

SUB SECTION 4.2
GENERAL and SPECIAL CONDITION OF CONTRACT,
&
TECHNICAL SPECIFICATION
FOR
ELECTRICAL WORK

**VARIOUS CODES FOR ELECTRICAL WORKS****1.0 APPLICABLE IS STANDARDS**

1. METERS (MEASURING) FOR ANALOG METERS	IS:1248-1986
2. INSTALLATION AND MAINTENANCE OF SWITCH GEARS	IS:3072-1975
3. CODE OF PRACTICE FOR EARTHING	IS:3043
4. H.D. AIR BREAKER, SWITCH GEARS AND FUSES FOR	
a. VOLTAGE NOT EXCEEDING 1000 VOLTS	IS:4047-1977
5. SELECTION, INSTALLATION AND MAINTENANCE OF FUSES	IS:8106-1966
a. UP TO 650 VOLTS	
6. GENERAL REQUIREMENTS FOR SWITCH GEAR AND	IS:4237-1967
a. GEAR FOR VOLTAGE NOT EXCEEDING 1000 VOLTS	
7. DEGREE OF PROTECTION PROVIDED BY	
a. ENCLOSURES FOR LV S/GEARS	IS:2147-1962
8. INSULATED CONDUCTOR RATING	IS:8084-1972
9. ENCLOSED DISTRIBUTION FUSE BOARDS AND CUT-OUTS	
a. FOR VOLTAGE NOT EXCEEDING 1000 VOLTS	IS:2675-1983
10. MINIATURE CIRCUIT BREAKER	IS:8828-1978
11. FUSE WIRE USED IN RE-WEARABLE TYPE ELECTRIC FUSES	
a. UP TO 650 VOLTS	IS:9926-1981
12. PVC INSULATED ELECTRIC CABLES HEAVY DUTY	IS:1554 (PART I)
13. RECOMMENDED CURRENT RATING FOR CABLES	IS:3961 (PART II)
14. COPPER CONDUCTOR IN INSULATED CABLES AND CORES	IS:2982
15. CONDUCTOR FOR INSULATED ELECTRIC CABLES AND	
a. FLEXIBLE CORDS	IS:8130
16. MILD STEEL WIRES, STRIPS AND TAPES FOR ARMOURING	
a. CABLES	IS:3975
17. PVC INSULATION AND SHEATH OF ELECTRIC CABLES	IS:5831
18. ALUMINIUM CONDUCTOR FOR INSULATED CABLES	IS:1753
19. PVC INSULATED AND PVC SHEATHED SOLID ALUMINIUM	IS:4288
20. CONDUCTOR CABLES OF VOLTAGE RATING NOT EXCEEDING 1100 VOLTS	
21. RECOMMENDED CURRENT RATING FOR CABLE	IS: 961
22. CODE OF PRACTICE FOR ELECTRICAL WIRING	
a. INSTALLATION SYSTEM VOLTAGE NOT EXCEEDING 650	IS: 732
b. VOLTS CODE OF PRACTICE FOR FIRE SAFETY OF BUILDINGS	
c. GENERAL ELECTRICAL INSTALLATION	IS: 1646
23. RIGID STEEL CONDUITS FOR ELECTRICAL WIRING	IS:1653
24. FITTINGS FOR RIGID STEEL CONDUITS FOR ELECTRICAL	IS:2667
a. WIRING	
25. FLEXIBLE STEEL CONDUIT FOR ELECTRICAL WIRING	IS:3480
26. ACCESSORIES FOR RIGID STEEL CONDUITS FOR	IS:3837
a. ELECTRICAL WIRING	
27. PVC INSULATED CABLES (WIRES)	IS:694
28. RIGID NON-METALLIC CONDUITS FOR ELECTRICAL WIRING	IS:2509
29. FLEXIBLE (PLAYABLE) NON-METALLIC CONDUITS FOR	IS:6946
a. ELECTRICAL INSTALLATION	
30. THREE PIN PLUGS AND SOCKETS	IS:1293
31. CONDUCTORS FOR INSULATED ELECTRICAL CABLES AND	IS:8180
a. FLEXIBLE CODES	
32. SPECIFICATION FOR CONDUIT FOR ELECTRICAL	
a. INSTALLATION	IS:9537-1980
33. ACCESSORIES FOR NON-METALLIC CONDUITS FOR	
a. ELECTRICAL WIRING	IS:3419
34. SWITCHES	IS:3854
35. PLUGS	IS:6538
36. SHUNT CAPACITORS FOR POWER SYSTEMS	IS:2834-1954
37. HRC CARTRIDGE FUSES AND LINKS UP TO 660 VOLTS	IS:2208
38. GENERAL AND SAFETY REQUIREMENT FOR LIGHTING	



a. FITTINGS	IS:1913-1969
39. CODE OF PRACTICE FOR LIGHTING PUBLIC THOROUGH	
a. FARES	IS:2944-1981
40. WATERPROOF ELECTRIC LIGHTING FITTINGS	IS:3528
41. WATER TIGHT ELECTRIC LIGHTING FITTING	IS:3553-1966
42. MILD STEEL TUBULAR AND OTHER WROUGHT STEEL PIPE	
a. FITTING	IS:1239-1958
43. LUMINARIES FOR STREET LIGHT	IS:2149-1970
44. HRC FUSES HAVING RUPTURING CAPACITY OF 90 KA	IS:9224
45. EXHAUST FAN	IS:2312-1967
46. CLASS I CEILING FAN	IS:374-1979
47. DANGER NOTICE BOARDS	IS: 2551
48. Cabinets and Boxes	UL 50
49. Smoke Detectors for Fire Protective Signaling Systems	UL 268
50. Control Units for Fire Protective Signaling Systems	UL 864
51. Smoke Detectors for Duct Applications	UL 268A
52. Thermal Detectors for Fire Protective Signaling Systems	UL 521
53. Door Closers-Holders for Fire Protective Signaling Systems	UL 228
54. Audible Signaling Appliances	UL 464
55. Manually Activated Signaling Boxes	UL 38
56. Water flow Indicators for Fire Protective Signaling Systems	UL 346
57. Power Supplies for Fire Protective Signaling Systems	UL 1481
58. Proprietary Burglar Alarm Units and Systems	UL 1076
59. Visual Notification Appliances	UL 1971

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:

Indian Electricity Act of 1910 and rules issued there under revised up to date.

Special Attention should be given to Rule No. 50.

Regulations for electrical equipment in building issued by The Bombay Regional Council of insurance Association of India.

GENERAL TECHNICAL SPECIFICATIONS FOR ELECTRIC WORKS**L. T. PANELS / P.C.C. / M.C.C.****1.0 TYPE OF PANEL:**

All the PCC's / PDB's / MCC's shall be metal clad, totally enclosed, rigid, floor mounted, air - insulated, cubical type suitable for operation on three phase / single phase, 415 / 230 volts, 50 Hz.

The PCC's / MCC's shall be designed to withstand the and heaviest condition at site, with minimum expected ambient temperature of 45 degree Celsius, 80 percent humidity and dusty weather.

Should conform to Indian Electricity Act and rules (till last amendment) & approved as per FIA norms.

1.1 APPLICABLE IS STANDARDS

METERS (MEASURING) FOR ANALOG METERS	IS:1248-1958
INSTALLATION AND MAINTENANCE OF SWITCH GEARS	IS:3072-1975
H.D. AIR BREAKER, SWITCH GEARS AND FUSES FOR VOLTAGE NOT EXCEEDING 1000 VOLTS	IS:4047-1977



SELECTION, INSTALLATION AND MAINTENANCE OF FUSES UP TO 650 VOLTS	IS:8106-1966
GENERAL REQUIREMENTS FOR SWITCH GEAR AND GEAR FOR VOLTAGE NOT EXCEEDING 1000 VOLTS	IS:4237-1967
DEGREE OF PROTECTION PROVIDED BY ENCLOSURES FOR LV S/GEARS	IS:2147-1962
INSULATED CONDUCTOR RATING	IS:8084-1972
ENCLOSED DISTRIBUTION FUSE BOARDS AND CUT-OUTS FOR VOLTAGE NOT EXCEEDING 1000 VOLTS	IS:2675-1983
FUSE WIRE USED IN RE-WEARABLE TYPE ELECTRIC FUSES UP TO 650 VOLTS	IS:9926-1981
CONDUCTOR FOR INSULATED ELECTRIC CABLES AND FLEXIBLE CORDS	IS:8130
SHUNT CAPACITORS FOR POWER SYSTEMS	IS:2834-1954
HRC CARTRIDGE FUSES AND LINKS UP TO 660 VOLTS	IS:2208
HRC FUSES HAVING RUPTURING CAPACITY OF 50 KA	IS:9224
AC ELECTRICITY METERS: PART – 1 GENERAL REQUIREMENTS AND TESTS	IS:772 PART 1
DIRECT ACTING ELECTRICAL INDICATING INSTRUMENTS	IS:1248
CURRENT TRANSFORMERS	IS:2705
ELECTRICAL RELAYS FOR POWER SYSTEMS PROTECTION	IS:3231
PHOSPHATE TREATMENT OF IRON AND STEEL FOR PROTECTION AGAINST CORROSION	IS:3618
GUIDE FOR MARKING OF INSULATED CONDUCTOR	IS:5578
CODE OF PRACTICE OF PHOSPHATING OF IRON AND STEEL	IS:6005
FACTORY BUILT ASSEMBLIES OF SWITCHGEAR AND CONTROL- GEAR FOR VOLTAGES UP TO AND INCLUDING 1000V AC AND 1200V DC.	IS:8623
GUIDE FOR UNIFORM SYSTEM MARKING AND IDENTIFICATION OF CONDUCTORS AND APPARATUS TERMINALS	IS:11353
LOW VOLTAGE FUSES	IS:13703
LV SWITCHGEAR AND CONTROL GEAR (PART 1 TO PART 5)	IS:13947
STRUCTURE CONSTRUCTION (IP-54)	IS:2147
MINIATURE CIRCUIT BREAKER (MCB)	BS:3871PART-1 1965 IS:8825 (1996)
FUSE	IS:2000-1962
AIR CIRCUIT BREAKER	IS:2516 PART 1,2,3
CONTACTORS	IS:2959 & BS:775
DIGITAL METER	IS:13779
ELECTRICAL POWER & CONTROL WIRING CONNECTION WIRING INSIDE THE MODULE FOR POWER, CONTROL PROTECTION	IS:694 & IS:8130
DANGER NOTICE PLATE	IS:2551-1982 & IS:5-1978
MCCB	IEC 60439-2 / IS:8623-2
SFU	IS:13947 (PART-3) & IEC 60947-3
ELCB	BS 3871 & 4293, IS, CEE 27

1.2 STRUCTURE :

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

CRCA sheet steel used in the construction of PCCs / MCCs / PDBs shall be 2 mm thick for structure, 1.6 mm thick for doors, covers shrouds and 3 mm thick for gland plate and shall be



folded and braced as necessary to provide 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.

