EN300 386

1.5. TYPE-5 EDGE SWITCH (ACCESS SWITCH)

L2- 48 Ports with 2xSFP+ Uplinks Ports

Switch Architecture

- Switch should be standard 19" width rack mountable switch
- The Switch shall be designed for continuous operations. The bidder shall furnish the MTBF (Mean Time Between Failures) values along with calculations by the manufacturer.
- In case of full system failure, Switch shall maintain a trace area in the NVRAM / Flash which would be used for analysis / diagnosis of the problem.
- Switch shall have built in power-on diagnostics system to detect hardware failures
- Switch shall have suitable Visual Indicators for diagnostics and healthy / unhealthy status of Ports & modules.
- Switch should have 48 Nos. 10 Base-T/100Base-Tx/1000Base-T auto-sensing ports complying to IEEE 802.3,IEEE 802.3u and 802.3ab standard, supporting half duplex mode, full duplex mode and auto-negotiation on each port.
- Switch should have minimum 2 SFP+ uplinks ports complying to IEEE standards which should support 10GBase-SR, LRM, LR/LW& Base-X SFP+ cables.
- The switching fabric for all the LAN ports shall be non-blocking and each port shall run at wire-speed / line-rate. Switching fabric capacity of the switch should be capable to run all the ports at line-rate.
- Switch should be provided with dedicated stacking ports with minimum of 40Gbps of stacking bandwidth, no additional hardware should be required to use stacking.
- Switch should be provided with stacking cable.
- Switch should support auto switch replacement in an existing stack with the new switch without any configuration for joining the stack.
- Switch should support link aggregation across multiple switches in a stack.
- Switch should support both IPv4 and IPv6 – Switch should support features like Neighbour Discovery, Syslog, Telnet, SSH, Web GUI, SNMP, NTP, DNS, RADIUS overIPv6.
- Switch should have non-blocking switching fabric of minimum 88 Gbps or more.
- Switch should have Forwarding rate of minimum 65 million packets per second.
- Type-1, Type-2, Type-3 and Type-4 switches must be stackable together.
- Switch should be IPv6 Ready from day 1.

Layer 2 Features

- IEEE 802.1Q VLAN tagging
- 802. 1Q VLAN on all ports with support for minimum 1024 VLANs.
- Support for minimum 8k MAC addresses.
- Spanning Tree Protocol as per IEEE 802.1d.
- Multiple Spanning-Tree Protocol as per IEEE 802.1s.
- Rapid Spanning-Tree Protocol as per IEEE 802.1w.
- Self-learning of unicast & multicast MAC addresses per switch port.
- Jumbo frames up to 9000 bytes.
- Link Aggregation Control Protocol (LACP) as per IEEE 802.3ad.

QOS Features

- Switch should support classification and scheduling as per IEEE 802.1P on all ports.
- Switch should support DiffServ as per RFC 2474/RFC 2475.
- Switch should support eight hardware queues per port.
- Switch should support QoS configuration on per switch port basis.
- Switch should support classification and marking based on IP Type of Service (TOS)and DSCP.
- Switch should provide traffic shaping and rate limiting features (for egress as well as ingress traffic) for specified Host and network etc.

Management Features

- The switch should support Web-based Management
- Switch should be SNMP manageable with support for SNMP Version 1, 2 and 3.
- Switch should support all the standard MIBs (MIB-I & II).
- Switch should support TELNET and SSH Version-2 for Command Line Management.
- Switch should support 4 groups of embedded RMON (history, statistics, alarm and events).
- Switch should support System & Event logging functions as well as forwarding of these logs to multiple syslog servers.
- Switch should support online software reconfiguration to implement changes without rebooting. Any changes in the configuration of switches related to Layer 2 and 3functions, VLAN, STP, Security and QoS should not require rebooting of the switch.
- Switch should have comprehensive debugging features required for software &hardware fault diagnosis.
- Switch should support multiple privilege levels to provide different levels of access.
- Switch should support SNTP (Network Time Protocol)
- Switch should support FTP/TFTP for software upgrade
- Switch support multiple configuration file & backup configuration file

Environmental Ranges

- Operating temperature: 0° to 40° C
- Storage temperature: -25° to 70° C)
- Relative humidity operating: 10% to 85% (non-condensing)

Certifications

- CISPR22 International EMC Emissions
- EN55022:2006 European EMC Emissions (CE)
- EN61000
- EN300 386

1.6. Stacking Module for Layer 2 Switches

S/N	Performance Specification / Parameter	Compliance (Yes/No)

1	General Hardware and Interface requirements	
1.1	Should have 2 dedicated staking ports.	
1.2	Should have minimum 48 Gbps of stacking capability with each stacking port.	
1.3	Should have dedicated stacking cables.	
1.4	Should be from same OEM of access switches.	

1.7. 10 Gig SFP Modules (SMF)

S/N	Performance Specification / Parameter	Compliance (Yes/No)
1	General Hardware and Interface requirements	
1.1	Connector types LC	
1.2	10G Base-LR	
1.3	Support 10 Gbps upto 10 KM on SMF	
1.4	Should be from same OEM of switches.	

1.8. 1 Gig SFP Modules (SMF)

S/N	Performance Specification / Parameter	Compliance (Yes/No)
1	General Hardware and Interface requirements	
1.1	Connector types LC	
1.2	1000 Base-X	
1.3	Support 1 Gbps upto 10 KM on SMF	
1.4	Should be from same OEM of switches.	

1.9. WIRELESS LAN INFRASTRUCTURE (CONTROLLER AND ACCESS POINT)

ARCHITECTURE

- Wireless deployment shall be on centralized controller-based architecture in High Availability mode providing seamless scalability
- The architecture should have minimum 50 access point licence and scalable up to 128 APs in the campus
- Redundancy should be built in the architecture, i.e., 1+1 configuration
- IEEE 802.1x with multiple EAP types (TLS or EAP/MSCHAP or TTLS or equivalent)
- Wireless system should support IPv6 from Day 1
- Radio assurance for radio self-test and healing
- Increase available 2.4 and 5GHz wireless device density through management of spurious association traffic
- IEEE 802.1q – VLAN Tagging
- IEEE 802.1d – Spanning Tree
- IEEE 802.1p – Layer 2 Traffic Prioritization
- IPv6 Control – Increase wireless device density through control of unnecessary IPv6

traffic on IPv4-only networks

WIRELESS CONTROLLER

- The controller shall have two 10Gb ports
- The controller shall have 256 access point license installed from day 1.
- The controller shall support 512 access points without hardware change
- Shall support 10,000 users from day one
- Shall support 1+1 ,N+1 ,N+N redundancy models

WLAN controller management features

- Shall support spectrum analysis from day one - to detect and mitigate non Wi-Fi interference
- Shall support band navigation to enables redirection of 5Ghz clients to 5Ghz radio
- Shall support VLAN pooling which ensures dynamic assignment of VLANs to same SSID. VLAN pool shall be associated with multiple SSIDs
- Shall support policy-based forwarding. Traffic shall be forwarded to centrally and local switched based on the L3 & L4 ACLs
- Shall support AP grouping to enables an admin to easily apply AP-based or radio based configurations to all the AP that are in the same group

WLAN controller security features

- Shall support integrated system of detection for wireless intrusion from day one which protects against honeypot attacks and enforces STA security and DoS attacks protection
- Controller shall have a functionality to verify whether Client's IP address must be dynamically allocated and shall automatically block manually assigned IP address in both centralized and distributed WLAN architecture

WLAN controller performance features

- Shall support layer 3 roaming and fast roaming
- Shall support airtime fairness
- Shall support client load balancing based on sessions and traffic load
- Shall support bandwidth limiting per SSID

1.10. Wireless Access Point (Indoor)

S/N	Performance Specification / Parameter
1	Access Points proposed must include radios for 2.4 GHz and 5 GHz with 802.11ac Wave 2 with ceiling mount options.
2	Access point must support flexible Dynamic Frequency Selection across 20Mhz, 40Mhz, 80MHz and 160Mhz wide channels to combat performance problems due to wireless interference. And when radar is detected, it should able to identify the exact 20 Mhz channel & should able to block that channel only
3	Access point must have an additional USB port for future use.
4	Access point should have 2x10/100/1000 Ethernet and serial/console port.
5	Must support 3X3:3 multiple-input multiple-output (MIMO) and three spatial stream.
6	Must support the physical rate of 1.3 Gbps on 5GHz radios.

7	The access point should have a capability to enable both the radios on 5Ghz for serving the client thereby increasing the bandwidth capacity to 5.2 Gbps per access point.
8	Must support minimum of 23dbm of transmit power on both 2.4 Ghz & 5GHz Radio.
9	The AP must be capable of optimizing the SNR exactly at the position where 802.11a/g/n/ac client is placed (beamforming) without requiring any support or feedback from clients, hence it should work with all 802.11a/g/n/ac clients.
10	Should have detecting and classifying non-Wi-Fi wireless transmissions while simultaneously serving network traffic.
11	Should support configuring the access point as network connected sensor to access any network location covered by the access point to get real-time Spectrum analysis data.
12	Must incorporate radio resource management for power, channel, coverage hole detection and performance optimization.
13	Must have -90 dB or better Receiver Sensitivity.
14	Must support Proactive Key Caching and/or other methods for Fast Secure Roaming.
15	Must support Management Frame Protection.
16	Should support locally-significant certificates on the APs using a Public Key Infrastructure (PKI).
17	Must operate as a sensor for wireless IPS.
18	Should support non-Wi-Fi detection for off-channel rogues and Containment for both radio while serving the client simaltaniously.
19	Access Points must support Hardware-based encrypted user data and management traffic between controller and Access point for better security.
20	AP model proposed must be able to be both a client-serving AP and a monitor-only AP for Intrusion Prevention services.
21	Mesh support should support QoS for voice over wireless.
22	Must be plenum-rated (UL2043).
23	Must support 16 WLANs per AP for SSID deployment flexibility.
24	Must continue serving clients when WAN link to controller is back up again, should not reboot before joining
25	The APs must support centralized wireless mode with the use of a controller, but the APs must also support operation in autonomous mode without the presence of any controller, when needed.
26	When operated in remote AP mode, the AP must not disconnect any clients when the connection to the controller fails or in the case the failed connection has been restored again.
27	When operated in remote AP mode, the AP must be able to authenticate new users with local radius server directly at the AP itself in case of link failure to controller.
28	Access point should able to do the spectrum scanning for WiFi and non-WiFi interference for both on-channel and off-channel at all 20Mhz ,40Mhz, 80Mhz and 160Mhz channels
29	Must support telnet and/or SSH login to APs directly for troubleshooting flexibility.
30	Must support Power over Ethernet)/ power injectors.
31	802.11e and WMM

1.11. Wireless Access Point (Outdoor)

S/N	Performance Specification / Parameter
1	Access Points proposed must include radios for both 2.4 GHz and 5 GHz.
2	AP should support dual band antenna ports.
3	Must support wall and pole mount options.

4	4x4 MIMO with three spatial streams, multiuser MIMO
5	Must support 802.11ac, Wave 2 and back word compatible with 802.11n standards
6	Must support 80 MHz wide channels in 5 GHz.
7	Must support WAP enforced load-balance between 2.4Ghz and 5Ghz band.
8	Must support PHY data rates up to 1.7 Gbps (80 MHz in 5 GHz)
9	Access point should 802.11ac, 802.11n and 802.11a/b/g Beam forming
10	The Wireless Backhaul/Mesh shall operate in 5Ghz
11	Support Encrypted and authenticated connectivity between all back haul components
12	Access point should have multiple wired uplink interfaces including 10/100/1000BASE-T Ethernet auto sensing (RJ-45) and a build-in SFP port
13	Should have console port
14	Wireless AP should support beam forming technology to improve downlink performance of all mobile devices, including one-, two-, and three-spatial-stream devices on 802.11ac without taking the inputs from client.
15	Wireless AP Should able to detect and classify non-Wi-Fi wireless transmissions.
16	Must incorporate radio resource management for power, channel, coverage hole detection and performance optimization
17	Access point shall support powering from AC /DC/ PoE/PoE+.
18	Access point shall support pole, wall and Cable strand mounting options.
19	The equipment shall support up to 100 MPH sustained winds and 165 MPH wind gusts.
20	The Access point shall be IP67 and NEMA rated
21	The Access point shall support operating temperature of -40 to 65°C
22	802.11e and WMM
23	WiFi Alliance Certification for WMM and WMM power save
24	Must support Reliable Multicast to Unicast conversion to maintain video quality at AP level
25	Must support QoS and Video Call Admission Control capabilities.
26	Must support Spectrum analysis including @ 80 MHz
27	Same model AP that serves clients must be able to be dedicated to monitoring the RF environment.
28	Should support mesh capabilities for temporary connectivity in areas with no Ethernet cabling.
29	Must support 16 WLANs per AP for BSSID deployment flexibility.
30	Must support telnet and SSH login to APs directly for troubleshooting flexibility.

1.12. EPABX – Voice Communication Server

The Voice Communication Server should support minimum specifications as follows.

- The system shall be 100% IP-ready providing IP connectivity on Trunk side (IP, SIP, Trunks and VPN support) as well as a choice of IP end-points on users' end (H.323 hard-phones, SIP hard-phones, PC based soft-phone clients, SIP soft-clients, as well as SIP and IP clients on GSM handsets).
- The requisite licences for above shall be provided for the defined users.
- The System should support Analog, ISDN, VoIP & SIP Trunks as well as Extensions.
- System Capacities shall be as follows:

Technical Specifications for EPABX system and accessories		
Sr. No.	**Parameters**	
1	**System Specification**	
		SITC proposes to deploy a Server - Gateway based Communication/EPABX Systems for Hospital Main Building
		Server Hardware and Applications
	a	The system should be based on Server - Gateway Architecture with redundancy of Server. The connection from Server to Gateway shall be on IP and/or E1. The vendor must quote for branded Servers as mentioned below. Card based Server shall not be acceptable.
	b	The server should be Industry standard Servers from reputed manufacturers like Lenovo/Dell/IBM/HP. The minimum specifications required are as follows : - Processor : Quad Core Intel Xeon, Dual Core, i3 - Memory : Upto 16 GB - Hard Disk : SATA SSD with 4 TB - Operating System : Linux SUSE - Card based / OEM based Servers shall not be acceptable - Vendors to provide Duplicate Servers in HOT STANDBY MODE
	c	Vendors to provide Redundancy of Server and both the servers shall work in Active- Active mode which means if Primary Server fails the secondary server takes over and with same class of service and programming. The ongoing calls during such switch over should not get. Vendors shall be required to demonstrate the same
	d	The Server's primary media shall be IP/E1 and secondary shall be E1/IP. if IP link fails the E1 network takes over automatically without any manual intervention and vice versa
	e	At Hospital main Building shall deploy 2 Servers in Redundancy Mode and Gateway/EPABX at Main building and any Gateways/EPABXs at remote location respectively. It shall be possible to manage the entire programming and administrative functions centrally from Primary Server at main location. It should be possible to also program all the Gateways/EPABX Systems of Main Location as well as remote. It must be possible to have Single copy of Voice mail and Call billing for network of all media gateway.
	f	All the IP phones/devices shall be registered on both the servers as well as on Gateways/EPABX Systems. If Server 1 fails the IP phones should automatically start working on Server 2. In case te Link from Server to Gateways/EPABXs fail then the IP phones must work on

		native EPABX Systems. Vendors to quote for required licenses if applicable which shall enable IP Phones working on both the Servers adn also on EPABX System.
	g	In case both the Servers (Primary + Secondary) fail or IP link fails the IP Phones which were registered to Servers should start working with same numbering scheme on local Gateway/EPABX where they are physically connected. In case this arrangement requires licenses to be loaded in Gateway the same may be quoted by vendor.
	h	The entire solution should have inbuilt firewall protection for security. The entire stack shall have inbuilt FW application with 128 bit encryption employing SRTP/TLS protocols
	i	The Server should support up to 500 IP devices (SIP). This means that up to 500 SIP extensions/Devices can be connected to Server without any extra hardware. Vendors to quote Server configuration accordingly
	j	The entire stack (including Server + Gateway/EPABX) should support IPV4 and IPV6 from day1 and the same shall have to be proven by the Vendor. Necessary TEC Certificate stating that the EPABX works on Server Gateway architecture and supports IPV6 to be provided by Vendor
	k	It shall be possible to connect atleast 5 Gateways/EPABX system spread over different locations to a single server via IP or E1.
14		**Krone MDF with IPM of 600/200 Pairs**
		1. No. of terminations for subsciber lines equal to exchange equipped capacity +50% spare
		2. No. of terminations for IP trunk Equal to exchange equipped capacity + 50% spare
		3. No. of termination for 2 MBPS tributary interface Equal to exchange equipped capacity + 50% spare
		4. Type Panel mounted
		5. Terminations Krone type
		6. Protection Heat coils, Arrester and fuse (Gas discharge tube).
		1.2 Specification for IPM Fuse:
		Electrical
		1. Insulation resistance (100V DC for 60 sec) : > 30000 M ohms
		2.RMS Voltage proof (2000V AC for 60 sec) : To withstand
		3. Loop resistance : 50 m ohms (max)
		Mechanical
		1. IPM contact reliability : To withstand 1500 times insertion / extraction
		2. IPM: To withstand 10,000 times insertion and Extraction with Module
		Over voltage protection by 230 V GDT with fail safe
		1. D.C. spark – over voltage at 100 V/S : 180V-300V
		2. Impulse spark – over voltage at 1 KV/micro Sec. : 900V (Max)
		Over current protection by 120 mA PTC
		1. Delivered resistance: 7-12 ohms.
		2. Max operating voltage : 60V D.C
		3. Max AC fault voltage : 250V rms.
		4. Max interrupt current (for reset ability) : 3A rms
		5. Time to trip at 1 amp : 2.5 sec (max)0.25 amp : 90 sec (max)

15		**EMERGENCY RESPONSE SYSTEM**
		1.Emergencies can arise in any situation & environment 2.. Immediate action to notify all is the Key 3. Allows to trigger a group calling during Emergency 4. The messages can be broadcasted to all or in groups 5. Different messages can be broadcasted to different groups simultaneously: 6.The group can be notified with Instantly Recorded Message Pre recorded Message SMS Email **Unified Platform :** Groups or Zones can be created. Unified interface to send Voice Call, Email or SMS to groups **IVRS Message :** Messages can be pre-recorded or recorded live and played **Notifying :** Recorded messages can be played to Internal & external (Mobile &/or Landline) subscribers **Auto Recycling :** Calls which are not answered can be redialed and no of redial and time between retries can be flexibly programmed **Anywhere Access:** Web browser based access for easy configuration **Multi Codes :** Can operate multiple calling lists & multiple codes at same time **Calling List :** Can upload an Excel Sheets in CSV format **Live Status Display :** Live display/status of PRI channels **Monitoring :** Lets you monitor everything **Reports :** Various reports can be downloaded with query builder search engine **Minimum System Requirement:-** 4 GB RAM 500 GB HDD 1 Ethernet Port 1 PCIe Slot (Full Height, Full/Half Length) USB Port, Sound Card Windows OS.
16		**Installation and Commissioning:**
		1) It is to be noted again that "supply, installation and commissioning of complete system with all accessories, auxiliaries and any item not covered in the specification but essential for proper installation, operation and maintenance of the EPBX system shall be included and executed by the vendor. 2) The project will not be deemed complete until the commissioning of Complete system with all features and extensions is carried out successfully by the vendor and the same is verified and handed over to customer 3) No. of extensions to be considered for declaration of commissioning should be decided based on the available fronts and the minimum requirements. Decision of customer in this regard shall be final.

1.13. 4 Line LCD display IP Hardphone

The IP telephone shall have following features:

- Display – 4 rows by 24 characters with adjustable display angle. Green / White backlight and a dual position flip stand.
- Four-way navigation cluster button.

- Fixed feature buttons such as: Volume up/down (separate volume levels for the handset, speaker, and ringer), Mute, Speaker, Headset, Menu for settings, Telephony application, Hold, Conference, Transfer, Drop, Contacts, Call log, Redial, Quick-access voicemail Message button.
- 16 keys for call appearance / programmable feature key buttons – with dual LEDs (red, green) - three contextual softkey buttons.
- Mobile-Phone style menu with access to most often used features like Call Forwarding, Call Parking and Settings etc.
- On screen status indication for activated features like call forwarding and other features used most often.
- High quality two-way hands-free speaker and microphone.
- The telephone shall be Hearing Aid Compatible.
- Message Waiting Indicator which shall also be used as ringing call alert indicator.
- At least 8 Personalized Ring Patterns shall be configurable on the telephone.
- The telephone shall have a Headset Socket.
- Embedded Applications: Centralized call log and contact application. Contacts application (up to100). Call Log (Missed, Incoming, Outgoing, up to 30 calls). Access to company directory and Visual Voice applications on IP PBX.
- Upgradeable Firmware – new software versions shall be made possible via firmware upgrade from communications server.
- It shall have an expansion port for an additional programmable 32 keys with LED.
- Power requirements/PoE: It shall be a PoE powered device, no separate AC/DC power shall be required by the device. It shall be a IEEE 802.11af Power over Ethernet (PoE) class 2 device.
- Codecs: G.711, G.729a/b, Dynamic Jitter buffer, Echo cancellation, Comfort Noise, Automatic Gain Control.
- QoS Options: UDP Port Selection, DiffServ and 802.1p/B (VLAN)
- SNMP Support
- Static or dynamic IP address assignment

1.14. Specification for 2 Line LCD display IP Hard phone

The IP telephone shall have following features:

- Display – 2 rows by 24 characters with White backlight.
- Fixed feature buttons such as: Volume up/down (separate volume levels for the handset, speaker, and ringer), Mute, Speaker, Menu for Settings, Hold, Conference, Transfer, Drop, Redial.
- Programmable feature key buttons – 3 call appearance key buttons with dual LEDs (red, green).
- High quality two-way hands-free speaker and microphone.
- The telephone shall be Hearing Aid Compatible.
- Message Waiting Indicator.
- At least 8 Personalized Ring Patterns shall be configurable on the telephone.
- Upgradeable Firmware – new software versions shall be made possible via firmware upgrade from communications server.

- Power requirements/PoE: It shall be a PoE powered device, no separate AC/DC power shall be required by the device. It shall be a IEEE 802.11af Power over Ethernet (PoE) class 2 device.
- Codecs: G.711, G.729a/b, Dynamic Jitter buffer, Echo cancellation, Comfort Noise, Automatic Gain Control.
- QoS Options: UDP Port Selection, DiffServ and 802.1p/B (VLAN)
- SNMP Support
- Static or dynamic IP address assignment

- Ethernet interface (10/100Mbps) with a secondary 10/100Mbps port for co-location of another network device with VLAN separation.

1.15. Analog telephone handset

The analog telephone shall have following features:

- DTMF (Touchtone) as well as Dial Pulse (DP) dialling facility.
- It shall have ringer control switch.
- It shall have a Mute key
- It shall have a Flash key for signalling to the Pbx system
- It shall have desktop as well as wall mounting facility.

2. VIDEO SURVEILLANCE SYSTEM

- The Surveillance System Components must be TCP/IP based components working on the same backbone network as the Data Network (LAN).
- Must have mix of IP Cameras as specified in this document.
- Must have the Video Analytics and monitoring software capable of meeting the requirements mentioned in this document. The video analytics has to be server based system with capability to interact with third party VMS systems.
- Must have the network based storage for the specified time and quality as specified.
- Must be scalable in terms of equipment (no. of cameras) as well as features (Analytics).
- True open platform functionality is an essential aspect of this specification; cameras from different OEMs must be able to integrate seamlessly with the specified 3rd party VMS platforms without any loss of features' functionality. Similarly, specified VMS platforms must also be able to integrate with a variety of cameras from different manufacturers.
- Cameras and VMS system shall be from different OEMs to ensure open-ness of solution and to avoid dependency on any single brand.
- Camera vendors shall be direct original equipment manufacturers.
- All cameras must be with wide dynamic range and True D/N capability with removable IR cut filter.
- For better saving on storage and bandwidth the compression used shall be H.264 high profile for all types of cameras and devices. H.264 high profile shall be a common requirement for all cameras and devices irrespective of whether mentioned in individual sub-sections or not or if mentioned otherwise.
- All cameras shall be vandal resistant as per IK10 rating.
- All cameras shall be ONVIF Profile S compliant
- Cameras shall have a wide dynamic range of between 90 to 100dB for ensuring good image performance in varying light conditions.

2.1. IP BASED OUTDOOR VERI-FOCAL IR BULLET CAMERAS

Parameter	Required Minimum Specifications
Imaging Device	1/2.8" 4Megapixel progressive scan CMOS
Lens	2.7-12 mm motorized zoom and auto focus lens F1.6
Maximum Resolution	2MP - 1920x1080
ONVIF Protocol	Profile S and G
Minimum Illumination	Color : 0.01Lux @f/1.6 B/W : 0Lux @f/1.6(IR on)
Day/Night Method	Mechanical ICR (ON / OFF / AUTO selectable)
Signal-to-Noise Ratio	50 db minimum
Auto Iris Lens Type	DC IRIS
Electronic Shutter Range	Auto/Manual, 1/3(4)~1/100000s
IR Illuminator	Required, IR range 50 mtr or better
Wide Dynamic Range	120 db minimum
Lighting compensation	BLC / HLC / WDR
Digital Noise Reduction	3D Noise Reduction (ON / OFF selectable)
Privacy Zone	4 configurable windows
On-board Analytics Event	Motion Detection/ Video Tampering/ Face Detection/ Audio Detection/Tripwire/Intrusion/Object Abandoned/Object Missing/Trigger line/loitering
Motion Detection	Off/ On / By Schedule
Image Settings	Compression,3D digital noise reduction (ON/OFF) color, brightness, sharpness, contrast, white balance, exposure control, exposure zones, backlight compensation, fine tuning of behaviour at low light, rotation , and all other Image Settings in Web UI
Network	RJ-45 (10/100Base-T)
Power Input	PoE/12VDC/24VAC
Power Consumption	Max 20.5W (with IR on, motorized lens working)
Local Storage	Required, Micro SDXC Capacity Max 128GB
Audio In / Out	1 In / 1 Out
Alarm In / Out	2 In / 1 Out

Audio Encoding	G.711a/ G.711u/ AAC/G.726
Video Encoding	H.264 and MJPEG bit rate control (CBR and VBR)
Video Streams	Main Stream: 1080P(1~50/60fps)
	Sub Stream: D1(1~50/60fps)
	Third Stream:1080P(1-25/30fps)
Frame Rate	Selectable for each independent stream
	1080P - 60 (full) ~ 1 fps
	720P - 60 (full) ~1 fps
Resolution	1080P(1920x1080)
	1.3M(1280× 960)
	720P(1280× 720)
	D1(704× 576/704× 480)
Supported Protocols	HTTP; HTTPs; TCP; ARP; RTSP; RTP; UDP; SMTP;FTP; DHCP; DNS; DDNS; PPPOE; IPv4/v6; QoS;UPnP;NTP; Bonjour; 802.1x; Multicast; ICMP;SNMP
Security Access	Multiple user access levels with password protection IP filtering, HTTPS, IEEE 802.1x, signed certificate, Data Encryption
Users	20users
Ingress Protection	IP 67
Vandal Resistant	IK10
Operating Temperature	–22°F to 140°F (–30°C to 60°C)
Operating Humidity	0% to 95%, non-condensing
Certifications	UL, CSA 60950-22, CE (EN 50130-4 & EN 55022) , FCC Part 15 & RoHS
Cyber Security	PCI-DSS and UL-CAP

2.2. IP BASED VERI-FOCAL DOME CAMERAS

Parameter	Required Minimum Specifications
Imaging Device	1/2.8” 4Megapixel progressive scan CMOS
Lens	2.7-12 mm motorized zoom and auto focus lens F1.6
Maximum Resolution	2MP - 1920x1080
ONVIF Protocol	Profile S and G
Minimum Illumination	Color : 0.01Lux @f/1.6 B/W : 0Lux @f/1.6(IR on)
Day/Night Method	Mechanical ICR (ON / OFF / AUTO selectable)
Signal-to-Noise Ratio	50 db minimum

Auto Iris Lens Type	DC IRIS
Electronic Shutter Range	Auto/Manual, 1/3(4)~1/100000s
IR Illuminator	Required, IR range 50 mtr or better
Wide Dynamic Range	120 db minimum
Lighting compensation	BLC / HLC / WDR
Digital Noise Reduction	3D Noise Reduction (ON / OFF selectable)
Privacy Zone	4 configurable windows
On-board Analytics Event	Motion Detection/ Video Tampering/ Face Detection/ Audio Detection/Tripwire/Intrusion/Object Abandoned/Object Missing/Trigger line/loitering
Motion Detection	Off/ On / By Schedule
Image Settings	Compression,3D digital noise reduction (ON/OFF) color, brightness, sharpness, contrast, white balance, exposure control, exposure zones, backlight compensation, fine tuning of behavior at low light, rotation , and all other Image Settings in Web UI
Network	RJ-45 (10/100Base-T)
Power Input	PoE/12VDC/24VAC
Power Consumption	Max 20.5W (with IR on, motorized lens working)
Local Storage	Required, Micro SDXC Capacity Max 128GB
Audio In / Out	1 In / 1 Out
Alarm In / Out	2 In / 1 Out
Audio Encoding	G.711a/ G.711u/ AAC/G.726
Video Encoding	H.264 and MJPEG bit rate control (CBR and VBR)
Video Streams	Main Stream: 1080P(1~50/60fps)
	Sub Stream: D1(1~50/60fps)
	Third Stream:1080P(1-25/30fps)
Frame Rate	Selectable for each independent stream
	1080P - 60 (full) ~ 1 fps
	720P - 60 (full) ~1 fps
Resolution	1080P(1920x1080)
	1.3M(1280× 960)
	720P(1280× 720)
	D1(704× 576/704× 480)