The PCCs / MCCs / PDBs shall be totally enclosed, completely dust and vermin proof and degree of protection being no less than IP-54 confirming to IS 2147. 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 gasketed with neoprene gaskets and shall be lockable.

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 tapped 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.

A base channel of 75 mm x 75 mm x 5 mm or as per the weight of the panel shall be provided at the bottom.

PCCs / MCCs / PDBs shall be arranged in multi-tier formation. The PCCs / MCCs / PDBs shall be of adequate size to facilitate enough space for maintenance and cooling. 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 does not attain temperature more than 40 degree Celsius. Openings shall provide for natural ventilation, but the said openings shall be screened with fine weld mesh.

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.

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

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

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

1.3 PROTECTION CLASS:

All the indoor PCCs / MCCs / PDBs shall have protection class of IP - 54.

1.4 POWDER COATING:

All sheet steel material shall undergo seven-tank process after all the necessary shearing and other mechanical works are completed. After the seven-tank process powder coating treatment shall be adopted using powder of reputed make. After the powder coating is complete welding in the panel or any sort of shearing, bending or cutting activity shall not be done. The colour shall be Siemens Grey 631

1.5 CIRCUIT COMPARTMENT:

Each circuit breaker and switch fuse units shall be housed in separate compartments and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly inter locked with the breaker / switch fuse units in ON and OFF position. Safety interlocks shall be provided for non-opening of the door when the breaker is in ON position.

The door shall not form integral part of the draw out 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 tiers in a vertical section.

1.6 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.

1.7 BUSBARS :

The busbar shall be air insulated and made high quality, high conductivity, high strength copper and as per relevant IS code. The busbar shall be for three phases and neutral system with separate neutral and earth bar. The busbar and interconnection between busbar and various components shall be of high conductivity, hard drawn, electrolytic copper. The busbar shall be of rectangular cross section designed to withstand full load current for phase busbar and full rated current for neutral busbar and shall be extensible type on either side. The busbar shall be rated for the frame size of the main incoming breaker. The busbar shall have uniform cross section through out the length. Ratio of 1 sqmm = 1.2 A shall be adopted for tinned copper busbars.

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 sufficiently 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.

The busbar shall be housed in a separate compartment. The busbar shall be isolated with 3 mm thick FRC sheet to avoid any accidental contact. The busbar shall be arranged such that minimum clearances 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.

All busbar connection shall be done by drilling holes in busbars and connecting by chromium plated 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.

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.

1.8 ELECTRICAL POWER & CONTROL WIRING CONNECTION :

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.

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

Both control and power terminals shall be properly shrouded.

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.

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



Wiring inside the module for power, control protection and instrument etc. shall be done with use of 1100 V 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 1.5 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.

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).

Particular care shall be taken to ensure neat and orderly laying of the wiring. Identification ferrules shall be tagged to all the wire termination for ease of identification and to facilitate and testing.

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

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.

1.9 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 be 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.

1.10 WIREWAYS:

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

1.11 CABLE COMPARTMENT:

Cable compartment of adequate size shall be provided in the PCCs, MCCs, and PDBs for easy termination of all incoming and outgoing cables entering from top. Adequate support shall be provided in the cable compartment.

1.12 EARTHING:

Copper earth busbar of minimum 25 mm x 6 mm size shall be provided in the PCCs, MCCs, PDBs for the entire length of panel. As per the rating of the main busbars the size of earthing busbar shall be decided. The framework 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 sides of the PCCs, MCCs, PDBs.

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.

1.13 LABELS:

Engraved Aluminium sheet 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.

1.14 NAME PLATE:

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



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

Engraved nameplates shall be of Aluminium strip of black colour and silver letters format.

Nameplate shall be fastened by counter sunk screws / riveted and not by adhesives.

1.15 DANGER NOTICE PLATE:

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

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

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

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.

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

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

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

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

1.16 INTERNAL COMPONENTS:

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.

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.

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

1.17 INSPECTIONS / TESTING:

Each equipment should inspect and witness by client & consultant.

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

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

The PCC / MCC / PDB shall be checked for rigid mounting, earthing connections, proper rating



and size of components, internal wiring, etc.

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

1.18 Type test:

Type test certificates for all switchgears shall be provided.

Routine Test:

Prior to dispatch of the PCC / MCC / PDB following tests shall be carried out.

Mechanical endurance test shall be carried out by closing and opening of all the ACB's, MCB's switches etc.

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.

All the interlocks, controls and tripping mechanism of the switchgears shall be tested for their proper functioning.

High voltage test, Continuity test, Control circuit test shall be carried out.

L. T. SWITCHGEARS:

GENERAL:

The type, size, and rating of the components shall be as indicated on the relevant single line diagrams.

MINIATURE CIRCUIT BREAKER (MCB):

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 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 faulty 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 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.

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.

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 only on those used as main incomer of all sources, bus coupler and inter connector. The trip devices shall be direct acting.

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

The ACB's shall have an arc-quenching device on each pole. The ACB's shall have 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 insulating 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 draw-out 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.

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 microprocessor based trip units. 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 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.

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.

TRIVECTOR METER:

Flush mount 96 x 96 x 80 mm load manager type Enercon EM 6400 or equivalent meter of accuracy class 1 as per IS 13779 shall be provided. The meter shall be accurate on distorted waveforms; simultaneous sampling of voltage and amperes shall be done. It shall have low burden on PT and CT shall have bright display, shall view 3 parameters together shall have auto scaling from kilo to mega to giga units, shall have programmable CT, PT ratios with built in phase analyser. Auto scrolling shall be programmable as per user choice and communication with PC; PLC DCS shall be possible through RS 485 serial port. It shall be dust proof, tamper proof with data import export option and 10 years back up of integrated data.

Parameters to be monitored shall be Frequency, Line to line and average and line to neutral and average voltage, phase wise and average current, phase wise and total KVA, KW and P.F. reading and KWH monitoring.

User programmable facility for delta 2e and star 3e measurement, C.T. and P.T. ratios, sliding window auto sync. And auto scrolling of parameters shall be available.

Sensing shall be 3 phase, 4 wire measuring True RMS with voltage input range of 110 to 415 V nominal and current input of 5 amps or 1 amps as per field configuration. Current range shall be from 50 mA to 7.5 A and burden on PT or CT shall be app 0.2 VA.

Accuracy for kW / kWh shall be as per IS 1377 / CBIP88 and for all other parameters shall be +/- 0.5% of full scale + 0.5% of reading + 1 digit. Digital readout shall be of 3 rows of 4 digits each (12.5 mm size) with 7 segments bright red LED. Input frequency shall be 50Hz / 60Hz +/- 5%. Power factor range shall be 0.5 lag – unit – 0.8 lead.

Resolution for power parameters shall be for 4 digits and energy parameters shall be 8 digits. Display update shall be at every 15 seconds for demand parameters and 1 sec for other parameters. Display sequence shall be parameter followed by value. Temperature range shall be 0-50°C and humidity <95% non-condensing.

Display pages shall be as follows:

Instantaneous – VLL, A avg., F
VLn, A avg., F
KVA, kW, PF

Individual pages of above parameters.

Integrated - kVAh
KWh
Run hours
On hours
Interruption

CURRENT TRANSFORMER:

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

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.

INDICATING LAMP:

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. Push button shall be of self-glowing type with LED lamp.

Indicating Lamp shall be LED type and shall supplied complete with translucent covers to diffuse the lamp light. Indicating lamps shall be part of push buttons.

Colour shade for the indicating lamps shall be as below:

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

VENDORS DATA : TO BE SUBMITTED WITH OFFER :

Approved Makes:

Vendor shall provide information on the offered make and Cat nos. of items offered for respective Panels:

Sr. No.	Item Description	Specified Make	Vendor Confirmation
1.0	All incoming breakers in main L.T. panel (SEC / DG) Air Circuit Breakers Ics=Icu=Ics(1sec) –		
1.0A	All other Breaker		
2.0	MCCB Microprocessor based release – Ics = Icu		
3.0	MCB		
4.0	SFU		
5.0	Capacitors – APP type / heavy duty type		
6.0	Contactors		
7.0	Starters		
8.0	CRCA sheet		
9.0	Gaskets		
10.0	Meters		
11.0	Indicating lamps – LED		
12.0	Push Buttons		
13.0	Connectors		
14.0	C.T.s		
15.0	APFC Relay		
16.0	Selector Switches		

Note:



All material and workmanship has to be as per latest IS / international standards.

CABLE LAYING AND TRENCHES WITH TRAYS

1.0 SPECIFICATIONS

CABLE TRENCH

Cable trench shall be dug to the minimum depth of 1 mtr and the width shall dependent on the no of cables to be kept with the layer of brick in between two cables.

BRICKS

The bricks shall be hand or machine moulded and made from suitable soils and kiln burnt. They shall be free from cracks, flaws and modules of free lime. They shall have smooth rectangular faces with sharp corners and shall be uniform in colour. The bricks shall be moulded with a frog of size 100 mm. x 40 mm., and 10 mm. to 20 mm. deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 6 m. B – grade brick shall be used.