Supported Protocols	HTTP; HTTPs; TCP; ARP; RTSP; RTP; UDP; SMTP;FTP; DHCP; DNS; DDNS; PPPOE; IPv4/v6; QoS;UPnP;NTP; Bonjour; 802.1x; Multicast; ICMP;SNMP
Security Access	Multiple user access levels with password protection IP filtering, HTTPS, IEEE 802.1x, signed certificate, Data Encryption
Users	20users
Ingress Protection	IP 67
Vandal Resistant	IK10
Operating Temperature	–22°F to 140°F (–30°C to 60°C)
Operating Humidity	0% to 95%, non-condensing
Certifications	UL, CSA 60950-22, CE (EN 50130-4 & EN 55022) , FCC Part 15 & RoHS
Cyber Security	PCI-DSS and UL-CAP

2.3. Full High Definition (HD), True Day/Night, Network PTZ Rapid Outdoor PTZ Camera

Parameter	Required Minimum Specifications
Imaging Device	1/2" or better 4Megapixel progressive scan CMOS
Lens	6-180 mm(30x Optical Zoom), F1.4-F4.8
Maximum Resolution	2MP - 1920x1080
ONVIF Protocol	Profile S
Minimum Illumination (May vary depending on the lens)	Color : 0.005Lux @f/1.6 B/W : 0.0005Lux@f/1.6 0Lux (IR on)
Day/Night Method	Mechanical ICR (ON / OFF / AUTO selectable)
Signal-to-Noise Ratio	50 db minimum
Auto Iris Lens Type	DC IRIS
Electronic Shutter Range	Auto/Manual, 1/1~1/30000s
White Balance	Auto, ATW, Indoor, Outdoor, Manual
True Wide Dynamic Range	120 db
Back light compensation	BLC / HLC /WDR
Digital Noise Reduction	DNR (2D/3D)
Alarm Triggers	Alarm I/O
Analog video output	BNC(1.0Vp BNC(1.0Vp/75Ω), PAL / NTSC
Tracking Trigger Mode	Manual/Auto
Privacy Zone	24 configurable windows
Motion Detection	Off/ On / By Schedule
Network	RJ-45 (10/100Base-T)
Power Input	24VAC/3A(±25 %) , Hi-POE
Power Consumption	40W (IR on)

Audio Input / Output	1 channel in / 1 Channel Out
Alarm Input/ Output	7 In/ 2 Out
Local Storage	Required, Micro SDHC up to 128GB
IR Illuminator (Internal or External)	Required, 150 Mtr or better
Focus Mode	Auto/Semi Auto/Manual
NTSC/PAL switch	Support NTSC/PAL switch IN WEB UI
Pan Range	360-degree endless rotation
Pan Speed	Manually 240 degree per second; preset speed 240 degree per second
Preset Accuracy	0.1 degree per second
Tilt Range	-10~90 degree (auto flip)
Tilt Speed	Manually 120 degree per second; preset speed 200 degree per second
Smart Zoom	3D positioning
Number of Preset	245 or better
Video Encoding	H.264 and MJPEG bit rate control (CBR and VBR)
Audio Encoding	G.711a/ G.711u/PCM
Video Streams	Main Stream: 1080P(1~25/30fps)/720P(1-50/60fps)
	Sub Stream: D1/CIF(1 ~ 25/30fps)
	Third Stream: 720P/D1/CIF(1 ~ 25/30fps)
Frame Rate	Selectable for each independent stream
	1080P - 30 (full) ~ 1 fps
	720P - 60 (full) ~1 fps
Resolution	1080P(1920x1080)
	720P(1280× 720)
	D1(704× 576/704× 480)
	CIF(352× 288/352× 240)
Supported Protocols	IPv4/IPv6,HTTP,HTTPS,SSL,TCP/IP,UDP,UPnP,ICMP,IGMP,SNMP,RTSP,RTP,SMTP,NTP,DHCP,DNS,PPPOE,DDNS,FTP,IP Filter,QoS,Bonjour,802.1x
Unicast	20users
Security Features	Multiple user access levels with password protection IP filtering, HTTPS, IEEE 802.1x, Digest Authentication, Signed Certificates, Data Encryption
Ingress Protection	IP 67
Vandal Resistant	IK10
Operating Temperature	–22°F to 140°F (–30°C to 60°C)
Operating Humidity	0% to 95%, non-condensing
Certifications	UL, CSA 60950-22, CE (EN 50130-4 & EN 55022) , FCC Part 15 & RoHS compliant.
Approved Makes	Arecont Vision, Axis, Honeywell, Avigilon

2.4. 65 inch LED Videowall display

General Features	Technical Specification Requirement
Screen size (inches)	Min 55 Inches
Aspect Ratio	16:9
Resolution	Min 1920X1080 pixels
Brightness (cd/m2)	Min 500cd/m2
Contrast Ratio	5000:1
Panel Type	LCD VA Panel/E-LED
Viewing Angle (°)	Min 176°/176°
Bezel	Maximum 3.5 mm or better
Video Requirement	DVI-D Loop out-Daisy chain, DVI- D IN X 1, VGA X 1, HDMI X 2, DVI-I Out x 1, LAN
Connectivity Input	Digital : Main : Min HDMI(2), DVI-D (1) with HDCP for all input
	Analog: Main : Mini D-sub 15-pin x 1/Stereo Mini Jack (M3) x 1
	Audio: Main : Audio In (L/R) with DVI-D and PC In
	External Control: Main : RJ45(1), IR(1), D-sub 9-pin x 1, RS-232C Compatible
Connectivity Output	Analog : Stereo Mini Jack (M3) x 1 or Equivalent
	Audio : External Speaker – 20 Watt
	External Control: RS232C(1), IR(1)
Specific features	Display Zoom, Multiscreen, Orientation: Portrait/Landscape
Standard & Certification	IEC60065, CISPR22 Class-B or Equivalent
Power Requirement	Power Supply: 220-240V, 50/60Hz, Built-in Power Power Consumption Typ.: Min Saving: 150W

3. FIRE DETECTION & ALARM SYSTEM

GENERAL SYSTEM DESCRIPTION

- This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

- The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signalling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

- The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

- 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 panel shall be supplied with all accessories, control modules and power supplies in the required quantities as per site requirements for all types of field devices to make the system fully operational.

- The FAS shall be supplied with necessary hardware and software so as to ensure networking of all panels. This shall include all devices such as modules and interfaces for providing fiber-optics based connectivity between panels and any licences, as applicable.

- All the panels of FAS system shall be monitored and controlled from industry standard computer system that shall be supplied with necessary application software having a user friendly graphical user interface. The software and all licences for the same shall be supplied by OEM in the name of the client.

- The FAS system shall be supplied with all functionality including hardware, software and licences for integration with a third party IBMS system for real-time monitoring, supervision and control. The necessary interfaces and functionality for such networking protocols as BaCNet/IP shall be provided by the OEM.

- Refer CPWD Specification for the Addressable Fire Alarm System Specification, Installation & Commissioning purpose, it has to be complied with the CPWD Specification

SCOPE

- A new intelligent reporting, addressable microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.

- Basic Performance:

  - Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signalling 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 Signalling 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.

- 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:

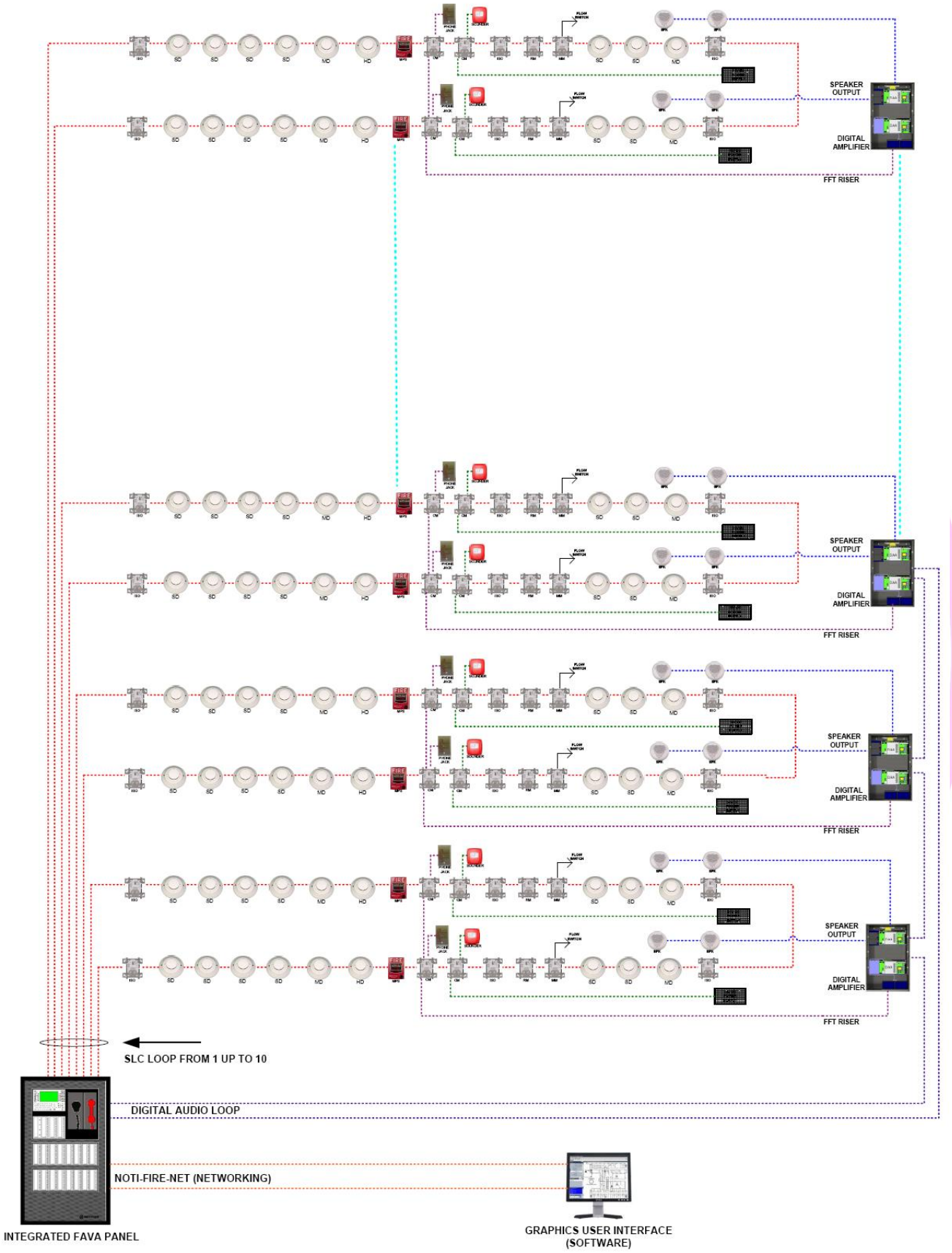
  - The system alarm LED on the system display shall flash.

  - A local piezo electric signal in the control panel shall sound.

  - A 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 the information associated each new fire alarm control panel condition, along with time and date of occurrence.

  - 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.



APPLICABLE STANDARDS AND SPECIFICATIONS:

- The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

A. National Fire Protection Association (NFPA) - USA:

No. 12 CO2 Extinguishing Systems (low and high)
No. 12B Halon 1211 Extinguishing Systems
No. 13 Sprinkler Systems
No. 13A Halon 1301 Extinguishing Systems
No. 15 Water Spray Systems
No. 16 Foam/Water Deluge and Spray Systems
No. 17 Dry Chemical Extinguishing Systems
No. 17A Wet Chemical Extinguishing Systems, Clean Agent Extinguishing Systems
No. 72 National Fire Alarm Code
No. 101 Life Safety Code

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

No. 268 Smoke Detectors for Fire Protective Signalling Systems
No. 864 Control Units for Fire Protective Signalling Systems
No. 268A Smoke Detectors for Duct Applications
No. 521 Heat Detectors for Fire Protective Signalling Systems
No. 464 Audible Signalling Appliances
No. 38 Manually Actuated Signalling Boxes
No. 346 Water-flow Indicators for Fire Protective Signalling Systems
No. 1076 Control Units for Burglar Alarm Proprietary Protective Signalling Systems
No. 1971 Visual Notification Appliances

APPROVALS:

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

UL : - Underwriters Laboratories Inc

- The fire alarm control panel shall meet UL Standard 864 Ninth Edition (Control Units) and UL Standard 1076 (Proprietary Burglar Alarm Systems).

EQUIPMENT AND MATERIAL, GENERAL:

- 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 protective signalling system, meeting the National Fire Alarm Code.

- All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

- 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.

CONDUIT AND WIRE:

A. Conduit:

- Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
- Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
- Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-55.
- Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signalling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
- Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or back-boxes, except where conduit entry is specified by the FACP manufacturer.
- Conduit shall be 1”-inch (25.4 mm) minimum.

B.Wire:

- All fire alarm system wiring shall be new.
- Wiring shall be in accordance with local, state and national codes (e.g., 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 18 AWG (1.02 mm) for Initiating Device Circuits and Signalling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.
- All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system.
- Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
- Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.

- All field wiring shall be electrically supervised for open circuit and ground fault.

- The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signalling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.

C.Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signalling line circuits connected to intelligent reporting devices.

E.The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labelled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to a grounding rod.

MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Main FACP or network node shall contain a microprocessor based Central Processing Unit (CPU) and power supply. 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, printer, annunciators, and other system controlled devices.

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

1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
2. Supervise all initiating signalling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.

System Capacity and General Operation

A. The FACP shall can communicate on a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mbps and support up to 200 panels / nodes per network.

B. The control panel shall be capable of expansion via up to 2 and 10 SLC loops. Each module shall support up to 240 analog/addressable devices for a maximum system capacity of 2400 points for 10 loop & 240 Point for 2 Loop Panel. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 600-character liquid crystal display, individual, color coded system status LEDs, and a QWERTY keypad for the control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either company.

C. All programming or editing of the existing program in the system shall be achieved without interrupting the alarm monitoring functions of the fire alarm control panel.

D. The FACP shall be able to provide the following software and hardware features:

1. 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.
2. 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.
3. 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.
4. 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.
5. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
6. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.
7. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the sensitivity testing requirements of NFPA 72.
8. 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.
9. 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. A single change to one CPU database shall not require a database download to other CPUs.
10. History Events: The panel shall maintain a history file of atleast 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 5000 event history file.
11. Smoke Control Modes: The system shall provide means to perform Fire Smoke Control Station mode. This mode controls all dampers, smoke extraction fan, fresh air supply fans, etc during Fire condition. Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.
12. 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.
13. 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.
14. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions
15. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.
16. 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.

17. 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.
18. 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.
19. 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.
20. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.
21. Multi-Cooperating Detectors: The system shall provide means to link one detector with up to two detectors at other addresses in cooperative multi-detector sensing. The detector shall take feedback from the other two adjacent detectors to take fast and genuine alarm decision mitigating the risk of false alarm. There shall be no requirement for mandatory sequential address setting in the detectors to achieve this function. Multi-cooperative detection shall be a built-in intelligence in the system to take fast & reliable decision on genuine alarm triggering. The alarm event shall be a result of all cooperating detector chamber readings considered as a consolidated alarm signal.
22. 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.
23. 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.
24. Mass Notification Override: The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.
25. Security Monitor Points: The system shall provide means to monitor any point as a type security.
26. 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 Control By Event 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.

27. 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.
28. 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.
29. 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.
30. 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.
31. 100 trouble equations per device: The system shall provide support for up to 100 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.
32. Control-By-Time: A time-based logic function shall be available to delay an action for a specific period 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.
33. 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-zone and four abort options to satisfy any local jurisdiction requirements.
34. 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. 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.

E. Central Processing Unit

1. 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.
2. 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.
3. 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.
4. The CPU shall provide an RS-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
5. The CPU shall provide two RS-485 ports for the serial connection to annunciation and

control subsystem components.

6. The RS-232 serial output circuit shall be optically isolated to assure protection from earth ground.
7. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Systems not offering degrade mode shall offer Redundant CPU. 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.

F. Display

1. The system display shall provide a **600-character** backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven 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, CONTROLS ACTIVE, and CPU FAILURE.
2. These characters shall be only for fire alarm / trouble information and not for Logo or other purpose. It shall be UL Listed. Repeater panel displays in FACP is not allowed unless until approved by UL
3. The system display shall provide a QWERTY keypad for ease of operation.
4. The keypad shall have control capability to command all system functions, entry of any alphabetic or numeric information, and field programming without the use of any external equipment or laptop. 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.

G. Loop (Signaling Line Circuit) Control Module:

1. The control panel shall be capable of expansion via up to **2 and 10 SLC loops**. Each module shall support up to **240 addressable devices combination of 120 Detectors and 120 addressable devices** for a maximum system capacity of **240 points for 2 SLC and 2400 for 10 SLC.**
2. 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.
3. Each loop shall maintain 20% spare capacity for future expansion.
4. Each Loop shall be capable of operating as a NFPA Class B circuit in case of single open circuit fault in existing SLC Circuit
5. 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.

H. Network Communication

The FACP shall communicate over a peer-to-peer communication network, inherently over a regenerative communication format and protocol. The network shall support

communication speed up to 100 Mbps and support up to 200 Control Panels/ Network Nodes, over a single medium (copper conductor / fiber optic), redundant ring, communication channel for fire alarm, voice evacuation and telephone talk-back system. The system shall support up to 200 such networks in a single system.
The network card shall have inbuilt Fiber port for terminating Fiber Optic Cable without any third party converters.

I. Digital Voice Command Center

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

   a. Operate as a supervised multi-channel emergency voice communication system. Operate as a two-way emergency telephone system control center.
   b. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
   c. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
   d. Provide all-call Emergency Paging activities through activation of a single control switch.
   e. As required, provide vectored paging control to specific audio zones via dedicated control switches.
   f. 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.
   g. Provide a software utility capable of off-line programming for the DVC 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 DVC shall not inhibit the emergency operation of other nodes on the fire alarm network.
   h. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SLC controlled switching.
   i. 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.
   j. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.
   j. **Fire, Voice & Telephone data shall flow through single network cable.**
   k. **The Voice Evacuation System shall be capable of establishing communication between the master voice controller and amplifier over fiber optic cable network without using any third party media converter.**
   l. **Failure of Fire Panel CPU shall not affect the operation of DVC. Incase DVC / Amplifiers are controlled by Fire Panel CPU, a separate panel with dedicated CPU shall be considered for each DVC & Amplifier.**

J. Power Supply

1. The Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all

necessary power for the FACP.

2. The 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.
3. The 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 7-200 amp-hours within a 48-hour period.
4. The Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
5. The Main Power Supply shall be power-limited per UL864 requirements.
6. The Main Power Supply shall communicate power supply, line voltage, battery status and charger status to the local LCD display. Any abnormal condition shall be annunciated and logged to the system alarm history log.
7. 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.
13. 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.
14. 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 zero, two, eight or sixteen hours shall be programmable.
15. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be programmable.
16. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.
17. Each of the power supply's four output circuits shall be programmed- 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.
18. 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 24 VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
19. When selected for Notification Appliance Circuits, the output circuits shall be individually programmable for Steady, March Time, Dual Stage or Temporal.
20. 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.
21. 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.
22. 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.

K. Audio Amplifiers

1. The Audio Amplifiers shall provide Audio Power 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:

   a. Earth Fault Detection & Annunciation for Communication bus
   b. Audio Amplifier Failure Trouble Annunciation
   c. External trigger input indication in case of Amplifier failure
   d. Audio Detected on Firefighter's Telephone Riser
   e. Receiving Audio from digital audio riser
   i. Short circuit on detection &annunciation on each speaker circuit
   j. Communication Status
   n. Board failure
   r. Active fiber optic media connection
   t. Power supply monitoring of below conditions –Earth fault, Low Battery, Charger Trouble

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.
8. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.
9. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.
10. System shall support distributed architecture of voice evacuation system to enable remote installation of amplifiers. Remote Amplifer's shall communicate with the centrally located Digital Voice Command.

L. Controls with associated LED Indicators

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

M. Field Programming

1. The system shall be programmable, configurable and expandable in the field without the need for special tools. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
2. All field defined programs shall be stored in non-volatile memory.

N. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity

range shall be within the allowed UL window and have a minimum of 9 levels.

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 delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. 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.

O. System Point Operations

1. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or Graphics User Interface.
2. System output points shall be capable of being turned on or off from the system keypad or the video terminal.
3. 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:

    a. Device Status.
    b. Device Type.
    c. Custom Device Label.
    d. Software Zone Label.
    e. Device Zone Assignments.
    f. Analog Detector Sensitivity.
    g. All Program Parameters.

4. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 5000 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.
5. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.
6. 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.
7. 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.
8. 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.

SYSTEM COMPONENTS

A. Network Control Annunciator

A network control annunciator shall be provided to display all system intelligent points. The NCA shall be capable of displaying all information for 200,000 points on the network. Network display devices, which are only capable of displaying a subset of network points, shall not be suitable substitutes.

The NCA shall include a minimum of 600 characters, backlit by a long life, solid state LCD display. It shall also include a full QWERTY style keypad with tactile feel. Additionally, the network display shall include ten soft-keys for screen navigation and the ability to scroll events by type. i.e. Fire Alarm, Supervisory Alarm, Trouble, etc.

The network control annunciator shall have the ability to display up to eight events in order of priority and time of occurrence. Counters shall be provided to indicate the total number of events by type.

The NCA shall mount in any of the network node fire alarm control panels. Optionally, the network display may mount in a backbox designed for this useand shall connect to the network over either a wire or fiber interface.

The network control annunciator shall have an event history buffer capable of storing a minimum of 1000 events in non-volatile memory. Additionally, the NCA shall have a fire alarm history buffer capable of storing a minimum of 200 events in non-volatile memory. Systems that do not protect fire alarm events from being overwritten by other events are not suitable substitutes.

The NCA shall include two optically isolated, 9600 baud, industry standard RS-232 ports for UL864 listed printers and CRT's. These peripheral devices shall print or display network activity.

The network control annunciator shall include control switches for system wide control of Acknowledge, Signal Silence, System Reset, Drill, and local Lamp Test. A mechanical means by which the controls switches are "locked out", such as a key, shall be available.

The NCA shall include long life LEDs to display Power, Fire Alarm, Pre-Alarm, Security Alarm, System Trouble, Supervisory, Signals Silenced, Disabled Points, Other (non-fire) Events, and CPU Failure.

The network control annunciator shall include a Master password and up to nine User passwords. Each password shall be up to eight alpha-numeric characters in length. The Master password shall be authorized to access the programming and alter status menus. Each User password may have different levels of authorization assigned by the Master password.

The NCA shall allow editing of labels for all points within the network; control on/off of outputs; enable/disable of all network points; alter detector sensitivity; clear detector verification counters for any analog addressable detector within the network; clear any history log within the network; change the Time/Date settings; initiate a Walk Test.

The network control annunciator shall support an optional WindowsTM based program utility. This utility shall allow the user create an NCA database, upload/download an NCA database, and download an upgrade to the NCA executive. To ensure program validity, this utility shall check

stored databases for errors. A compare function shall be included to identify differences between databases.

For time keeping purposes the NCA shall include a time of day clock.

B. Network Control Station / Graphics User Interface

The NCS shall utilize a Microsoft(tm) operating system. Each Network Control Station shall be capable of graphically annunciating and controlling all network activity and at least 2,50,000 network points. Network display devices that are only capable of displaying a subset of network points shall not be suitable substitutes.

The NCS shall be an IBM (or compatible) personal computer with the following minimum requirements: Intel Pentium II(tm)-processor, operating at a minimum of 400 Mhz, 128Mbytes of RAM, 8 Mbytes Video RAM, 1.44 Mbyte floppy drive, 3.2 Gbyte hard disk, mouse, 32X CD-ROM, 3PCI / 1 ISA expansion slots, internal 3.2 Gbyte tape drive, sound card, 200 watt power supply, and SVGA graphics with a screen resolution of 1024 x 768. The network control station shall include a 19-inch monitor.

The NCS shall be capable of storing over 100,000 network events in a history file. Events shall be stored on hard disk and shall be capable of back-up storage to a tape drive. The history buffer allows the operator to view events in a chronological order. A filter shall be available for displaying chronological events by operator, date, time, fire alarms, troubles (including security, supervisory and system/device), disabled points/zones, system programming, operator response and operator log in/log out. The ability to print NCS history files shall also be available.

The NCS shall use a Windows(tm) dialog box technology to address, interrogate, control, and/or modify intelligent points on each fire alarm node. This shall include, and not be limited to: Activating outputs, enabling or disabling points, adding or removing intelligent points, viewing intelligent detector sensitivity levels and modifying point information (custom messages, detector type, verification, day/night selection etc.)

The NCS shall include the ability to display system information in a graphical (floor plan) form. Each view, created using standard Windows bitmap files, shall include icons created for intelligent devices. These icons shall blink and change to the appropriate programmed icon when an event occurs. When the device has been acknowledged, the icon shall become steady. Once the point has returned to normal, the normal icon is displayed. In addition to the graphical representation of the device, the user shall be able to link pictures, documents and sound files to the device. The NCS shall also provide the ability to auto-vector to the floor plan (screen) of the device that is active. By selecting a device in the graphic presentation, the operator of the NCS shall have the ability to log onto the corresponding node and interrogate the associated intelligent point.

The NCS shall have the ability to provide the following information through a Windows(tm) pull down menu: An Event Counter that contains the number of new and total events on the network. The information that is displayed shall consist of Fire Alarms, Pre-Alarms, Security Alarms, Supervisory Alarms, and Troubles. A Detailed Event window that contains all Off-Normal events, both unacknowledged and acknowledged that are present in the system. It shall contain two views, Fire events and Non-fire events that shall be user selectable. A Current Event window that shall contain all network and local events as well as system messages with a maximum of 1,000 events displayed. A Disabled Device window that shall contain all disabled devices in the system.

The NCS shall have the option, from a Windows pull down menu, to connect to a third party paging service that allows the NCS to automatically send text-based messages regarding system status to a typical text pager.

The NCS shall include help screens, available to aid the user without leaving the selected application screen.

The NCS shall be UL-Listed for fire protection (UL864) and burglary (UL1076).

The NCS shall interface with other panels as a node in the pear to pear network.

The operator shall be able to monitor the FFT system from GUI software and shall be able to monitor and control Integrated Voice Evacuation System.

The NCS shall have a flexible way of assigning operator passwords. There shall be an unlimited number of possible operators, each with specific levels of control. Each operator shall have his/her own password. Operator password and control selection shall be available to a high level "administrator" who shall have complete control over levels of control. If no action has taken place on the NCS after 10 minutes, the current operator shall be logged out and require a new log-in.

The NCS shall include an industry-standard RS-232 port for a UL864 listed printer.

The NCS shall be a table top hardware configuration.

C. Interactive Firefighters' Touchscreen Display

The network will interface and report the individually monitored system's alarm status via a user-friendly Graphical User Interface (GUI) based software.

The software shall operate under Microsoft® Windows® XP Embedded platform as manufactured by Microsoft Corporation.

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. It shall be capable of mapping at least 2,50,000 network points

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.

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.

The fire alarm device icon shall be visible only when it is in an alarm (or active) condition.

The software shall display the activated smoke detectors in a time sequence to track smoke progression.

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.

The software shall provide a intuitive and easy way to navigate to different screens representing floors and areas within a facility.

The system shall provide for continuous monitoring of all fire alarm conditions regardless of the current activity displayed on the screen.

The software shall display "YOU ARE HERE" along with icons representing standard building objects (stairs, elevators, etc) to be shown on the floor plan.

The software shall allow icons that represent hazardous materials stored in a facility.

The software shall provide a screen that displays preprogramed building contact information.

The software shall provide a screen the displays building occupancy and other general building information.

The software shall allow a site plan to be imported that shows an aerial view of the facility.

The software shall display all active fire, supervisory, and security events within an event list.

GATEWAY AND WEB SERVERS

A. BACnet Interface Gateway: The system shall be capable of being interfaced with BACNet compliant clients. A BACnet interface supporting BACnet/IP communication shall be available from the fire alarm control panel manufacturer. BACnet shall support 14000 data points. BACnet gateway shall communicate with all the panels in a peer to peer network.

B. MODbus Interface Gateway: The system shall be capable of being interfaced with MODbus compliant clients. A MODbus interface supporting MODbus/TCP communication shall be available from the fire alarm control panel manufacturer .MODbus shall support 22500 data points. MODbus gateway shall communicate with all the panels in a peer to peer network.