SAND

Sand shall be natural sand, clean, well graded, hard, strong, durable and gritty. Sand particles should be free from injurious amounts of dust, clay, kankar nodules, soft or flaky particles of shale, alkali, salts, organic matter loam, mica or other deleterious substances and shall be got approved from the CLIENT AND/OR ITS ARCHITECT. The sand shall not contain more than 8% of silt as determined by field test, if necessary the sand shall be washed to make it clean. The sand used by civil agency shall be used.

CABLE TRAYS

Cable trays shall be fabricated from Hot Dip GI and channels of 14 gauge and shall be powder coated with 7 tank process if specified. The design shall be ladder type with optional cover. Shall be fixed or suspended from the ceiling with the help of suspenders which shall have adequate diameter to sustain the weight of the cables and channels. Also if necessary anchor fasteners shall be used for grouting purpose.

1.1 WORKMANSHIP

The cable shall be laid side by side in trench with brick covering on all the three sides. The trench shall be such that sharp bends shall be avoided while laying the cable. The bedding of fine sand under the cable shall be not less than 6 mm. The trench shall be terminated in Manholes with specified size of R.C.C. hume pipes as shown in drawing. Cable markers shall be provided through out the route of cable at 10 mtrs distance. The trenches shall be refilled after the cable are laid and the Ground level shall be done as per original after pressing the same. The cables shall be checked for insulation resistance and continuity tests shall be carried out.

1.2 MODE OF MEASUREMENT

The cable laying shall be measured in rmt. The trenches dug and refilled shall be measured in cu. Mtr. The bricks and sand bedding shall be measured in rmt. The cable trays shall be measured in rmt.

Note:

All material and workmanship has to be as per latest IS / international standards.

DISTRIBUTION BOARDS:

1.0 SPECIFICATIONS

Distribution boards shall be fabricated from 18 gauge M.S. sheet or shall be readymade as



specified in the make of material list. It shall be of double door type with hinged (lockable if required) door suitable for recessed mounting in wall. Distribution boards shall be powder coated with 7-tank process application.

The distribution boards shall be provided with phase barriers, wiring channels to accommodate wires and individual per phase neutral links. There shall be separate or individual earth link as per requirement. Proper arrangement shall be made for mounting of MCB's and other accessories.

Distribution boards shall meet with the requirements of IS 2675 and marking arrangement of bus bars shall be in accordance with I.S. standards.

Bus bars shall be suitable for the incoming switch rating and sized for a temperature rise of 35° C over the ambient. Each board shall have two separate earthing terminals. Circuit diagram indicating the load distribution shall be pasted on the inside of the DB as instructed. One earthing terminal for single phase and two terminals for 3 phase DB's shall be provided with an earth strip connecting the studs and the outgoing ECU earth bar.

The top and the bottom faces of the D.B. shall be provided for conduit entry of minimum 1" dia. The faces if asked shall be kept detachable.

All outgoing feeders shall terminate on a terminal strip which in turn is interconnected to the MCB/Fuse base by means of insulated single conductor copper wires as follows

Up to 15 A	2.5 sq.mm.	40 A	10 sq.mm.
25 A	4.0 sq.mm.	63 A	16 sq.mm.
32 A	6.0 sq.mm.		

Each DB shall have indicating lamps preferably neon type denoting power availability in the board after the switch indicating lamps shall be complete with fuses.

MINIATURE CIRCUIT BREAKERS (MCB) :

MCB's shall have quick make and break non-welding self-wiping silver alloy contacts for 10 KA short circuit both on the manual and automatic operation. Each pole of the breaker shall be provided with inverse time thermal over load and instantaneous over current tripping elements, with trip-free mechanism. In case of multi-pole breakers, the tripping must be on all the poles and operating handle shall be common. Breakers must conform to BS 3871 with facility for locking in OFF position. Pressure clamp terminals for stranded/solid conductor insertion are acceptable up to 4 sq.mm. aluminium or 2.5 sq.mm. copper and for higher ratings, the terminals shall be suitably shrouded. Wherever MCB isolators are specified they are without the tripping elements.

RCCB / ELCB

The RCCB should suffice all the requirements of IS as per code IS - 12640 - 1988. The RCA should be current operated and not on line voltage.

The RCCB should ensure mainly the following functions:

Measurement of the fault current value.

Comparison of the fault current with a reference value.

The RCCB should have a toroidal transformer which has the main conductors of primary (P - N) which check the sum of the current close to zero.

All metal parts should be inherently resistant to corrosion and treated to make them corrosion



resistant.

It should be truly current operated.

It should operate on core balance torroidal transformer.

Its accuracy should be $\pm 5\%$.

It should operate even in case of neutral failure.

It should trip at a present leakage current within 100 mA

Its enclosure should be as per IP 30.

Its mechanical operation life should be more than 20,000 operations.

It should provide full protection as envisaged by IE rules - 61-A, 71 - ee, 73 - ee, 1985 and also rule 50 of IE rule 1956.

It should conform to all national and international standards like IS: 8828-1993, IS: 12640-1988, BS 4293 - 1983, CEE 27 (International commission Rules for the approved of electrical equipment).

1.1 WORKMANSHIP

The D.B. shall be properly grouted in the wall in concealed manner taking care that the powder coating is not scratched and dents are not formed on the D.B. The MCBs and ELCBs. In the distribution boards shall be fixed as per the circuit details provided. All the wires terminating in the MCBs and the ELCBs shall be lugged for proper contact and ferrules depicting the circuit nos shall be provided. D.B.s mounted in concealed manner shall have a groove around it so as to save the finish of the plaster and colour during future opening of the door. The distribution boards shall have circuit chart tagged on the door for future maintenance. Danger notice plates shall be fitted to the distribution boards with screws and not stuck so as to assure its presence for a longer duration.

1.2 MODE OF MEASUREMENT

The distribution boards shall be measured in nos and the MCBs and ELCBs shall be measured in numbers separately.

Note:

All material and workmanship has to be as per latest IS / international standards.

1.1 KV GRADE L.T. CABLES AND CABLE TERMINATION:

1.0 SPECIFICATIONS

L. T. XLPE CABLE:

GENERAL:

The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer's instructions. The cables shall be delivered at site in the original drums with manufacturer's name, size and type clearly written on the drums.

All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of handling during transportation, loading, unloading etc.

The cable shall be supplied in single length i.e. without any intermediate joint or cut unless specifically approved by the client.



The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practise.

CONDUCTOR :

Uncoated, annealed copper / aluminium, of high conductivity, upto 4 mm² size the conductor shall be solid and above 4 mm² the conductors shall be concentrically stranded as per IEC : 228.

INSULATION :

Cross link polyethylene (XLPE) extruded insulation rated at 70oc.

CORE IDENTIFICATION :

Two core	:	Red and Black
Three core	:	Red, Yellow and Blue
Four core	:	Red, Yellow, Blue and Black
Single core	:	Green, Yellow for earthing.

Black shall always be used for neutral.

ASSEMBLY :

Two, three or four insulated conductors shall be laid up, filled with non-hygroscopic material and covered with an additional layer of thermoplastic material.

ARMOUR :

Galvanised steel flat strip / round strips applied helically in single layers complete with covering the assembly of cores.

For cable size upto 10 sq mm : Armour of 1.4 mm dia G.I. round wire

For cable size above 10 sq mm : Armour of 4 mm wide 0.8 mm thick GI strip

SHEATH :

ST -2 PVC along with polypropylene fillers to be provided.

Inner sheath shall be extruded type and shall be compatible with the insulation provided for the cables.

Outer sheath shall be of an extruded type layer of suitable PVC material compatible with the specified ambient temp. of 50oc and operating temperature of cables. The sheath shall be resistant to water, ultra violet radiation, fungus, termite and rodent attacks. The colour of outer sheath shall be black.

Sequential length marking along with size and other standard parameters shall be required at every 1.0 mtr on the outer sheath.

TESTING:

Finished cable tests at manufacturers works : The finished cables shall be tested at manufacturer's works for all the routine tests for all the length and size of cables to be delivered at site and the certificate for the same shall be furnished to client. If required the cables shall be tested in presence of the client's representative.

Voltage test: Each core of cable shall be tested at room temperature at 3 KV A.C. R.M.S. for duration of 5 minutes.

Conductor resistance test: The D.C. resistance of each conductor shall be measured at room temperature and the results shall be corrected to 20oc to check the compliance with the values specified in the Is 8130 – 1976.

Cable tests before and after laying cables at site:



Insulation resistance test between phases, phase to neutral and phase to earth.
Continuity test of all the phases, neutral and earth continuity conductor.
Earth resistance test of all the phases and neutral.

All the tests shall be carried out in accordance with the relevant IS code of practice and Indian Electricity Rules. The vendor shall provide necessary instruments, equipments and labour for conducting the above tests and shall bear all the expenses in connection with such tests. All tests shall be carried out in the presence of client and the results shall be prescribed in forms and submitted.

CABLE MARKING :

The outer sheath shall be legibly embossed at every meter with following legend :

ELECTRIC CABLE : 1100 V, SIZE : ___ C X ___ MM² with Manufacturers name, year of manufacturing and ISI symbol.

SEALING DRUMMING AND PACKING :

After tests at manufacturer's works, both ends of the cables shall be sealed to prevent the ingress of moisture during transportation and storage.

Cable shall be supplied in length of 500 mtrs or as required in non-returnable drums of sufficiently sturdy construction.

Cables of more than 250 meters shall also be supplied in non-returnable drums.

The spindle hole shall be minimum 110 mm in diameter.

Each drum shall bear on the outside flange, legibly and indelibly in the English literature, a distinguishing number, the manufacturer's name and particulars of the cable i.e. voltage grade, 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. The drum flange shall also be marked with manufacturer's name and year of manufacturing etc.

CABLE TERMINATION:

Cable terminations shall be made with aluminium crimped type solder less lugs for all aluminium cables and stud type terminals. For copper cables copper crimped solder less lugs shall be used.

Crimping shall be done with the help of hydraulically operated crimping tool.

For joints where by cable is with aluminium conductor and busbars are aluminium, bimetallic lugs shall be used with compound. CUPAL type of washers shall be used.

Crimping tool shall be used for crimping any size of cable.

CABLE GLANDS:

Cable glands shall be of brass single compression type. Generally single compression type cable glands shall be used for indoor protected locations and double compression type shall be used for outdoor locations.