C. Webserver: The system shall support a webserver allowing remote connection via the Internet or Intranet. Authorized users will have the ability to view panel/network history, event status and device properties. The webserver shall also support sending event information via email or text to up to 50 registered users, the webserver shall be available from the fire alarm control panel manufacturer.

D. Web Portal Interface: The system shall be capable of being interfaced with a web portal to integrate with Inspection and Service Manager utilities. The web portal and inspection and service manager utilities shall be available from the fire alarm control panel manufacturer.

SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices – General

1. Addressable devices shall provide an address-setting means using **rotary decimal switches**. Addressable devices that require the address be programmed using a programming utility are not an allowable substitute.
2. Addressable devices shall use simple to install and maintain decade, decimal address switches.

3. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.
4. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
6. Addressable smoke and thermal detectors shall provide dual alarm and power/polling bi-colour LEDs. Both LEDs shall flash green 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 red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
7. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
8. 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.
9. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base, the programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.
10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (PHOTO, THERMAL).
11. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
12. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
13. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
14. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

B. Addressable Manual Call Point (Break Glass / Pull Down Type)

1. Addressable manual call point shall send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual fire alarm boxes shall be constructed of Lexan / ABS Plastic with clearly visible operating instructions provided on the cover. The word FIRE / Fire Sign shall appear on the

front of the stations.

C. Intelligent Photoelectric Smoke Detector:

The intelligent photoelectric smoke detector 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.

D. Intelligent High Sensitivity Photo Smoke Detector

The intelligent high sensitivity photo smoke detector shall be a spot type detector that incorporates an extremely bright high sensitivity diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.

1. The high sensitivity detector shall have conductive plastic so that dust accumulation is reduced significantly.
2. The intelligent high sensitivity photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.02 percent per foot.
3. The high sensitivity detector shall not require expensive conduit, special fittings or PVC pipe.
4. The intelligent high sensitivity photo detector shall support standard, relay, isolator and sounder detector bases.
5. The high sensitivity photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.
6. The high sensitivity photo detector shall include two bicolor LEDs that flash green in normal operation and turn on steady red in alarm.

E. Intelligent Multi Criteria Detector

The intelligent multi-criteria detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings for early detection and reduction in false alarm. The detector design shall allow a wide sensitivity window, 0.5 to 2.5% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

1. 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).
2. 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.

F. Intelligent Thermal Detectors

The intelligent thermal detectors shall be 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. A high heat thermal detector rated at 190 degrees Fahrenheit (87.8 degrees Celsius) shall also be available. The thermal detectors shall connect via two wires to the fire alarm control panel signaling line circuit.

G. Intelligent Duct Smoke Detector

The smoke detector housing shall accommodate an intelligent photoelectric detector that provides continuous analog monitoring and alarm verification from the panel. 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. The Intelligent Duct Smoke Detector shall support the installation of addressable Photoelectric detector capable or being tested remotely.

H. Advanced Multi-Criteria Intelligent Fire/CO Detector

1. Advanced Multi-Criteria Fire/CO detector be an addressable advanced multi-criteria smoke detector with a separate signal for carbon monoxide (CO) detection per UL 2075 standards.
2. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical CO sensor, a daylight-filtered infrared (IR) sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.
3. The advanced multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in order to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The detector shall be capable of selecting the appropriate sensitivity levels based on the environment type (office, manufacturing, kitchen, etc.) in which it is installed, and then have the ability to automatically change the setting as the environment changes.
4. The CO detector component shall be capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.
5. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20 percent of the drift range is remaining, when 100 percent of drift range is used, and when there is a chamber fault to show the unit requires maintenance.
6. The detector shall indicate CO trouble conditions, including six months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self-test failure, IR self-test failure, and freeze warning.
7. The detector shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detector shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 159 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.
8. The detector shall provide a test means whereby it 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 switch) or initiated remotely on command from the control panel. There shall be four test methods: functional magnet, smoke entry aerosol, carbon monoxide

aerosol or direct heat method.

9. The detector shall provide two LEDs to provide 360° visibility. The LEDs shall be placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED. The detector must be capable of connecting to a sounder base that provides both temporal 3 and temporal 4 patterns for fire and CO alarm.
10. Two LEDs on the sensor shall be controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, shall cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.
11. The detector shall be plug-in mounted into a twist-lock base. The detector shall be constructed of off-white, UV-resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. The mounting base shall be mounted on a junction box that is at least 1.5 inches (3.81 cm) deep. The mounting base shall be available to mount to standard junction boxes. Suitable boxes include:

    a. 4.0" (10.16 cm) square box with and without plaster ring.
    b. 4.0" (10.16 cm) octagonal box.
    c. 3.5" (8.89 cm) octagonal box.
    d. Single-gang box.
    e. Double-gang box

12. Meets Agency Standards

    a. ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
    b. CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
    c. FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling
    d. UL 2075 – Gas and Vapor Detector and Sensors – Systems Connected

I. Intelligent Addressable Aspiration Detector

The intelligent aspiration detector shall be an addressable aspiration detector that communicates directly with the fire alarm control panel via the SLC communication protocol, no modules or high level interfaces shall be required. The fire alarm control panel shall support up to thirty one intelligent aspiration detectors per SLC loop. The aspiration detector shall have dual source (blue LED and infra-red laser) optical smoke detection for a wide range of fire detection with enhanced immunity to nuisance particulates. The FACP shall be capable of monitoring and annunciating up to five smoke event thresholds and eleven trouble conditions. Each event threshold shall be capable of being assigned a discrete type ID at the FACP.

J. Intelligent Addressable Reflected Beam Detector

1. The intelligent single-ended reflected beam smoke detector shall connect with two wires to the fire alarm control panel signaling line circuit (SLC). The detectors shall consist of a transmitter/receiver unit and a reflector and shall send data to the panel representing the analog level of smoke density. The detector shall be capable of being tested remotely via a key switch; It shall be equipped with an integral sensitivity test feature.
2. The Beam Detectors shall be long range, projected beam type smoke detectors which consist of a Transmitter and receiver in a single unit and reflector on the other side.
3. The Beam Detector shall have a range upto 100 mtrs. There shall be multiple sensitivity

levels. Starting from 25 %, 30 %, 40 %, 50 % and acclimate levels also 30 % to 50 % and 40 % to 50 %. There shall be trouble alarm if obscuration block is more than 96 %.

K. 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 IDC zone shall be suitable for Class A or Class 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.

L. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device)
2. The IDC zone may be wired for Class A or 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.

M. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional circuit of compatible Notification Appliances, 24 VDC powered, polarized audio/visual notification appliances
2. The control module NAC may be wired for Class A/B with a current rating of 2 Amps
3. Audio/visual power shall be provided by a separate supervised circuit from the main fire alarm control panel or from a supervised UL listed remote supply.

N. Addressable Releasing Control Module

1. An addressable releasing module shall be available to supervise and control compatible releasing agent solenoids
2. The module shall operate on a redundant protocol for added protection.
3. The module shall be configurable for Class A/B and support one 24 volt or two 12 volt solenoids.

O. Addressable 4-20 mA Module

Addressable 4-20 mA module shall be available to monitor industry-standard, linear-scale, 4-20 mA protocol sensors. The module converts the sensor output to communication protocol that can be interpreted by the FACP for monitoring and display

1. The module shall support programming of up to five programmable event thresholds.
2. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the FMM-4-20 monitor module and industry standard 4-20 mA gas detectors.

P. Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other network building

functions

2. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.
3. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% of all auxiliary devices energize at the same time on the same pair of wires;
4. For multiple relay control a module shall be available that provides 6 programmable Form-C relays.

Q. Addressable Two-In / Two-Out Monitor/Relay Module

1. An addressable Two-In / Two-Out module shall be available.
2. The two-in/two-out module shall provide two Class B/Style B dry-contact input circuits and two independent Form-C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.

R. 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.

1. 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.
2. The isolator module shall not require 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.
3. The isolator module 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.

S. Serially Connected Annunciator

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. RS-485 wire runs. Up to 32 annunciators, each configured up to 96 points, may be connected to the connection, for a system capacity of 3,000 points of annunciation.
2. An RS-485 repeater shall be available to extend the RS-485 wire distance in 3,000 ft. increments. 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 RS-485 driven relays. This shall extend the system point capacity by 3,000 remote contacts.
7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

T. Speakers

1. The Speaker appliance shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
2. A universal mounting plate shall be used for mounting ceiling and wall speaker products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.
3. Speakers shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker design shall isolate speaker components to reduce ground fault incidents.
4. The speaker shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.
5. All notification appliances shall be backward compatible.

U. Advance Speaker Strobes

1. The Speaker Strobe appliance shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
2. A universal mounting plate shall be used for mounting ceiling and wall speaker strobe products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. Also, Advance speaker strobes shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts (includes fire alarm panels with built in sync). 12-volt rated notification appliance circuit outputs shall operate between 8.5 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 16.5 to 33 volts.
3. Speaker strobes shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker strobe design shall isolate speaker components to reduce ground fault incidents.
4. The speaker strobe shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, or 115 when operating on 24V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range.

5. All notification appliances shall be backward compatible.
6. Strobe lights shall meet the requirements of the ADA, UL Standard 1971and be fully synchronized.

V. Addressable Portable Emergency Telephone Handset Jack

1. Portable emergency telephone handset jacks shall be flush mounted on stainless steel plates as indicated on plans. Handset jacks shall be approved for emergency telephone system application.
2. Insertion of a remote handset plug into a jack shall send a signal to the fire command center which shall audibly and visually indicate the on-line condition, and shall sound a ring indication in the handset.
3. The two-way emergency telephone system shall support thirty five (35) handsets on line without degradation of the signal.
4. Remote Telephone Handset shall be capable of making paging announcement across all the zones in the system.

W. Addressable Fixed Emergency Telephone Handset

1. The telephone cabinet shall be painted red and clearly labeled emergency telephone. The cabinets shall be located where shown on drawings.
2. The handset cradle shall have a switch connection such 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. The two-way emergency telephone system shall support thirty five (35) handsets on line (off hook) without degradation of the signal.
4. Remote Telephone Handset shall be capable of making paging announcement across all the zones in the system.

X. Batteries

The battery shall have sufficient capacity to power the fire alarm system for not less than 48 hours in standby plus 2hours of alarm upon a normal AC power failure.

The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

If necessary to meet standby requirements, external battery and charger systems may be used.

EXECUTION

INSTALLATION

A. 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.

B. All conduit, junction boxes, conduit 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.

C. 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.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

CAUSE & EFFECT LOGIC

System shall be programmed as per the attached cause & effect logic.

TESTING

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
C. Verify activation of all waterflow switches.
D. Open initiating device circuits and verify that the trouble signal actuates.
E. Open and short signaling line circuits and verify that the trouble signal actuates.
F. Open and short notification appliance circuits and verify that trouble signal actuates.
G. Ground all circuits and verify response of trouble signals.
H. Check presence and audibility of tone at all alarm notification devices.
I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
J. Each of the alarm conditions that the system is required to detect shall 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.
K. When the system is equipped with optional features, the manufacturer's manual shall 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.

FINAL INSPECTION

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

INSTRUCTION& TRAINING

A. Instruction shall be provided 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.

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

SUBMITTALS

a) Power calculations.

- Battery capacity calculations.
- Supervisory power requirements for all equipment.
- Alarm power requirements for all equipment.
- Justification showing power requirements of the system power supplies.
- Voltage drop calculations for wiring runs in worst case condition.

b) Complete manufacturer's catalogue data including supervisory power usage, alarm power usage, physical dimensions, finish and mounting requirements.

c) Submit panel configuration and interconnection of modules and all other data as required to make an informed judgment regarding product suitability. As a minimum, data shall be submitted on the following:

- Main system including all fire detection with main and secondary control panels.
- Circuit interface panels including all modules.
- Power supplies, batteries and battery chargers.
- Equipment enclosures.
- Intelligent addressable manual pull stations, multi-criterion detectors, heat detectors, analogue smoke detectors, alarm monitoring modules, and supervised control modules.
- Audible and visual evacuation signals and devices.
- Software and firmware as required providing a complete functioning system.
- Wiring.
- System driven remote annunciators.
- Interface module and wiring configuration from local system to Fire Command System.

d) Submit copies of UL listing or FM approval data showing compatibility of the proposed devices or appliances and the panels being provided.

e) Submit the following shop drawings.

- Floor plans showing all initiating, end of line, supervisory, indicating appliances, and output control devices; including circuit interface panels, enunciators, printers, Control panel location.
- Raceways, marked for size, conductor count with type and size
- Calculations and mathematical justification for speakers meet the code required 15 dBA above ambient for audible warning signals.
- Wiring diagrams showing points of connection and terminals used for all electrical connections to the system devices and panels.
- Complete single-line riser diagram showing all equipment and the size type and number of all conductors.

f) Submit Method Statement for systems component wiring, installation, testing, commissioning and operating.

g) Typical installation drawings

h) Complete operation and maintenance manual with two sets of proposed installation drawings shall be submitted.

i) Warranty all system components, devices, peripherals, wiring, for Three years from date of practical completion Certificate.

j) Guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for One years from date of practical completion Certificate.

4. DIGITAL EVACUATION & PUBLIC ADDRESS SYSTEM

GENERAL DESCRIPTION:

This section of the specifications includes the Supply, installation, Testing, Commissioning and wiring of the IP Based Public address & voice alarm system as shown on the drawings and specified herein. The hardware and software must be designed and manufactured by organizations accredited under ISO 9000 series quality procedures.

5.1 USER REQUIREMENTS:

The broadcasting system uses the same device to play the background music, business announcement and emergency broadcast. It has an emergency call microphone in the fire control center for evacuating the crowds in specific zones when accidence happens and a paging microphone in the broadcasting center to broadcast announcements and search notices.

The background music, business announcement and emergency broadcast share the same loudspeakers. In ordinary situation, the loudspeakers are for playing background music and business announcement, but for emergency broadcast instead during the fires.

The broadcasting devices located in the broadcasting center or the specified location according to the user's requirement. The placement of the devices should meet the operating environment requirement and save up floor space. The amplifier capacity should comply with national standards and be with redundancy. Meanwhile, the emergency broadcast can achieve the linkage of the adjacent layers. Users can select the layers to be linked.

5.2 SYSTEM DESIGN REQUIREMENTS:

As the development of modern science and technology, all kinds of the advanced technologies have been applied in the intelligent buildings to save the labor costs, to improve the efficiency and to ensure the intelligence for the modern buildings. The modern technologies support the public address applications in the intelligent buildings.

5.3 FUNCTIONALITY AND RELIABILITY:

Besides the technical advancement mentioned above, functional design, system structure, system performance, manufacturing process and after-sales support are also important as to ensure the reliability and stability of the system operation, maximizing the mean error-free time. A mature technical platform and the rigorous manufacturing process are the bases of functions' realization. During the runtime, system should be able to discover and eliminate all the functional faults in time. The core components can achieve auto backup. System administrators can easily access the failures and work logs.

5.4 SYSTEM FUNCTION:

The distributed control device (DCS) is integrated with many functions and supports the connection via Ethernet. It has 8 loudspeaker output circuits to connect the loudspeaker in zones and 4 network connection interfaces to connect to 4 network paging control panel or Ethernet. Each DCS can connect up to 4 amplifier channels. The device has integrated amplifier switching matrix to support the redundancy switching and the Client: M/S Ruby Hall Clinic general dry contact input/output interface to connect the external audio sources and dry contact interface of the linkage fire system. It has a built-in 1G memory to store the audios such as digital voice messages and the alarm tone of the emergency broadcast. This device can operate independently without the PC. It encompasses

the functions like the audio playing, zone control, fault monitoring, log recording, volume control and amplifier switchover.

The control device for the system customized NPM. It has the LCD touch screen for operations, like zone selecting, calling, audio sourcing selecting, emergency broadcast, monitoring and internal communication. The functions of the Programmable network paging console NPM can be configured using the configuration software. The system management software installed in the central control room has a user friendly operation interface, enabling the Electronic Map, Devices and Zones statuses' graphic monitoring. Users can set shortcuts and broadcasting programs via the software, as well as proceed background music playing, audio announcement, equipment status view, log view and time-based broadcast configurations.

Distributed Control

This distributed design for the system is based on the building structure to facilitate the connection of the loudspeakers in several nearby zones, which will make the control of the loudspeakers easier. The selected system devices should use the TCP/IP technologies and build on the standard network platform to ensure the extensibility, compatibility for multiple technology platforms and advancement of the system.

Faults detection and Isolation

The Faults detection function for the broadcasting system can automatically examine the host system, power amplifier, power source, communication, and detect the open circuit, short circuit and grounding fault to generate the fault alarm and log. When the grounding fault or short circuit occurs, the amplifier or the main controller of the system should isolate the circuit to ensure the operation of the main devices and normal circuits.

Background Music Audio Source

The broadcasting system can use audio sources from devices such as the CD, radio and MP3 to provide the zones with different audio sources, which can meet the various requirements for different zones. In the tolerant power range, different zones using the same audio source can share an amplifier, reducing the system cost. The background music inputs methods are multiple: both network and local inputs are allowed.

Service Broadcasting

The paging microphone allows users to make paging and broadcast search notices by zone. The paging microphone has a 7" color LCD touch screen. Users can configure the functions directly on the screen. Users can select the zone and audio source, adjust the volume, and enable the emergency broadcast by pressing the button on it. Paging microphones can intercommunicate. 255 broadcast priorities levels available. When the connected distributed control unit is out of order, a paging microphone can continue the intercommunication with other microphones in the network and proceed the remote broadcasting configuration on other control units.

Emergency broadcast

The broadcasting system can be linkage of the fire system to achieve the alarm function in the adjacent layers. The layers for linkage can be configured with the software as the requirements. Users can record the voice message for the emergency broadcast and save it in the host system. The emergency broadcast can start automatically (when linkage of the fire system) and manually. The broadcasting system has its own 1 PPT emergency microphone, which could be used to play emergency broadcasts and evacuate the crowds in specific zones.

When the fire alarm rings, the system can display the fires in planar graph and show the fire zones. According to the fire status, users can call the emergency microphone to make the fire zones enter alarm and evacuation two modes.

Priority

The broadcasting system allows users to set the priorities. Generally, the priority for the broadcast is in the order: Emergency Broadcast > Service Broadcast >Background Music, and for the microphone is Emergency Microphone > Service Broadcast Microphone.

Automatic Amplifier Shift

The system has standby amplifiers. When a main amplifier fails to function, the standby amplifier replaces it automatically. After the main amplifier recovers, the system will use it instead of the standby amplifier in an automatic way.

Internal Communication

The call stations can communicate with each other using the simple communication functions. The paging microphone in the broadcasting center has a 7" color LCD touch screen. Users can configure the functions according to the actual requirements.

The call station's calling zone can be authorized. Each call station can call the local authorized zones. Several call stations can call the same zone, and one call station can call the zones of other call stations.

System Electronic Map

The system interface has several optional views. The electronic map can display statuses of all broadcast zones within the building structure. Users can operate on the broadcasting zones using the electronic map. Maps can be layered into three levels.

Background Music Broadcast

The background music broadcasting functions and local audio sources can be specified in different zones. The administrator can configure the background music according to the time and occasion. The system will automatically switch to the emergency broadcast under emergency.

Program Source

The broadcasting control center has various audio sources, including the professional digital players for background music, CD, FM/AM tuner, remote control microphone for zone calling and high-capacity digital record and playback devices.

Power Source Forced Switchover

The key devices, like DCS and amplifiers, have main power source and 24V standby power source. When the main power source fails to function, the standby power source is responsible for the power supply.

Distributed Call Station

The distributed call station can call the specified zones. The call station has remote control function, which can control emergency broadcast, zone audio sources and external devices.

Automatic Volume Control

The volume of the system can adjust automatically responding to different levels of environment noise
in the crowded areas.

Local & Remote Monitoring

Users can monitor audio sources status via local distributed control units and remote call stations.

5.5 DEVICE SELECTION

The system should be based on the TCP/IP network technologies with high level of integration and flexible configuration to meet various requirements. It is designed for the emergency broadcast and background music application enabling fire emergency broadcast functions like automatic fire warning, voice message presetting, emergency calling, emergency call recording and circuit monitoring, and service broadcasting functions like zone background music broadcasting, zone call broadcasting, timed music broadcasting and monitoring. The device is accordance with the Automatic Control System for Fire Protection (GB16806) and Standard EN 54-16. With public address and voice alarm system integrated into one, the system should solve the duplication of investment and security risks and other problems caused by two individual systems. The distributed intelligent systems of the should be capable of accessing the 10/100M Ethernet network and multiple audio sources from the network. It supports connections in the Ethernet and the networking for several other control systems to perform centralized and distributed management via software. This product should be suitable for medium-scale and large-scale buildings.

5.6 TECHNICAL CHARACTERSTICS

High Integration

The controller should be able to integrate audio source storage, network audio reception, voice broadcasting, audio matrix, volume control, monitoring, troubleshooting and main/standby amplifier switch functions together.

Safety

The system should be GB16806/EN54-16 compliant and can work in severe environment. It can be used to broadcast in case of emergency to disperse and evacuate people. It is a great guarantee for people's life security

Ethernet Based Extension

The central controller should be able to connect over the Ethernet without any external device. The configurable Network Paging Microphone could be placed anywhere in the Ethernet, which will enable the following:

1. The method of distributed installation can save the cost of wiring.
2. If the band width is sufficient, it can use current internal network.
3. Provide plentiful network audio sources.
4. Centralized management of the system via system software.
5. Control the local or global broadcasting by the manner of permissions.
6. Easy to upgrade.

Multiple Audio Sources Support

The system supports the audio sources from emergency microphone, network audio, ancillary line input, build-in audio/music files and web microphones.

Prioritized Control

The system supports 255 priorities. Users can configure it in any way they want and realize all kinds of prioritized broadcasting controlling.

Touch screen

Programmable network paging console (NPM) is equipped with a 7" touch screen. Users can operate on the touch screen to configure multi-zones settings without the need to extend hardware key modules, saving floor space on the desktop.

Input/output Triggering

This system has input/output interfaces which can be triggered by dry contacts. Engineer staffs can configure the contact input to achieve the broadcasting control by the external device (linkage of the fire system). The contact output can be used to control the external devices for the volume, forced switchover and so on. The contact output interface can be linked of the broadcasting operations.

Voice Recording

Besides in the system server, the controller should have a 1GB solid-state storage to store the alarm voice, service voice and other audio files. Users need to upload the audio files to the device using the specified configuration software.

Automatic Recording

When users make broadcasting using the emergency microphone, the system can automatically record the broadcast for 30 minutes or more. The recorded broadcast can be played as the audio source.

Multichannel Digital Power Amplifier

Multi-channel digital power amplifiers with CLASS-D technology design should be used in the system. Its output efficiency is more than 80%, which can reduce the power costs. Besides low power consumption, it is small in size. In this case, several amplifiers can be put in the same chassis to save the space. This kind of power amplifier has the features as below:

1. CLASS-D Amplifier saves the energy with high efficiency.
2. Channel number can be 1, 2 or 4
3. 100V or 70V output is used for each channel.
4. Support balanced input or unbalanced audio input mode.
5. Cooling mode is forced air-cooling mode.
6. Able to limit output voltage automatically.

System Management Software

The system management software can run on the Windows XP/Windows Vista/Windows 7 operation system. It can communicate with the system via the Ethernet. The operation is as simple as below:

System Configuration

– Configure the components and functions of the system management software.
– Configure the devices for the server.
– Configure the electronic map or operation interface.
– Configure audio sources and preset broadcasting operations.
– Drag the maps, icons and buttons to modify the layout on the server operation interface.
– Configure the managing scope and authorities for software on the client end.

User Management

– It can add, edit and delete users and manage access control of the users.
– The broadcasting control function allows users to manage all the broadcasting businesses and to manage the broadcasting management client ends. System State Management
– The software can obtain broadcasting states of each device in the system. The buttons and icons representing devices or zones will be green when all functions are normal, and will turn red when fire occurs.

System Warning

– System Warning Function allows for centralized management of device failure states in the system, and recording the fault log automatically in the log module. When the system detects failure, the interface of the system management software will give out audible & visual alarm. Failed device unit is yellow. Users can accurately locate the failure unit using the interface of the system management software.

Log Management

– System can record and store all system operations histories and failure events for future analysis. Work log and failure log will be stored in separate memories and cannot be deleted manually. Only the logs of the latest one year will be stored. Users can query the logs according to time, workgroup, device, etc. and export the result logs.

Voice Synthesis

– The system management software provides the interfaces for the third party voice synthesis software. It can convert the text words into voice for playing.

Audio Management

– It allows users to perform centralized management of the audio files on the server, and to play them on the network. The audio management function can convert the audio source files in different format into the specified formats of the system. It can put the audio files to the specified broadcasting zones by configuring the preset broadcasting operation.

5.7 Device Description

Digital Integrated System Manager / controller

– The Digital Integrated System Manager is hereinafter referred to as the DCS.
– The DCS is control equipment in the system designed for extending the number of loudspeaker zones, and can support multiple sound source files for broadcasting. The system integrates with functions such as the sound source file storage system, the network audio broadcasting system, the loudspeaker zone control system, and the system for monitoring and diagnosing faults.

The DCS offers various features, which are listed below:

- Supports the manual selection of sound source files, zone buttons, and can be directly operated.
- Supports emergency microphone input for emergency broadcast in the event of, for example, a fire evacuation.
- Includes different indicator lights that identify system running states.
- Performs remote paging and broadcasting operation through the Configurable Network Paging Console.
- Includes 8 zone outputs. The number of zones can be configured through the software.
- 4 auxiliary inputs that can connect to external sound source equipment such as a CD player or tuner
- 4 auto volume control input ports that can set the phantom power supply and gain of each input.
- Auto loudspeaker circuits' short-circuit and open-circuit detection.
- A fuse protects the main power supply. In the case of a power supply short circuit within the DCS, the system automatically disconnects the main power supply.
- Built-in loudspeaker that can monitor the zones and sound sources, as well as monitor the network audio through the NPM.
- Contains 1GB of built-in flash memory that can store recorded voice files so as to fulfill functions such as voice information broadcasting and voice synthesis

- Can simultaneously broadcast four types of sound sources, such as voice audio sources and external input or network audio sources.
- Can automatically record operation and fault logs, and can store up to 10,000 logs of each log type (operation and fault log types).
- Supports switching between the main and backup power amplifiers, and is capable of configuring the standby mode.
- Contains a self-test function.
- Supports automatic fault diagnosis.
- Supports broadcasting volume adjustment.
- Can define the zone and sound source functions. Button function description labels are also easy to install.
- An audio matrix enables broadcasting any audio source in any zone.
- Supports fire emergency broadcast mode so as to improve personnel evacuation efficiency in case of an emergency.
- Supports broadcasting designated recorded voice audio at a designated time so as to allow for unattended broadcasting.
- Capable of system extension through an Ethernet network.

Parameter Value

Power Supply

Main power supply ~100-240V, 50/60Hz
Backup power supply DC 21.5V-28.5V
Main power fuse T2AL 250V
Max. input power 120 W
Rated power 50 W

Audio Input

Auxiliary input 0dB
Input impedance 20 kΩ
Frequency response 60Hz-16KHz
PTT microphone input -51dB
SNR >85dB

Audio Output

Audio output channels 4个
Output signal 0dB
Record output 0dB

AVC Input

Channels 4个
Input signal -50dB/0dB, configured by switch
Input impedance 20KΩ
Phantom power DC 24V, configured by switch
Frequency response 60Hz-16KHz
SNR >65dB

Loudspeaker Circuit

Output channels 8, with circuit fault detection function
Max. output load power 250W

Trigger Input / Output

Trigger input ports 8
Trigger output ports 8 (NO, NC and COM)
Max. working voltage AC 250V/DC 30V
Max. working current 2.5A

Others

Monitoring loudspeaker 10W/8W
Ethernet speed 10M/100M
Ethernet interface number 4
Storage space 1GB

Work Condition

Humidity < 95%, without condensing
Working temperature -10°C~+55°C
Storage temperature -40°C~+70°C

i. 4X125W / 2X250W/1X500W High Efficiency Power Amplifier

- The DA has the following main characteristics:
- Energy-efficient CLASS-D power amplifier
- Contains 1/2/4 independent channels`
- Each channel has 100V or 70V of output
- Supports balanced or unbalanced audio input
- The DA is cooled through forced air-cooling
- Provide automatic re-settable overcurrent, overload, overheating, overvoltage, under-voltage and DC protection

1X500W High Efficiency Power Amplifier

Parameters Values

Rated output power 1X500W
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 10`0V / 70V
Frequency response 70~15KHz (+1dB ~ -3dB)
Input sensitivity and impedance 1.414VRMS & 20K ohm
Output voltage/impedance 100V/40ohm, 70V/19.6ohm
Signal-to-noise ratio (SNR) >90dB
Nonlinear distortion < 0.1% (1KHz, 1/3 rated output power)
Number of channels 1
Environment humidity < 95%, without condensing
Working temperature 0 to +40°C
Storage temperature -10°C to +55°C

500W High Efficiency Power Amplifier

Parameters Values

Rated output power 1X500W
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 70-15KHz (+1dB to -3dB)
Input sensitivity and impedance 1.414VRMS & 20K ohm
Output voltage/impedance 100V/40ohms, 70V/19.6ohms
Signal-to-noise ratio (SNR) > 90dB
Nonlinear distortion < 0.1% (1KHz, 1/3 rated output power)

Number of channels 2
Environment humidity < 95%, without condensing
Working temperature 0 to +40°C
Storage temperature -10°C to +55°C

ii. Volume Controllers

- Volume Controllers have the following four types: 6W, 30W, 60W and 120W respectively.
- The features are as follows:
- Build-in 24V DC forced cut-off relay;
- 5 volume levels control;
- Applicable to 3-wire, 4-wire and 6-wire systems;
- Standard 86X86 installation base-shell.