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.

CABLE JOINTS:

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

1.1 WORKMANSHIP



Cables shall be laid in the routes marked in the drawings. Where the route is not marked, the Contractor shall mark it out on the drawings and also on the site and obtain the approval of the CLIENT AND/OR ITS ARCHITECT before laying the cable. Procurement of cables shall be on the basis of actual site measurements and the quantities shown in the schedule of work shall be regarded as a guide only.

Cables shall be laid on walls, cable trays, inside shafts or trenches. Saddling or support for the cable shall not be more than 500 mm apart. Plastic identification tags shall be provided at every 30 m.

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

In the case of cables buried directly in ground, the cable route shall be parallel or perpendicular to roadways, walls etc unless marked on drawing by architect / consultant. Cables shall be laid on an excavated, graded trench, over a sand or soft earth cushion to provide protection against abrasion. Cables shall be protected with brick or cement tiles on all the three sides as shown on drawings. Width of excavated trenches shall be as per drawings. Back fill over buried cables shall be with a minimum earth cover of 750 mm to 1000 mm. The cables shall be provided with cables markers at every 10 meters and at all loop points.

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

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

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

- Continuity on all phases.
- Insulation Resistance.
- between conductors.
- all conductors and ground.

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

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

Format for cable testing certificate :

- a. Drum no. from which cable is taken :
- b. Cable from _____ to _____
- c. Length of run of this cable _____ mtr
- d. Insulation resistance test
 - between core 1 to earth _____mega-ohm
 - between core 2 to earth _____mega-ohm
 - between core 3 to earth _____mega-ohm
 - between core 1 to core 2 _____mega-ohm
 - between core 2 to core 3 _____mega-ohm
 - between core 1 to core 3 _____mega-ohm



duration used :			
e.	High voltage test : between core and earth between individual cores	Voltage	Duration

1.2 MODE OF MEASUREMENT

The cables shall be measured in rmt and terminations on unit basis.

Note:

All material and workmanship has to be as per latest IS / international standards.

INTERNAL WIRING

1.0 SPECIFICATIONS

RIGID PVC AND FLEXIBLE PVC FRLS LHSFT CONDUITS:

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

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

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

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

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

ACCESSORIES:

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

WIRES:

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

All wires shall be colour coded as follows:

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

SWITCHES & SOCKETS:

Switches shall be modular type with silver-coated contacts. Sockets shall be 5 pins with switch and plate type cover. Combination of multiple switch units and sockets should be used to minimize the switch boxes.

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



shall be provided.

SWITCH PLATE AND BOX:

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

1.1 WORKMANSHIP

The size of conduit shall be selected in accordance with the number of wires permitted under table given below. The minimum size of the conduit shall be 25 mm diameter unless otherwise indicated or approved. Size of wires shall not be less than 1.0 sq.mm. Copper or 2.5 sq.mm. Aluminium.

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

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

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

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

Separate conduits/raceways shall be used for :

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

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

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

Emergency lighting.

Telephones.

Fire alarm system.

Public address system & Music system.

For all other voltages higher or lower than 230 V.

T.V. Antenna.

Water level guard.

Computer Wiring

Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc., shall be installed in flexible conduits. Otherwise rigid conduits shall be used. No flexible extension shall exceed 1.25 m.

Conduits run on surfaces shall be supported on metal 12 mm. thick G.I. pressure saddles which in turn are properly screwed to the wall or ceiling. Saddles shall be at intervals of not more than 500 mm. Fixing screws shall be with round or cheese head and of rust-proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building. Unseemly conduit bends and offsets shall be avoided by using fabricated mild steel junction/pull through boxes for better appearances. No cross-over of conduits shall be allowed unless it is necessary and entire conduit installation shall be clean and neat in appearance.

Conduits embedded into the walls shall be fixed by means of staples at not more than



500 mm. intervals. Chases in the walls shall be neatly made and refilled after laying the conduit and brought to the finish of the wall but the building Contractor will do final finish.

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

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

Inspection boxes shall be provided for periodical inspection to facilitate withdrawal and removal of wires. Such inspection boxes shall be flush with the wall or ceiling in the case of concealed conduits. Inspection boxes shall be spaced at not more than 12 meters apart or two 90° solid bends or equal. All junction and switch boxes shall be covered by 6 mm clear plate. These junction boxes shall form part of point wiring or conduit wiring as the case may be including the cost of removing the cover for painting and re-fixing. No separate charges shall be allowed except where specially mentioned.

Conduits shall be free from sharp edges and burrs and the threading free from grease or oil. The entire system of conduits must be completely installed and rendered electrically continuous before the conductors are pulled in. Conduits should terminate in junction boxes of not less than 32 mm. deep.

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

Lighting & Power Wiring :

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

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

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

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

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

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

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



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

Testing: the entire installation shall be tested for :

Insulation resistance.

Earth continuity.

Polarity of single pole switches.

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

The size of wires shall as follow :

25-32 Amp. metal clad points:

Phase / Neutral 4.0 mm²

Earth 2.5.0 m m²

20 Amp. out let points :

Phase / Neutral 4.0 m m²

Earth 2.5 m m²

Two nos. of 15 Amps. socket out let connected in parallel
from DB to first outlet

Phase / Neutral 4.0 m m²

Earth 2.5 m m²

from first outlet to second outlet.

Phase / Neutral 2.5 m m²

Earth 2.5 m m²

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

Phase / Neutral 1.5 m m²

Earth 1.0 m m²

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

Phase / Neutral 2.5 m m²

Earth 1.5 m m²

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

Phase / Neutral 2.5 m m²

Earth 1.5 m m²

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

Phase / Neutral 2.5 m m²

Earth 2.5 m m²

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



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

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

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

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

1.2 MODE OF MEASUREMENT

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

Note:

All material and workmanship has to be as per latest IS / international standards.

LED LIGHT FIXTURES & FANS

1.0 SPECIFICATIONS

General Purpose Led Luminaries suitable for Office /Industry / Street Light applications. The Fixtures should be Operational for 220-240 V Single Phase 50 HZ AC , and operational from 170-280 V without significant drop in output .T he LED modules should be from Cree/Nichia/Philips Lumi Leds Only with efficiency of a min 130 lm/watt and efficacy of fixtures should be greater than 80 lm/w for both indoor and outdoor fixtures, built with Integral driver . The Min degree of Protection for Indoor Fixtures should be IP20 and IP65 for Outdoor/ Semi Indoor Fixtures. The THD of Fixtures should be strictly <10 % and drivers should be compulsarily provided with miswiring/ overload and short circuit protections .For Indoor applications the housing should be made of die cast/ Metal Housing and diffusers should be polycarbonate only, out door fixtures should be with die aluminum / extruded aluminum housing only .The Fixtures should be prewired upto the terminal block and easy to mount and Install and maintain if necessary. 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 a period of 3yrs 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 . The fixture may be tested from govt approved Lab for Claimed parameters by the manufacturer.

1.1 WORKMANSHIP

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

1.2 MODE OF MEASUREMENT

The unit rate shall be considered for fitting one fixture. The rate shall include following

All fixing accessories, mounting bracket, ballast condensers and control gear wherever applicable.



Supplying and fixing Ball and socket joints wherever required.

Earthing of fittings.

Electrical connections to fittings/fans from the junction box/ceiling rose.

Installation and interconnection of Electronic regulators for ceiling fans.

Supplying and fixing 300 mm. GI down rod for ceiling fans.

Note:

All material and workmanship has to be as per latest IS / international standards. Vendor has to give 5 years replacement warranty for all LED fixtures.

EARTHING

1.0 SPECIFICATION

EARTH ELECTRODES

The earth electrode is the main component of the earthing system, which is in direct contact with the ground and, thus provides a means of releasing or collecting any earth leakage currents. In earthed systems, it will normally be required to carry quite a large current for a short period and so will need to have adequate mechanical and electrical properties to continue to meet the demands on them over a relatively long period, during which actual testing or inspection is difficult. The material should have good electrical conductivity and should not corrode in a wide range of soil conditions.

Galvanized steel, Copper, and Stainless steel are generally the preferred material. Aluminum is sometimes used for above ground bonding, but most of the standards forbid its use as an earthing electrode, due to the risk of accelerated corrosion. The corrosive product which is the oxide layer on the electrode is non-conductive in nature, so could reduce the effectiveness of the earthing.

The heavy flat strip is placed inside the bigger dia. pipe and the annular space between the two is filled with a special type of conductive, non-corrosive Backfill Compound. The completed Earth Electrode is heavily electroplated externally as per UL standards to enhance the life of the Electrode susceptible to corrosion (depends on the soil conditions). The water is used once during installation and fitting, and then the moisture is retained by the compound, throughout its life eliminating the use of water in regular intervals.

PROPER INSTALLATION METHOD : The Earthing Electrode can be installed by any one of the following methods depending on the soil condition.

Normal Soil:

Make a bore of 8" to 10" in diameter manually up to the electrode length (2 Mtr or 3 Mtr). Put a little quantity of Back Fill Compound (a layer of min. 3 to 4 inch) inside the pit and drop the electrode exactly in the center of the pit. Now mix the soil that has been dug out with the B.F.C. (conductive and non corrosive mixture) eliminating the stones, rocks and other bigger shapes. Now pour the above mixture in small quantity in to the pit followed by water and remove the trapped air inside the pit by poking a rod in to the mixture repeatedly. Repeat the above exercise till the pit is completely filled up. Pour sufficient water so that mixture is in paste /mud form. Allow the pit to stand for 24 hrs. and absorb the water and becomes compact. Test the earth pit and connect to the electrical circuit. Avoid excess watering. Do not hammer the earth electrode.

Sandy Soil:

Make a big pit of 06' x 06' and 11' deep; fill the entire pit with black cotton soil or normal soil, pour enough water so that pit is full with water, leave it for three days so that soil soaks up the water. You will notice that soil level has gone down and again top up the pit with soil & fill the water. Now after two or three days this pit is ready for earthing purpose and our earthing can be installed there by above described normal method, that will definitely give you a very good earth resistivity value. However, if the pit is filled with BFC mix soil then that will show better earth resistance value. These types of installations may need regular watering after certain



intervals that depends on the characteristics of the soil described in the "Factors determining the soil resistivity". It is to be noted that more than one earth electrode may be required to be installed and connected in parallel to bring down the earth resistance value within safe limits.

Semi-Rocky Soil:

If enough soil is there then earthing can be done by normal method otherwise that can be done by making a big pit as in case of sandy soil. Ours is a corrosion resistant, long life and almost maintenance free earthing system in normal soil conditions & if installed properly it will give better earth resistivity value than conventional earthing system throughout its life. It is a Fit & Forget earthing system. However, these types of installations may need regular watering after certain intervals that depends on the characteristics of the soil described in the "Factors determining the soil resistivity". It is to be noted that more than one earth electrode may be required to be installed and connected in parallel to bring down the earth resistance value within safe limits when done on ROCKY SOIL.

BACK FILL COMPOUND (BFC)

In all cases, the backfill medium should be conductive but non-corrosive in nature, be of a relatively small particle size and should help to retain moisture for a considerable period of time. More often than not the previous excavated soil is suitable as a backfill, but should be sieved to remove any large stones and rubbles and placed around the electrode, taking care to ensure that it is well compacted. The soil should maintain a pH value between 6.0 (acidic) to 10.0 (alkaline). Normal stiff clay is not a suitable backfill material as, if heavily compacted; it may become almost impervious to water and could remain relatively dry. It may also form large lumps, which do not consolidate around the electrode avoiding to make good contact with soil to the electrode itself.

BFC, (back fill compound) is a specially developed compound, which is capable of absorbing and retaining the moisture for a long time, it reduces the soil resistivity, it helps in faster dissipation of fault current, least fluctuation of Ohmic value and it eliminates the use of Salt, Charcoal etc. around the Earthing Electrode. It has low solubility, hence is not easily washed away, and has a low resistivity (approximately 5-10 Ohm-meters in a saturated solution). It is virtually neutral, having a pH value of between 6.2 and 6.9. should not generally cause environmental difficulties in use.

1.1 WORKMANSHIP

Following points shall be followed strictly.

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.

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.

The earth conductors (Hot dip G.I. strips) 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.

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.

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



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

Additional equipment earthing shall be done with Cu strip / Bare Cu Wire as per size indicated in drawing.

Lightening arrestors shall be installed at topmost point of the building. The quantity for the same shall be designed & specification in BOQ to cover total building area. Final type arrestor shall be used with Cu pipe & Cu base plate. The arrestor / base plate shall be connected to separate earth pit with Cu Strip.

Following tests shall be carried out:

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

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

- Each earthing station
- Earthing system as a whole
- Earth continuity conductor

Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 Ohm in each case.

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

1.2 MODE OF MEASUREMENT

Earthing stations shall be measured in units whereas earthing strips and wires shall be measured in rmt.

Note:

All material and workmanship has to be as per latest IS / international standards.

TELEPHONE AND NETWORKING SYSTEM

1.0 SPECIFICATIONS

TELEPHONE CABLES AND WIRES:

The type of cables and the services shall be as follows:

Indoor – Multipair PVC sheath armoured / un-armoured as specified 0.6 mm tin Cu. Cable.

Outside -- Multipair PVC sheath armoured / jelly filled as specified 0.6 mm tin Cu. Cable.

All multi core cables and wires shall be of tinned copper conductor of not less than 0.6 mm dia and shall be colour coded twisted pairs with rip cord.

The conductor resistance shall be less than 150 ohms per KM and the insulation resistance between the conductors not less than 50 mega ohms and the nominal capacitance of about 0.1 microfarad per kilometre.

Cables laid under ground or locations subject to dampness and flooding shall be filled with polyethylene compound and shall have sufficient protection against moisture and water ingress.

All armouring 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.

All un-armoured single core cables and inner sheath of armoured cables shall be provided with ripcord.

TELEPHONE TAG BLOCKS:

The telephone tag blocks shall be suitable for the multi core telephone cables and shall have two terminal blocks, cross connect type. All incoming and outgoing cables shall be terminated on separate terminal blocks and termination shall be silver soldered. The cross connecting jumpers shall be insulated wires of same diameter and screw connected.

The tag blocks shall be mounted inside fabricated sheet steel boxes with removable hinged covers and shall be fully accessible. The enclosure shall be painted with 2 coats of red oxide and stove enamelled.

TELEPHONE OUTLET SOCKET:

Telephone outlet socket shall be of the same make as that of the switches and accessories. The outlet sockets shall consist of 2 A 2 Pair polyethene connector in M.S.I / PVC boxes with switch plate of the same make as that of switches and telephone socket. The telephone outlet socket unless and otherwise specified shall be jack type and not pin type.

COMPUTER WIRES :

The computer wires shall be of 4 pair enhanced Cat 5 category and shall be of the makes as specified in the tender. The wires used shall be as per the specifications laid down by AVAYA for the certification of the network installed.

COMPUTER DATA OUTLET SOCKETS:

The computer sockets shall be of e Cat 5 category and of the make specified in the tender. The sockets shall be installed in the plates of the modular switches range to be used. The sockets shall be crimped using crimping tool with the Cat 5e wire. For clean room application the plates shall be of SS 316 with no sharp edges.

FLOOR RACEWAY :

Floor raceway of hot dip galvanised / aluminium sheet of 14 g / 2.0 mm shall be used and the dimensions for the same shall be as per the BOQ. The raceways shall be as per the make specified in the tender. The raceways shall be free of any sort of welding edges or other sharp edges to protect cutting of wires during pulling. The raceways shall be laid with use of junction boxes fabricated from 14 g hot dip GI as per drawing.

PABX SYSTEM :

Features	Required or Not
Technology	PCM TDM
KTS Support	Yes
ISDN BRI & PRI	Yes
E & M Support	Yes
E1 Support	Yes
Hybrid technology	Yes
External Caller ID display on console and Key phone	Yes



External Music	Yes
Paging Port	Yes
Conference facility	Yes-8 Party
Memory Storage	32 MB Secure Digital (SD) RAM
DISA Card	Yes. 4 Port. 64 different messages. 8 minutes storage
DOSA Feature	Yes
VoIP	Yes. Open Industry standard
System connectivity	V.24 Port and USB Port built in on system
Range of Key phone	Yes
Auto Redial on Key Phones	Yes
Back Lit Key Phones USB/Comp. connectivity on	Yes
Key phones	Digital-XDP. Also USB
No. of keys on Key Phones	9 to 37 keys
DSS Connectivity	60 keys
Supports PC Console	Yes
OHCA on Key Phone	Yes
Jog Dialler/Navigator Keys	4 Navigator Keys
Absence messages	Yes. On Key phones and also simple phones
Incoming call routing based on caller ID	Yes
Two way recording of external call	Yes
Personal greeting to external caller	Yes
MS Outlook integration	Yes
POP UP of incoming caller	Yes
WEB Site/URL integration	Yes
Call details/log of incoming callers	Yes
Tenant Facility	Yes
System modes	3. Day, night and lunch



Appointment reminders

Yes

19 inch variants

Yes

Passive Cabling and Components

Cat 6 4 Pair UTP Cable.

All category 6 UTP cables shall comply with TIA/EIA 568B Category 6 and ISO/IEC 11801 Class E Standard.

The Category 6 Cable should consist of 4 pair of solid insulated Conductor: 23 AWG Annealed bare solid copper.

The Category 6 Cable should provide a significant margin above the minimum Category 6 Near End Crosstalk.

Standard Length : 305 Meters (1000 Feet)

4 Pair Twisted Cable

Support for Fast and Gigabit Ethernet, IEEE

802.3/5/12, Voice, ISDN, ATM 155 and 622 Mbps.

Core Color:

Pair 1 : White – Blue

Pair 2 : White – Orange

Pair 3 : White – Green

Pair 4 : White – Brown

Approx. Cable OD: 6.5 mm

Operating Environment: Indoor

Electrical Specification: (at 550 MHz)

Standards: TIA / EIA 568 B.2-1

Impedance: 100 +/- 15 ohm

TP 4Pr. Patch Cord

All Category 6 Patch cords shall comply with TIA/EIA 568 Category 6 Standard.

Should conform or exceed the EIA/TIA 568 B standards for CAT 6 Factory molded boots on RJ 45 plugs at both ends.

Patch cords should compliance with Cat 6 standards of ISO/IEC 11801,

Patch cords should EIA/TIA 568, EN50173 and UL, ETL, 3P.

The Length should not be exceed more then 3 feet/1m

The Jacketing on all Category 6 Patch Cord Shall be UL Rated.

UTP 4Pr. Patch Cord

All Category 6 Patch cords shall comply with TIA/EIA 568 Category 6 Standard.

Should conform or exceed the EIA/TIA 568 B standards for CAT 6 Factory molded boots on RJ 45 plugs at both ends.

Patch cords should compliance with Cat 6 standards of ISO/IEC 11801,

Patch cords should have EIA/TIA 568, EN50173 and UL, ETL, 3P.

The Length should not be exceed more then – 7 feet/2m

The Jacketing on all Category 6 Patch Cord Shall be UL Rated.

I/O Module

I/O module have Screw cap design for better looking fronts.

Suitable for use with all RJ45 installations including CAT5, CAT 5e and CAT6.

RJ-45 sockets With Blanking spacer if required.

I/O module should have Surface Single / Dual Shutter outlet with back box.

I/O module should have Single Gang

I/O module should have PVC-U Molded

I/O module should be facilitated with Tough shatter resistant PVC

It should be Designed for ease of use

I/O module should have Square in Size

I/O module should have Uncluttered internal design



UTP Shuttered Patch Panel

Patch Panel Should have Rack Mount arrangement.

Patch Panel should have RJ45 female ports on front - 110 type wire termination blocks on back.

Patch Panel should have 24 Port-Loaded with cable Manage

Patch Panel should be Compatible with 23 - 24 AWG solid Conductor UTP cable.

Patch Panel Should conform or exceed the EIA/TIA 568 B.2-1 standards for CAT6

It should be Fully Compatible with Gigabit Ethernet.