Parameters Values

Rated power 6W/30W/60W/120W
Supply voltage 100V
Frequency response 50Hz~20KHz
Attenuation 5X2dB + off
Current consumption 20mA, 24V DC

iii. Loudspeakers

Ceiling Loudspeaker

- 6W Metal Ceiling Speaker with 6/3/1.5W taps
  Parameters Values

Max power 9 W
Rated power 6 W
Power taps @ 100V 6W / 3W / 1.5W
Sound pressure level at 6W/1W
(4kHz,1m)
96dB / 88 dB
Frequency range (-10dB) 80 Hz -20 kHz
Dispersion angle (1kHz/-6dB) 160°
Rated input voltage 100 V / 70 V
Rated impedance 1.7 kΩ / 3.3 kΩ
Connection Plastic terminal blocks
Size of speaker 5”

Wall Loudspeaker

- 6W Wall mount speaker with 6/3W taps
  Parameters Values

Rated power 6 W

Power taps @ 100V 6 W / 3 W
Sound pressure level at 6W/1W (1kHz,1m)
96 dB / 88 dB
Frequency range (-10dB) 110 Hz -13 kHz
Rated impedance 1.7 kΩ / 3.3 kΩ
Connection Cable

Horn Loudspeaker

- 15W Horn Loudspeaker with IP66 protection

Parameters	Values
Max power	25 W
Rated power	15 W
Power taps @	100V 15 W / 7.5 W
Sound pressure level at (1kHz,1m)	6W/1W
110.3 dB / 98.5 dB	
Frequency range	(-10dB) 500 Hz - 5 kHz
Dispersion angle	(1kHz/-6dB) 140°
Rated input voltage	100 V / 70 V
Rated impedance	500 Ω / 1 kΩ
Connection Cable	
Case material ABS	

1.4.7 CABLE SPECIFICATIONS:

For Amplifier to Speaker & Between Speakers:

Sr. No.	Description
1	2 Core X 1.5 Sq. mm Multi Stranded Copper, Overall Shielded, Twisted Pair, FRLS PVC Insulated Flexible cable

5.8 Training

- Train the clients to know the system structure and principles.
- Train the clients to know and master the installation methods of the digital broadcasting systems.
- Train the clients to master the configuration methods of the digital broadcasting systems.
- Train the clients to use digital broadcasting system software.

5. Train the clients to know basic troubleshooting and maintenance methods of the digital broadcasting systems.ACCESS CONTROL SYSTEM - SPECIFICATIONS

6.1. Finger & Card Based Controller

Technical Specifications	
Credential Support	Card, Pin and Finger
User Capacity	2,000
Sensor	Optical
Templates Capacity	9600
Templates per User	Up to 10
Cards per User	Up to 2
Type of Card	EM Prox, HID Prox, HID i-class & Mifare and UHF card
Verification Method	1:1 and 1:N
Verification Time	Less than 1 second
CPU	32 Bit Microcontroller
Flash Memory	512 KB Internal Flash + 2 MB External Flash
RAM Memory	128 KB SRAM
Tamper Detection	Yes
Display	128 x 64 Dot Matrix Display
Keypad	16 Sense Keys
LED	4 LED (Status, Alarm, Allowed and Denied)
Buzzer	Yes
USB	1 USB for Data Transfer
Event Buffer	50,000
Exit Switch Port	Yes
Door Status Sense	Programmable NO, NC , Supervised
Door Lock Relay	Relay SPDT, Form C, 1A @ 30 VDC
Door Lock Power	Internal 12 VDC @ 0.5 A or External
Auxiliary Input Ports	Programmable NO, NC, Supervised
Auxiliary Outputs Relay	Relay SPDT, Form C, 1A @ 30 VDC
Input Power	12 VDC @ 2 A
Reader Interface Types	RS-232, and Wiegand
Reader Types	1 Port for Card Reader / Finger Reader / Card Finger Combo Reader / UHF Reader
Reader Power Output	Internal 12 VDC @ 0.5 A or External
Communication Port	Ethernet and RS-485
Operating Temperatures	- 10 °C to + 50 °C
Humidity	5% to 95% RH Non-Condensing
Battery Backup	Minimum 4 hours (Internal/External)
Certifications	CE and RoHS

6.2. CARD BASED READER

Technical Specifications	
Credential Support	EM Proximity Card

LED Indication	Tri Color LED
Buzzer	Yes
Communication	RS232
Temper Detection	Yes
IP65 (Weather Proof)	Yes
Operating Temperatures	- 10 °C to + 50 °C
Humidity	5% to 95% RH Non-Condensing
Certifications	CE and RoHS

6. CABLE TV DISTRIBUTION SYSTEM

7.1. SCOPE

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

- Television cables
- Television wiring in conduits

7.2. CONDUITS

Conduits shall be as given below :

- The conduit shall generally be as specified in the BOQ.

7.3. INSTALLATION

- The connection at the spiller/junction boxes shall be made with end sockets as to achieve minimum contact resistance.
- The final branch connections with single cables in conduits and the maximum number of cables in each conduit shall be as follows :

Conduit diameter Inch / mm.	Max. No. of cables
1" / 25	2/3 nos. RG 6 /11
1¼"/ 32	6 Nos. RG 6 /11

LIST OF APPROVED MAKES (CIVIL WORK)

S.N.	ITEM DESCRIPTION	Suggested Makes/Manufactures
1	OPC Cement Grey – 33 Grade-43 grade-53 grade	Gujarat Ambuja /Sidhi/ultratech/ACC / J K lakshmi / Binani
2	White Cement, Putty, Primer to be applied with putty	Birla White/ JK White / Birla putty & Primer / JK Putty & Primer
3	Coarse Aggregates 6mm to 40mm sizes	Approved quarry from locally available best quality as approved by
4	Autoclave Aerated concrete blocks	Ultra tech/ Eco Green/ Build tech/ Siporex/ Brixo
5	Water Proofing Compound,	Penetron USA./ / Myk/ Laticrete/ Mapei / M.C. Bauchemie /Roffee / Ardex Endura
6	Waterproof coating & Pre-formed HDPE Membrane	Mapei/ BSF/MYK Arment
7	Floor Hardener	Laticrete/ Mapei / Myk / M.C. Bauchemie /Roffee
8	P.U coating`	MRF/ Asian/ Berger
9	Reinforcement Steel-Fe500 (minimum)-all diameters.	Tata Tisco / Sail / JSW / Vizag/Kamdhenu / Electrotherm
10	Structural Steel and all Mild Steel elements and plates.	Tata Tisco / Sail /Essar / Vizag /Jindal/Arcelor Mittal
11	MS Tube/Pipe	Jindal/TATA Structural /Apollo
12	Stainless Steel	Salem/Jindal
13	Laminates, all Ply materials,	Century/Green lam/Durian
14	Compact laminate Sheet	Green lam, Bloom, Sundek,
15	Float glass & Mirrors	Modi GUARD/Asahi /Saint Gobain/ HNG
16	SS Fittings	Kich / DORMA / ENOX
17	Aluminium Sections	Hindalco/ Jindal/ BANCO/ Domal
18	Aluminium windows/DGU Windows	Technal/ Raynears /Schuco
19	Friction Stay	Hettich/Hafele/EBCO
20	Flush door	Green ply/ Century/ Kit ply/ Marino
21	Fire & non rated fire doors	J C fire doors/ Shakti Mate/ Radiant
22	Hydraulic Door Closure-IS-3564-1986	Kich / Enox/ Dorma/ Hardwyn/Everite
23	Door locks and hardware fittings	Enox/ Dorma/Kich/ Hardwyn/Everite
24	Floor Spring	Enox/Dorma/Kich
25	Aluminium Composite Panel	Alucobond/ Reynobond /Alpolic
26	All types of Paints /Primers/red-oxide & Polish (all premium quality)	Asian/Nerolac/Berger/ ICI Dulux/Jotun
27	Ceramic / Glazed tiles	Kajaria/ Somani /H&R Johnson/ Nitco/ Restile /Bell
28	Vitrified Tile/GVT tiles	Kajaria/ Restile / /Somany / H&R Johnson/ /Rak.
29	Anti termite Chemicals	Chlorpyriphos/ biflex TC/ Lindane/ Bayer
30	Tile/ stone Adhesive Chemical & Joint filler	Kerakol / Ardex Endura/ Myk /Laticrete/ Mpaei
31	Acid & Alkaline resistance Tiles/ Paver tiles	Pavit / Johnson/ Nitco
32	Calcium silicate false ceilings	Arolite/ hilux/ Armstrong
33	Gypsum Board	Saint Gobbin, Armstrong, Shera, Gyproc make
34	Green Kota	As Per Sample Approved Of Quarry From

			Reputed Local Supplier
	35	UPVC Pipe, Specials And Fittings/All PVC Materials	Finolex/Supreme/Astral/Prince
	36	PVC Vinyl Flooring	Bhor/ Armstrong /Tarket /Gerflor
	37	PVC Water Stop	Maruti / Equivalent/ Fixopan
	38	PVC Water Tank	Sintex / Polycon / Kaka
	39	CI/PVC Rungs	Neco/ Kapilance Or equivalent
	40	Polysulphide Silicon Sealant	Wecker, Dowcorning,Choksi,
	41	Bitumen, Sealing Compound, Bitumen Board	Shalitex, IOC , GE SILICON , CIBA TUL, STP, Or Equivalent Approved
	42	All Sanitary Wares Fittings, Accessories Etc All	Jaquar/ Parryware/Hindustan/Cera/ Kohler
	43	CP Fittings	Jaquar / Kohler/ Hindware/ Cera
	45	GI Pipes-Medium Class (IS:1239)	TATA / Jindal
	46	GI Fittings	“R” / “KS” / UNIK Brand Or Equivalent Approved
	47	SS Sink	Nirali /Kich / AMC / Carysil / Futura/ Cera
	54	Anti-Cockroaches Stainless Steel Perforated Trap	Chilly/ Kich/ Nirali/ Cera
	55	Stainless Steel Perforated Trap Cover	Chilly/ Kich/ Nirali/ Cera
	44	Ball valve for Water supply lines	Audco / RB / Intervalve /Zoloto / Normex
	45	Butterfly valve for Water supply lines	Audco / RB / Intervalve /Zoloto / Normex
	46	Air Realise valve for Water supply lines (ARV)	Audco / RB / Intervalve /Zoloto / Normex
	47	Non return valve for Water supply(NRV)	RB/Spirax /Zoloto
	48	Pressure reducing valve for Water supply(PRV)	Hawa / Kirloskar / Sant / VB /CIM/SKS/ Zoloto
	49	Foot valve	Audco/ Intervalve /Spirax
	50	G.M. Float valve	Prayag /R.B
	51	Solenoid valve	Aveon/ Danfoss, Airmex, Aira
	52	Strainer	Audco / RB / Intervalve /Zoloto / Normex
	53	.W.T Water Tank, (3 Layer / 4 layer)	Sintex/Kaka/Astral/Supreme/Rhino/Tanks
	54	Pipe Supports, Hangers	Intello Tech/G.M.G.R / Chilli / Hilti
	55	Drain Non return Valve	Viega/Capricom
	56	Air Admittance Valve	Capricom/Studor
	57	Internal Cold water supply	**For Pex :** Kitec/Viega/Goerge fisher/ Thermaflex /Gabrit Nuev tairran/ Cosmoplast
	58	Internal Hot water supply	**For Composite** : Kitec /(Bandable Astral)
			For Pex : Kitec/Viega/Goerge fisher/ Thermaflex /Gabrit Nuev tairran/ Cosmoplast
			For Composite : Kitec /(Bandable Astral)
	59	Cold water supply	**For Pex :** Kitec/Viega/Goerge fisher/ Thermaflex /Gabrit Nuev tairran/ Cosmoplast **For Composite** : Kitec /(Bandable Astral)
			For CPVC : Astral / Ashirvad / Supreme/Finolex
	60	Hot water supply	**For Pex :** Kitec/Viega/Goerge fisher/ Thermaflex /Gabrit Nuev tairran/ Cosmoplast

	61	Insulation for all Hot water pipes and External/Open Cold water pipes	Thermaflex / Armaflex /Kiflex/Vidoflex/Superlon
	62	Internal Drainage	**For C.I :** Neco/Kapilansh /SKF
	63	Internal Rain water	**For PVC** :Finolex /Supreme /Astral /Prince
	64	External Drainage	**For Upvc Foam Core:** Astral /Supreme/Ashirvad/Finolex
			For : R.C.C Alcock / Local
	65	Gully Trap	**For Stoneware :**First class / **RPI** / Vijapur or local **ISI Marked**
			For Upvc Foam Core: Astral /Supreme/Ashirvad
	66	Manhole Cover/Grating	Neco /Alcock K.K.Manhole/Jainspun/Pragati/Thermo drain
	67	External Strom/Rain water	**For Upvc Foam Core:** Astral /Supreme/Ashirvad / Finolex
			For : R.C.C Alcock / Local
	68	Garden Water supply	**For : HDPE** Dutron /Reliance / Time Techno
			For : UPVC Astral / Ashirvad / Supreme
	69	External Water supply	**For : HDPE** Dutron / Reliance / Time Techno guard
			For : UPVC Astral / Ashirvad / Supreme
70		H.D.P.E pipes	Dutron/Jain/ Noble

Special Notes

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LIST OF MAKES OF MATERIALS FOR ELECTRICAL WORK

I	H.T. MC /RMU PANEL	L&T /SIEMENS/ SCHNEIDER ELECTRIC. /CROMPTON
2	H.T. VCB	L&T /SIEMENS/ SCHNEIDER ELECTRIC. HT PANEL SHALL BE OEM OR OEM PARTNER.
3	PROTECTION RELAY FOR H.T PANEL	L&T / SIEMENS / SCHNEIDER / CSPC / ALSTOM
4	H. T. XLPE CABLE	FINOLEX / RR KABLE / AVOCABPOLYCAB
5	H.T. JOINT HEAT SHRINKABLE	RAYCHEM / 3-M
6	CSS	SCHNEIDER /ABB/ SEIMENS - C&S / VOLTAMP
7	DRY TYPE TRANSFORMER	SCHNEIDER/ VOLTAMP / UNIMAG/ ABB/ UNITRANS
8	SWITCHGEAR	SCHNEIDER / L & T / LEGRAND /SIEMENS
9	MEDIUM VOLTAGE CABLE/ FLEXIBLE CABLE/ WIRES FOR INTERNAL WIRING	RR KABLE / / POLYCAB / AVOCAB / FINOLEX/
10	DG SET	CUMMINS/ SUPERNOVA / PERKINS /KISLOSHKAR
11	DG SET AMF PANEL	AS PER THE DG SET SUPPLIER. {SWITCHGEAR AS PER MAKE LIST.)
12	LT PANELS AS PER IEC 61439 Ii TTAI PANELS	LEGRAND/ SCHNEIDER/ L&T / SEIMENS/OEM CERTIFIED IEC- 61439 REQUIRED.
		FABRICATED PANELS WITH STANDARD APPROVED SWITCH GEARS & ACCESSORIES CPRI / ERDA APPROVED PANEL SUPPLIERS, 65 **KA** SHORT CIRCUIT
13	LT PANELS AS PER CPRI	WITHSTHAND STRENGTH. OEM APPROVED.
14	APFC PANEL	SCHNEIDER -VARSET / DATAR /L & T / EPCOS
15	CAPACITOR	SCHNEIDER/ DATAR / EPCOS/CONZERV
16	DISTRIBUTION BOARDS	LEGRAND/ SCHNEIDER /SIEMENS/ HONEYWELL / L&T / MK
17	LT ACS	SIEMENS / SCHNEIDER / LEGRAND / L&T
18	LT MCCB WITH EARTH FAULT	SIEMENS / SCHNEIDER / / LEGRAND / L&T
19	LT MCB, ELCB,ISOLATOR	LEGRAND / SCHNIEDER / SIEMENS / HONEYWELL/ L&T
20	LT SFU	LEGRAND / SCHNIEDER / SIEMENS / HONEYWELL/ L&T

21	LT CONTACTORS	LEGRAND/ SCHNIEDER/ SIEMENS/ HONEYWELL/ L&T
22	CURRENT TRANFORMER & POTENTIAL TRANSFORMER	AE / ASHMOR / SEI / L&T
23	METERS IDIGITALI	CONZERVE / SCHNEIDER / SECURE / L & T / LEGRAND/
24	LOAD MANAGER/MFM	CONZERVE /SCHNEIDER/ SECURE/ L & T / LEGRAND
25	PROTECTION RELAYS- EARTH FAULT	SIEMENS / L & T / SCHNEIDER / ALSTOM / CSPC
26	INDICATING LAMP	SIEMENS/ SCHNEIDER ELECTRIC/ L & T - ESBEE / TEKNIC -KEYCEE
27	ELECTRIC TIMER	SIEMENS / L&T / LEGRAND
28	ROTARY SWITCH	SIEMENS/ SCHNEIDER ELECTRIC / TEKNIC - KEYCEE/ L & T
29	PUSH BUTTON AND PUSH BUTTON SET	SCHNEIDER ELECTRIC / L & T / BINAY / RAAS CONTROL
30	SELECTOR SWITCH	TEKNIC - KEYCEE / SALZER / L&T
31	ANNUNCIATOR	PROTON / EAPL / TEKNIKA
32	LUGS/ BIMETALLIC LUGS	DOWELL/ HMI /COMET/HEX
33	CABLE GLAND	JAINSON / COMET/ POLYCAB/ HEX
34	CONNECTORS I COLOURS AS PER PHASE & NEUTRAL	SALZER / ELEMEX / L&T
35	ATS	ASCO / SOCOMEC / L&T
36	CABLE TRAY I ALL TYPE	LEGRAND - CABL OF OIL / 080 BETTERMAN/ PROFAB
37	SPD	NISHARP - CAPE/ 080 / LEGRAND/ SCHNEIDER
38	OWE PIPE	REX/ NOBLE /ASTRAL
39	L.T. CABLE JOINTING KIT	RAYCHEM / 3-M
40	PVC CONDUITS AND ACCESSORIES	PRECISION/ NIHIR / POLYCAB /ASTRAL
41	CASING CAPING	PRECISION/ NIHIR / POLYCAB /ASTRAL
42	FLOOR TRUNKING & FLOOR JUNCTION BOX	MK-HONEYWELL/ LEGRAND / OBO
43	MODULAR SWITCHES, SOCKETS & OTHER ACCESSORIES	MK / HONEYWELL / LEGRAND/ SCHNEIDER
44	METAL CLAD SOCKET WITH MCB	LEGRAND / HONEYWELL/ SCHNEIDER
45	PVC TAPE	STEEL GRIP/ANCHOR
46	PVC JUNCTION BOX	PRECISION/ NIHIR / POLYCAB /ASTRAL
47	COAXIAL TV CABLE	DELTON/ HAVELLS / RR / FINOLEX / POLYCAB
48	INTERNAL LIGHT FIXTURE	TRILUX / LIGHTING TECHNOLOGIES / PHILIPS / /WIPRO

49	HIGH SPEED FAN & EXHAUST FAN	BAJAJ/ CROMPTON/USHA / ORIENT
50	EXTERNAL LIGHT FIXTURE	TRILUX / LIGHTING TECHNOLOGIES / PHILIPS / /WIPRO
51	POLE •	K - LITE/ AMBICA /FABRICATED/ OR AS PER ARCHITECT SELECTION
52	METAL CONDUIT	BEC / AKG / BHARAT/STEEL CRAFT
53	UPS SYSTEM	NUMERIC/ APC /VERTIV /EATON
54	EARTHING SYSTEM	CAPE - NISHARP / OBO BETTERMANN / ABB
55	LIGHTNING PROTECTION	CAPE - NISHARP / OBO BETTERMANN / ABB
56	IP JUNCTION BOX	HENSEL/ LEGRAND/ OBO / RITTAL
57	WATER COOLER	VOLTAS/ USHA/ BLUE STAR
58	MOTOR PUMP SET	CROMPTON/ KIRLOSKAR/ LUBI/ZYLEM
59	CALL BELL	ANCHOR/ ORPAT/ VISION
60	BUSDUCT	SCHNEIDER/ LEGRAND/ L&T

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ELV & AV Make List		
SR.NO.	ITEM DESCRIPTION	MAKE LIST
I	COMPONENTS FOR STRUCTURE CABLING SYSTEM	COMMSCOPE - TYCO/ MOLEX/ D-LINK/ R & M/ LEGRAND
2	NETWORK RACKS	NETRACK/ ELIXIR/ APW/ RITTAL/ VALRACK
3	NETWORK SWITCHES	HP ENTERPRISE/ CISCO ENTERPRISE/ EXTREME NETWORKS
4	l0G SFP MODULE	HP ENTERPRISE / CISCO ENTERPRISE / EXTREME NETWORKS
5	WIRELESS CONTROLLER	HP ENTERPRISE/ CISCO ENTERPRISE/ EXTREME NETWORKS
6	ACCESS POINTS	HP ENTERPRISE / CISCO ENTERPRISE / EXTREME NETWORKS
7	UNIFIED THREAT MANAGEMENT SYSTEM	CHECKPOINT/ CISCO/ FORTINATE /SOPHOS
8	EPABX SYSTEM	CISCO/ MATRIX/ UNIFY/ **AVAYA**
9	DIGITAL PHONE	CISCO/ MATRIX/ UNIFY/ AVAYA
10	CU PHONE	BEETEL/ PANASONIC/ UNIFY/ MATRIX
11	IP PHONE	CISCO/ MATRIX/ UNIFY/ AVAYA
12	FIRE ALARM PANEL	NOTIFIER/ SIEMENS / SIMPLEX / ESSER
13	REPEATER PANEL	NOTIFIER /SIEMENS/ SIMPLEX/ ESSER
14	SMOKE/ MULTI CRITERIA/ THERMAL/ MONITOR MODULE/ CONTROL MODULE/ ISOLATOR MODULE/ SOUNDER/	NOTIFIER / SIEMENS / SIMPLEX/ ESSER
15	2C I .5SQMM FRLS ARMOURED CABLE	CALIPLAST/ FINOLEX/ POLYCAB
16	NETWORK CONTROLLER	BOSCH / HONEYWELL/ Bl-AMP
17	POWER AMPLIFIER	BOSCH /HONEYWELL/ Bl-AMP
18	MULTICHANNEL INTERFACE	BOSCH/ HONEYWELL/ Bl-AMP
19	DIGITAL CALL STATION	BOSCH / HONEYWELL/ Bl-AMP
20	NETWORK CABLE & ASSEMBLIES	BOSCH/ HONEYWELL/ Bl-AMP
21	CEILLING SPEAKER	BOSCH / HONEYWELL/ Bl-AMP
22	CABINET SPEAKER	BOSCH / HONEYWELL / Bl-AMP
23	SOFTWARE FOR PA SYSTEM	BOSCH / HONEYWELL / Bl-AMP
24	2C I .5SQMM FLEXIBLE CABLE	CALIPLAST/ FINOLEX/ POLYCAB
25	FINGER & CARD BASED CONTROLLER	MATRIX/ HONEYWELL/ ROSSLARE / SUPREMA

26	CARD BASED READER	MATRIX/ HONEYWELL/ ROSSLARE/ SUPREMA
27	ACCESS CONTROL & TIME ATTENDANCE SYSTEM	MATRIX/ HONEYWELL/ ROSSLARE/ SUPREMA
28	DOME/ BULLET CAMERA (FIXED & VARIFOCALl	HIKE VISION/ BOSCH/ INFINOVA /HANWHA/MATRIX/ PELCO
29	PTZ CAMERA	HIKE VISION/ BOSCH/ INFINOVA /HANWHA/MATRIX/ PELCO
30	VIDEO MANAGEMENT SOFTWARE	MILESTONE /GENETEC /MIRASYS/ MATRIX/ PELCO/HIKE VISION
31	VIDEO MANAGEMENT SERVERS	HP/ DELL/ CISCO
32	RECORDING SERVER	HP/ DELL/ CISCO
33	CENTRALIZED STORAGE	DELL/ HP/ Q-NAP / NET-APP/INFORTREND
34	VIDEO CONFERENCE SYSTEM	CISCO/ POLYCOM/ AVAYA
35	INTERACTIVE DISPLAY	SAMSUNG/ NEWLINE/ CHRISTIE/ PRYSM
36	BUILDING MANAGEMENT SYSTEM· CONTROLLER	JOHNSON CONTROL-METASYS/ SIEMENS/ ALC /BECKHOFF
37	BUILDING MANAGEMENT SYSTEM· SENSORS	SIEMENS / DWYER / GREYSTONE / OMICRON / FILPRO
38	MULTIVIEWER	CRESTRON /KRAMER/ UGHTWARE / CISCO
39	MATRIX SWITCHER	CRESTRON /KRAMER/ LIGHTWARE / CISCO
40	ENCODING/ DECODING DEVICES	CRESTRON /KRAMER/ LIGHTWARE / CISCO
41	ROOM CONTROLLER	CRESTRON /KRAMER/ UGHTWARE / CISCO
42	POE TOUCH PANEL	CRESTRON /KRAMER/ LIGHTWARE / CISCO
43	HD STREAMING TRANSMITTER/ RECEIVER	CRESTRON /LUMEN$/ DATAVIDEO/ LIGHTWARE / CISCO
44	HDMI CABLES	CRESTRON /KRAMER/ LIGHTWARE / CISCO
45	PASSIVE HDMI WALL PLATE	CRESTRON /KRAMER/ LIGHTWARE / CISCO
46	AUDIO CABLE	CRESTRON /KRAMER/ LIGHTWARE / CISCO
47	SPEAKER CABLE	CRESTRON /KRAMER/ LIGHTWARE / CISCO
48	NETWORK MANAGEMENT SOFTWARE	CRESTRON /KRAMER/ LIGHTWARE / CISCO
49	HEAD CAMERA SOLUTION	DESIGN FOR VISION / SUN OPTICS / INTEGRA / BFW / LUXTEC
50	MEDICAL GRADE DISPLAY	BARCO / HIGHNESS / FNS
51	DIGITAL SIGNAL PROCESSOR	BOSCH/HONEY WELL/BOSE/JBL
52	CEILING SPEAKER	BOSCH/HONEY WELL/BOSE/JBL

53	AMPLIFIER	BOSCH/HONEY WELL/BOSE/JBL
54	HEAD WARM MICROPHONE	SENNHEISER / BEYERDYNAMIC / AUDIOTECHNICA
55	20X PTZ CAMERA	DATAVIDEO / LUMENS /SONY/ VADDIO/HIK VISION/ HIKE VISION

Special Notes

If "Equivalent Make" is proposed for the items then Contractor is required to submit Detailed specifications/ certificates for the proposed make for BOQitem, which·shall be considered/approved by the ARCHTECT.

Makes/ Models of items of all fixtures/ Items/ Materials must be got approved from the ARCHITECT well in advance before placing any order. The contractor/ agency is required to submit all relevant test certificates documents and along with the proposal. The decision of ARCHITECT is final & binding to the contractor

LIST OF HVAC APPROVED MAKES

Sr. No.	COMPONENT	APPROVED MAKE
1	OUTDOOR UNITS	DAIKIN / BLUE STAR / MISTUBISHI ELECTRIC / MEDIA
2	MOTORS	ABB / CROMPTON / SIEMENS /
3	AIR HANDLING UNITS	CITIZEN / JPC / ATMOS AIR EQUIPMENT
4	INSULATION	
a.	EXPANDED POLYSTYRENE	BEARDSELL / MODIFOAM /COOLINE
b.	NITRILE	A-FLEX / ARMAFLEX / PARAMOUNT / SUPERLON
c.	CCCL	TROCELENE / PARAMOUNT / SUPERLON
5	CONTROLS / MEASUREMENT / INSTRUMENTS	
a.	THERMOSTATS & CONTROLLER	HONEYWELL / STEAFA / SAUTER / JOHNSON / SIEMENS
b.	HUMIDISTATS	HONEYWELL / PENN / JOHNSON / SIEMENS
c.	THERMOMETERS	H. GURU / TEDDINGTON
d.	EXPANSION VALVES	SPORLAN / DANFOSS
e.	HP / LP SWITCHES	RANCO / DANFOSS
f.	GRILLES / DIFFUSERS /NOZZLES	DYNACRAFT / COSMOS / RAVI STAR / AIR PRODUCT
6	DUCTING SHEETS	SAIL / NIPPON / NATIONAL/ ESSAR/JINDAL
7	FAN	PUNKER / KRUGER / NICOTRA
8	CUSHY FOOTS MOUNTS	DUNLOP / DYNA / POLUBOND RESISTOFLEX