Patch Panel have Metallic high strength and 1RU height, Should have routing rings, ties, labeling strips for identification.

Patch Panel Should have protection on each port to protect from dust ingress and such particles by having shutter or cap.

Layer 2 24 port Gigabit Managed stackable Switch

Hardware details

Switch shall support maximum of 24-port 10/100/1000T ports

Should support additional 2 # Gigabit ports for connecting to sever and Inter switch connectivity

Shall support 4 Shared SFP slots to load 1000T/ 1000SX/ 1000LX/ 1000LHX/ 1000ZX/ 100FX fiber ports

Should comply to IEEE 802.3, IEEE 802.3u, IEEE 802.3ab and IEEE 802.3z with auto MDI/MDIX function

100FX should be supported with out any external media converter

Transmission and performance

Store and forward technology

Should support 108Gbps switching fabric

Should support minimum 35.7 Mpps forwarding rate

Port mirroring

9k jumbo frame

Broadcast storm control

IEEE 802.3x flow control

Stackability:

Should be stackable in nature

Either hardware based or IP based clustering with minimum 2 # additional 1G or 10G ports on-board excluding 24 ports.

Should support min 32 units per stack

Single IP management - The entire stack should be managed with Single IP

Virtual LAN - VLAN

Should support VLAN as per IEEE 802.1Q

255 LAN groups and 4K VLAN IDs

Port based VLAN

Private VLAN

IP subnet VLAN

Protocol based VLAN as per IEEE 802.1v

Voice VLAN

MAC VLAN

Q-in-Q

GVRP

Multicasting

IGMP snooping - v1/v2/v3

IGMP fast leave



MLD v1/v2 Snooping

Spanning tree

- IEEE 802.1d spanning tree
- IEEE 802.1w rapid spanning tree
- IEEE 802.1s multiple spanning tree
- bpdu guard
- root guard

Link aggregation

- IEEE 802.3ad link aggregation - LACP
- Support 32 trunk groups and 8 ports per trunks

Quality of service:

- Should IEEE 802.1p based QOS
- Classification based on ACL stream, VLAN ID, COS, IPv4 TOS precedence, IPv4 DSCP and IPv6 DSCP.
- Granular rate limiting with limiting 64Kbps per port
- SP - Strict priority
- WRR weighted round robin
- SWRR – Combination of SP + WRR

Security:

- Sflow
- RADIUS and TACACS+
- Access control list with IP based ACL, MAC Based ACL and IP + MAC combination based ACL
- IP source guard
- Anti-Dos attacks
- IEEE 802.1x port based security
- IEEE 802.1X and MAC based authentication and IP+MAC+VID binding for different access clients
- Management control by AAA and CPU processed traffic control
- Anti ARP attack, ARP rate limit
- Anti ICMP packet attack
- Ring redundancy protocol

L2+ / L3 features:

- Static routing support
- Should support minimum 512 static routers

IPv6 Features:

- IPv4/IPv6 Dual Protocol Stack
- Internet Protocol, Version 6 (IPv6) Specification (RFC2460)
- IPv6 Unicast Address Types
- IPv6 Multicast Address Types
- ICMPv6 Redirect
- IPv6 Stateless Auto Configuration as per RFC2462
- IP Version 6 Addressing Architecture (RFC2373)
- An IPv6 Aggregatable Global Unicast Address Format (RFC2374)
- Reserved IPv6 Subnet Anycast Addresses (RFC2526)
- Internet Protocol Version 6 (IPv6) Addressing Architecture (RFC3513)
- Transmission of IPv6 Packets over Ethernet Networks (RFC2464)
- DHCPv6 Server
- IPv6 VLAN registration
- IPv6 Multicast with MLD v1/v2 snooping support
- SNMP over IPv6
- HTTP over IPv6
- SSH over IPv6



DNS over IPv6
IPv6 Ping/tracert
IPv6 Telnet Support
IPv6 DNS Resolver
IPv6 RADIUS+ Support
IPv6 Syslog Support
IPv6 SNTP Support
IPv6 NTP
IPv6 FTP/TFTP Support
IPv6 sFlow

MIBs:

Should support the following MIB's

Bridge MIB
Ether-like MIB,
RFC2011 IP/ICMP MIB,
RFC2012 TCP MIB
RFC2013 UDP MIB
RFC2096 ip forward mib
RFC2233 if MIB
RFC2452 TCP6 MIB
RFC2454 UDP6 MIB
RFC2465 IPv6 MIB
RFC2466 ICMP6 MIB
RFC2573 SnmpV3 notify
RFC2574 SNMPV3
RFC2674 Bridge MIB Extensions (IEEE802.1Q MIB)
RFC2674 Bridge MIB Extensions (IEEE802.1P MIB)

Management

FTP/TFTP based Firmware upgrade
Dual Firmware support
SNMP v1/v2/v3
Should support SNMP user IP security check
Syslog support
Industrial standard CLI based management
Telnet management
Web based GUI bases management

OEM criteria

OEM should have a toll free no
OEM Should have service center in India.
OEM should have direct presence in India atleast for 10 Years.
OEM should have ISO 14001 Certificate.
OEM should have warehouse in India.

WORKMANSHIP

All cables shall be on cable racks and neatly stitched together.
The connection at the tag blocks shall be silver soldered so as to achieve minimum contact resistance.

The final branch connections with single pair cables in conduits and the maximum number of cables in each conduit shall be as follows:

Conduit Inch	diameter mm.	Max. No. of cables
3/4"	20	2 Nos. single pair



1"	25	6 Nos. single pair
1¼"	32	12 Nos. single pair
1½"	40	18 Nos. single pair

The tag blocks shall be mounted inside fabricated sheet steel boxes with removable hinged covers and shall be fully accessible. The enclosure shall be painted with 2 coats of red oxide and stove enamelled.

7.2 MODE OF MEASUREMENT

The wires, conduits and raceways shall be measured in rmt whereas the outlet sockets, junction boxes and tag blocks shall be measured in units.

Note:

All material and workmanship has to be as per latest IS / international standards.

CCTV CAMERA

9.1 General

The work under this system shall consist of design, supply, installation, testing, training & handing over of all materials, equipment's and appliances and labor necessary to commission the said system, complete with Hi-Speed Dome Cameras, Vandal resistant varifocal dome camera, Digital Video Recorder and Monitor. It shall also include laying of cabling, necessary for installation of the system as indicated in the specification and Bill of Quantities. Any openings/chasing in the wall/ceiling required for the installation shall be made good in appropriate manner.

9.2 Equipment

The CCTV System shall comprise of Fixed dome camera, Day/Night camera, Digital Video Recorder, power supply.

Fixed IR Dome Camera:

The Dome camera unit shall be 1/2.7" 1Megapixel CMOS type Color and shall provide a minimum resolution 25/30fps@720P. Camera shall support 2.45, 3.6, 6, 8, 12 mm any size of lens, standard with 3.6mm. Camera has min illumination 0.01Lux@F1.2(AGC ON),0Lux IR on with low lux image capture, ultra clear image with noise free image at same illumination. Having Smart IR LED. The complete unit shall be housed in a dome and base unit, both preferably made from injection moulded plastic. It shall be possible to adjust the camera head inside the dome in both the planes so that it can be wall or ceiling mounted.

Technical Data

Camera	
Image Sensor	1/2.7" 1Megapixel CMOS
Effective Pixels	1280(H) x720(V)
Electronic Shutter	1/50s~1/100,000s
Video Frame Rate	720@25 fps
Synchronization	Internal
Min. Illumination	0.01Lux@F1.2(AGC ON),0Lux IR on
Video Output	1-channel BNC HDCVI high definition video output
Camera Features	



Max. IR LEDs Length	20m, Smart IR
Day/Night	Auto(ICR) / Color / B/W
Noise Reduction	2D
Lens	
Focal Length	3.6mm (2.8mm, 6mm, 8mm optional)
Mount Type	M12
General	
Power Supply	DC12V±10%
Power Consumption	Max 2.5W
Working Environment	-30°C~+60°C / Less than 95%RH (no condensation)
Transmission Distance	Over 500m via 75-3 coaxial cable
Ingress Protection	IP66

Digital Video Recorder

Main Features

Up to 4/8/16 cameras with 1080p realtime preview

>H.264 dual-stream video compression

>HCVR5404/5408/5416L: All channel 720P

>HDMI / VGA/BNC simultaneous video output

>4/8 channel synchronous realtime playback, GRID interface & smart search

>3D intelligent positioning with Dahua PTZ dome camera

>Support 4 SATA HDD up to 16TB, 1 eSATA up to 16TB,3 USB2.0

>Multiple network monitoring: Web viewer, CMS(DSS/PSS) & DMS

Functions & Performances

Main Processor	Embedded processor
Operating System	Embedded LINUX
Video	
Input	16 channel, BNC
Standard	NTSC(525Line, 60f/s), PAL(625Line, 50f/s)
Audio	
Input	4 channel, BNC
Output	1 channel, BNC
Two-way Talk	Reuse audio input/output channel 1
Display	
Interface	1 HDMI, 1 VGA, 1BNC
Resolution	1920×1080, 1280×1024, 1280×720, 1024×768, 800×600
Display Split	1/4/8/9/16
Privacy Masking	4 rectangular zones (each camera)
OSD	Camera title, Time, Video loss, Camera lock, Motion detection, Recording
Recording	



Video/Audio Compression	H.264 / G.711
Resolution	720P(1280×720/1280×600)/960H(960×576/960×480)/D1/4CIF(704×576/704×480) / CIF(352×288/352×240) / QCIF(176×144/176×120)
Record Rate Main Stream:	720P/960H/D1/HD1/2CIF/CIF(1~25/30fps)
Extra Stream	CIF/QCIF(1~25/30fps)
Bit Rate	48~6144Kb/s
Record Mode	Manual, Schedule(Regular(Continuous), MD), Stop
Record Interval	1~120 min (default: 60 min), Pre-record: 1~30 sec, Post-record: 10~300 sec
Video Detection&Alarm	
Trigger Events	Recording, PTZ, Tour, Video Push, Email, FTP, Spot, Buzzer & Screen tips
Video Detection	Motion Detection, MD Zones: 396(22×18), Video Loss & Camera Blank
Alarm Input	16 channel
Alarm Output	6 channel
Playback & Backup	
Sync Playback	1/4/8/16
Search Mode	Time/Date, MD & Exact search (accurate to second)
Playback Functions	Play, Pause, Stop, Rewind, Fast play, Slow play, Next file, Previous file, Next camera, Previous camera, Full screen, Repeat, Shuffle, Backup selection, Digital zoom
Backup Mode	USB Device / Network
Network	
Ethernet	RJ-45 port (10/100M/1000M)
Network Functions	HTTP, IPv4/IPv6, TCP/IP, UPNP, RTSP, UDP, SMTP, NTP, DHCP, DNS, PPPOE, DDNS, FTP, IP Filter
Max. User Access	128 users
Smart Phone	iPhone, iPad, Android, Windows Phone
Storage	
Internal HDD	4 SATA port, up to 16TB



External HDD	1 eSATA port (Max 4 SATA HDDs), up to 16TB
Auxiliary Interface	
USB Interface	3 ports (2 Rear), USB2.0
RS232	1 port, For PC communication & Keyboard
RS485	1 port, For PTZ control
General	
Power Supply	AC 100~240 V, 50/60 Hz
Power Consumption	40W
Working Environment	-10 ~+55°C / 10~90%RH / 86~106kpa

LED Screen

Screen size 42" LED Backlighting

Full HD 1080p Resolution

ENERGY STAR® Qualified

Picture Wizard II (Easy Picture Calibration)

Warranty

All component, system software, parts and assemblies supplied by the contractor shall be guaranteed against defects in materials and workmanship for one year from the acceptance date.

Labour to troubleshoot, repair, reprogram, or replace system components shall be furnished by the contractor at no charge to the owner during the warranty period.

All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.

4. FACTORY ACCEPTANCE TEST FOR ALL BOUGHT OUT ITEMS

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

The Seller will permit client Inspectors, Consultant and their authorized representatives free access during normal working hours to his works, godown, storage or loading spot etc. and will give them all necessary assistance to perform their task including free use of all accessories, testing and control instruments. The seller shall ensure that the same facilities are granted by his sub-suppliers.



Unless specifically stated to the contrary in the order, all expenses relevant to the preparation and performance of testing, inspection and preparation of any test reports or certificates shall be borne by the Seller EXCEPT for the salaries, fees, traveling, lodging and boarding expense of the Consultant's / client's representatives. However, if the visit duration of UCJ / client's representatives is extended for the reasons not attributable to UCJ / client, the cost of the extended period of visit shall be borne by the seller.

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

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

1.0 Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra labour shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable footholds and handhold shall be provided on the Ladder and the ladder shall be given an inclination not steeper than 1/4 to 1 (1/4 horizontal and 1 vertical).

1.1 Safe means of access shall be provided to all working platform and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 meters in length. Width between side rails in a rung ladder shall in no case be less than 30 cm. for ladders upto and including 3 meters in length. For longer ladders this width shall be increased atleast 6 mm. for each additional 30 cm. of length. Uniform step spacing shall not exceed 30 cm.

Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites shall so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lightest to protect public from accidents and shall be bound to bear expenses of defense of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the contractor be paid to compromise any claim by any such person.

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

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

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

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

1.3 All necessary personal safety equipment as considered adequate by the



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

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

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

c) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

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

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

15 Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:

a) i. These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good repair and in good working order.

ii. Every rope used in hoisting or lowering materials or as a means suspension shall be of durable quality and adequate strength, and free from patent defects.

b) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years shall be in charge of any hoisting machine including any scaffold winch or give signals to operator.

c) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose of testing.

d) In case of a departmental machine, safe working load shall be notified by the Engineer-in-charge. As regards contractor's machines the contractor shall notify safe working load of each machine to the Engineer-in-charge whenever he brings it to site work and get it verified by the Engineer-in-charge.

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

1.7 All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered



or removed while it is in use. Adequate washing facilities shall be provided at or near places of work.

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

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

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

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

TESTING OF INSTALLATION

7.0 SCOPE

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

7.1 GENERAL

7.1.1 Tests

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

Insulation resistance test.

Polarity test of switch.

Earth continuity test.

Earth electrode resistance test.

7.1.2 Witnessing of tests

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

7.1.3 Test instruments

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

7.2 INSULATION RESISTANCE

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

7.2.2 The insulation resistance shall also be measured between all the conductors connected to one pole, or phase conductor of the supply, and all the conductors connected to the neutral, or to the other pole, or phase conductors of the supply with all the lamps in



position and switches in "off" position, and its value shall be not less than that specified in sub-clause 16.2.3.

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

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

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

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

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

7.3 POLARITY TEST OF SWITCH

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

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

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

7.4 TESTING OF EARTH CONTINUITY PATH

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

7.5 MEASUREMENT OF EARTH ELECTRODE RESISTANCE

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

$$R = V/I$$

Where,

R	-	Resistance of the test electrode in ohms,
V	-	Reading of the voltmeter in volts.
I	-	Reading of the ammeter in amps.

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





- c) If the work involves installation of overhead line and/or underground cable.
- d) i) Type & description of overhead line.
 ii) Total length and no. of spans.
 iii) No. of street lights and its description.
- b) i) Total length of underground cable & its size.
 ii) No. of joints: End joint:
 Tee joint:
 St. through joint:

II) Earthing

- i) Description if earthing electrode.
- ii) No. of each electrodes.
- iii) Size of main earth lead.
- III) Test results:
- a) Insulation resistance
- i) Insulation resistance of the whole system of
 Conductors to earth Mega ohms
- ii) Insulation between the phase conductor and neutral
- | | | | |
|-----------------------------|---|---|-----------|
| Between Phase R and neutral | - | - | Mega ohms |
| Between Phase Y and neutral | - | - | Mega ohms |
| Between Phase B and neutral | - | - | Mega ohms |
- iii) Insulation resistance between the phase conductors
 in case of polyphase supply.
- | | | | |
|-----------------------------|---|---|-----------|
| Between Phase R and Phase Y | - | - | Mega ohms |
| Between Phase Y and Phase B | - | - | Mega ohms |
| Between Phase B and Phase R | - | - | Mega ohms |

Polarity test

Polarity of won linked single pole branch switches.

Earth continuity test

Maximum resistance between any point in the earth continuity conductor including metal conduits and main earthingOhms

Earth electrode resistance

Signature of Bidder/JV Firm



Resistance of each earth electrode

- | | | | | | |
|------|---|---|---|---|------|
| i) | - | - | - | - | Ohms |
| ii) | - | - | - | - | Ohms |
| iii) | - | - | - | - | Ohms |
| iv) | - | - | - | - | Ohms |

Lighting protective system

Resistance of the whole of lighting protective system to earth before any bonding is effected with earth electrode and metal in/on the structure.....

Signature and name of
Junior Engineer (E) / AE (E)

Signature and name of the
Contractor

SPECIAL CONDITIONS OF CONTRACT

9.0 GENERAL

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

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

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

Clause in this specification shall apply equally throughout.

9.1 ORDERING

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

9.2 STANDARD OF MATERIALS

When the material and equipment is specifically described named in the specifications, it is so named or described for the purpose of establishing a standard of materials and workmanship to which the contractor must adhere. The Contractor must quote with the material as listed in the make of materials list attached later in the document. The Contractor may submit with his tender a list indicating any alternative make of material that he proposes to install. Before installing such a make the contractor shall take permission from the consultant. All materials condemned by the consultant as not approved for use are to be



removed from the premises and suitable material shall be delivered and installed in their place at the expense of the Contractor. If alternatives are not offered during the tender stage then the contractor will be deemed to have submitted his tender based on all materials and equipment specified or shown on the drawings and therefore no alternative manufacturer or supplier of such material and equipment specified or shown will be considered after the contract is awarded if however the material or equipment specified or shown on the drawing is not available due to any genuine reason. The contractor shall prior to order get the written approval of the consultant for the particular material/equipment.

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

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

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

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

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

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

9.3 WORKMANSHIP

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

Any work that in the opinion of the consultant does not confirm to the best standard practice shall be removed and reinstated at the Contractor's expense permits certificates and licenses must be held by all tradesman for the type of work in which they are involved where such permits certificates and licenses exist under government legislation.

9.4 PROCEDURE

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

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

The contractor in the interest of the work shall furnish a bar chart based on the chart



furnished by the civil contractor stating all the starting and completion dates clearly in the format that consultant approves or in the format of the civil bar chart.

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

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

9.5 PERMITS

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

9.6 TEMPORARY AND TRIAL USAGE

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

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

9.7 CLEANING

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

9.8 SETTING OUT OF WORKS

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

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

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

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

9.9 AS BUILT DRAWINGS / SHOP DRAWINGS

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



and get approval of consultant / EIC.

At the completion of the works and before issue of the certificate of virtual completion, the contractor shall submit to the consultant 4 sets (HARD AND SOFT FORMAT) of layout drawings drawn at approved scale indicating the complete wiring system as installed. These drawings must provide the following minimum information :

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

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

9.10 MANUFACTURER'S INSTRUCTIONS

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

9.11 GUARANTEE

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

- A. Any defective work or material supplied by the Contractor.
- B. Any material or equipment damage or destroyed as a result of defective workmanship by the Contractor.

9.12 SAFETY OF MATERIAL

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

9.13 COMPLETION CERTIFICATE

On completion of the Electrical Installation a certificate shall be furnished by the Contractor counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. The certificate shall be in the prescribed form as required by the local authority. The contractor shall be responsible for getting the Electrical installation inspected and approved by the local authorities connected.

9.14 ENGINEER AND FOREMAN

The Contractor shall employ a competent fully licensed, qualified full time electrical Engineer and foreman to direct the work of Electrical Installation in accordance with drawings and specification. The foreman shall be available full time on site to receive instruction from Architect/Consultant or his nominee in the day to day activities throughout the duration of the contract the foreman shall correlate the progress of work in connection with all relevant



requirements of the supply authorities.

9.15 LIASIONING WITH LOCAL SUPPLY COMPANY

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

9.16 SPECIFICATIONS AND SCHEDULE

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

9.17 SUPERVISION

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

9.18 TOOLS AND EQUIPMENTS

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

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

The contractor must have minimum following instruments :

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

9.19 SITE STORAGE

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

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

9.20 SPARES

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

9.21 OPERATING AND MAINTENANCE MANUALS

The Contractor shall furnish two sets of operating manuals which shall include services



maintenance instructions and circuit diagram for each item of equipment.

9.22 SITE CONDITIONS

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

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

9.23 LABELS AND NOTICES

On all switchgear identification name plates shall be fitted these will identify the substation and/ or out going ways. The labels shall be made on indestructible non deteriorating material with lettering engraved in black or white background except where otherwise specified. Fixing shall be by means of rivets or screws in addition to any adhesive. all labels shall be English/Hindi /mother language as directed by the Consultant. All pillars and mini feeder pillars in addition to identification labels shall have each way identified by a label to the same specification fitted in the feeder pillar. An indestructible "Danger 415 volts" plates should be fitted externally with a double flush danger signal. The letters to be 12 MM height minimum in signal red.

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

9.24 PACKING AND RECEIPT OF MATERIAL

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

9.25 RECORDING OF WORK

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

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

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

9.26 MARKING OUT

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

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

9.27 FIXING

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



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

9.28 CONTRACTORS RATES

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

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

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

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

- a) When there is difference between the rates in figures and words, the rate in words shall be taken as correct.
- b) When the rate quoted by the tenderer in figures and words, tallies, but the amount is incorrect, the rate quoted by the tenderer shall be taken as correct.
- c) When it is not possible to ascertain the correct rate, in the manner prescribed above, the rate as quoted in the words shall be adopted.

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

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

9.29 ARCHITECTS / CONSULTANTS DECISIONS

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

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

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

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

9.30 DEFECTS LIABILITY PERIOD

This period of 12 months, shall be in force from the date of "Virtual completion" and



minor defects if any shall be corrected / rectified within 24 hours and major defects within 3 day which shall develop during this period. However, if the same are not rectified by the Contractor within the period mentioned above the clients with the concurrence of the Architects shall get the work done at the risk and the cost of the Contractor.

9.31 OCCUPYING PART AREAS

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

9.32 TEMPORARY WIRING

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

9.33 DEPOSITS AND PAYMENTS

Earnest Money Deposit along with Security Deposit, as specified in schedule of fiscal aspects, has to be deposited with the employer in the form of draft in the name of the client, for the fulfillment of contract. Besides EMD and security deposit, retention money at the rate of 5% of the value of each bill but upto maximum of 2.5% of the contract value shall be deducted (cash) from each running bill.

On the Architects certificate of virtual completion of the works, the contractor would be paid 50% of the above mentioned amount and the remaining 50% will be released after the rectification of the defects, if any, pointed out during the defects liability period.

The contractor can have mobilization advance of 5% of the contract value against Bank Guarantee of the same amount till the defects liability period expires. The mobilization advance will be deducted at the rate of 20% (of the mobilization advance) from each running bill till total deductions are done. 75% of the value of the contract shall be raised by contractor in parts as running bills the value of which shall not be less than 15% of the contract value. 10% of the contract value shall be paid on commissioning of the installation. 10% of the contract value shall be paid on submission of as built drawings, test certificates and Final Bill.

For the material to be procured by the contractor please refer to the mode of payment sheet attached in the document.

MODE OF PAYMENT

The following payment will be made after deducting retention money.
Payment for various item shall be made as follows:

- | | | |
|----|--|---|
| 1. | A.) Light, Fan Plug, Bell, Etc.(Part payment of plug on Board will not be considered | 20 % when conduits are laid in slab & Boxes are fixed |
| | B.) Telephone, TV ,Computer | 20 % when conduits are laid in wall & boxes are fixed.
40 % when wires are drawn in above conduits.
10 % when switches are fitted and testing is done.
10 % after completion of the job. |
| 2. | Boards , Panels, Circuit D.B. s | 70 % for materials at site .
20 % for erection.
10 % after testing and commissioning |



- | | | |
|----|---|---|
| 3. | Bus ducts, cable trays etc. | 70 % for materials at site .
10 % of labour cost after laying.
20 % after testing and
commissioning. |
| 4. | Cables | 80 % of labour cost after laying.
20 % after testing and
commissioning. |
| 5. | Earthing | .
70 % for materials at site .
10 % of labour cost after earthing is
complete.
20 % after testing and
commissioning. |
| 6. | Fixing the fittings, Fans & street light
poles | 80 % of labour cost after fixing the
fittings, fans and erecting the poles.
20 % after testing and
commissioning. |



LIST OF APPROVED MAKE / MANUFACTURERS

- | | | |
|-----|--|--|
| 1) | Capacitor (APP / Heavy duty type) | Havells, Epcos, Subodhn, Schneider, Matrix |
| 2) | Main LT / HT Cables | XLPE armoured cable for 1.1 KV / 11 KV, Polycab, Havells, RR Kabel, Avocab. |
| 3) | Glands | Siemens type with rubber ring and double washers. – Comet, Standard Metal Industries |
| 4) | Distribution Boards | Legrand, Havells, Panasonic |
| 5) | MCBs, ELCB, ELMCB | Legrand, Havells, Panasonic, ABB, Eaton |
| 6) | MCCB | Legrand DPX, Havells, |
| 7) | Switches & Its accessories | MK Citric, Legrand Myris, Panasonic Vision. |
| 8) | Flexible Wires (FRLS) | RR Kabel, Havells, Lapp Infra, Avocab |
| 9) | Light Fixtures | Lighting Technologies, Havells, Panasonic, Ligman, Endo, Parisha, K-Lite. |
| 10) | Chemical type earthing | Erico, Rapid, Electroearth, Ashlok |
| 11) | Cat-6 | Legrand, Havells, D-link, Molex, |
| 12) | Meter (Digital) Elmeasure, Legrand, SEMS, Konzerv, HPL | |
| 13) | PVC PIPE & Accessories | Precision plastic industries, Polycab, Nihir, Vraj, Bhagyalaxmi Plastic, BBC |
| 14) | CCTV | Avtron, Honeywell, Bosch |
| 15) | Poles | Sumip, Valmont or any other approved by consultant or equivalent |
| 16) | Panel Vendor | Swati Switchgears, Active Panel & CPRI Approved |

Consultant/Client is ask to choose any make from above. Any other item which has not mention in make list, consultant/Engineer-in-charge is final authority to suggest.



LIST OF APPROVED PLUMBING MATERIALS / BRANDS FOR BUILDING WORKS

SR. NO.	ITEM	APPROVED MAKE
1	swr pvc pipe & fittings 6 kg cm ² ; fittings : 6 kg cm ² eco. drain pipe & fittings	finolex / prince / vector supreme / astral / truflo
2	gully trap	girco / tirumala / supreme/ vector / astral / truflo
3	ppr pipes & ppr fittings	sureme / prince / vector / truflo
4	astm/cpvc pipe & fittings for water supply	astral / supreme / ashirwad / vector / truflo
5	solvent cement	supreme / astral / finolex / truflo
6	ball valves	leader / zoloto / audco
7	wheel valves	leader / zoloto / audco
8	dcv / nrv	zoloto / spirex / audco
9	pumps	kirloskar / grundfoss / lubi
10	starter	siemens / l&t
11	pressure gauge	bells / h guru
12	bottle trap & waste coupling	grohe / jaquar / kohler / johnson
13	hydropneumatic system	kirloskar / grundfoss / lubi
14	sanitary fixtures	hindware / duravit / jaquar / cera / kohler / johnson
15	plumbing fitting (cp fittings & toilet accessories)	grohe / jaquar / kohler / johnson
16	r.o.plant	ion exchange /power h20 / thermax
17	softener plant	ion exchange /power h20 / thermax
18	electric geyser	a-o smith / racold / spherhot
19	hot water generator	thermax / a.o.smith / kepl / benchmark
20	sewage treatment plant	sintex/thermax / ion excahnge / thinkgreen
21.	flush tank	hindware / duravit / jaquar / cera / kohler / johnson

The selected bidder shall have to use the makes from above only after approval of client consultant.

**ELEVATOR TECHNICAL SPECIFICATION****1. STANDARDS**

The following Indian Standard Specifications and Codes of Practice, currently applicable and updated as of date irrespective of dates given below, shall apply to the equipment and the work covered by this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date shall also apply. Wherever Appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable

Sr. No.	Description	Code No.
1	Code of Practice for installation, operation and maintenance of electric passenger & goods lifts.	IS-14665 (Part 2) Sec-1: 2000
2	Code of practice for installation, operation and maintenance of electric service lift.	IS-14665 (Part 2) Sec-2: 2000
3	Safety Rules Section-1 Passenger and Good lifts	IS-14665 (Part 3) Sec-1: 2000
4	Safety Rules Section-2 – Service Lifts	IS-14665 (Part 3) Sec-2: 2000
5	Outline dimension for electric lifts.	IS-14665 (Part-1): 2000
6	Inspection Manual for Electric Lifts	IS-14665 (Part 5): 1999
7	Electric Traction Lifts – Components	IS-14665 (Part 4) Sec-1 to 9:2001
8	Installation and Maintenance of Lifts For Handicapped Persons (Code of Practice)	IS 15330:2003
9	Specification for lifts cables.	IS-4289 (Par-1): 1984 Reaffirmed 1991
10	Specification for hot rolled and slit steel tee bars.	IS-1173-1978 Reaffirmed 1987
11	Method of loading rating of worm gear.	IS-7443-1974 Reaffirmed 1991
12	Code of practice for selection of standard worn and helical gear box.	IS-7403-1974 Reaffirmed 1991
13	Isometrics screw threads.	IS-4218- (Part-II) 1976 Reaffirmed 1996
14	Degree of protection provided by enclosure for low voltage switchgear and control gear.	IS-2147-1962
15	Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service.	IS-1271-1985 Reaffirmed 1990
16	Code of practice for earthing.	IS-3043-1987
17	Electrical installation Fire Safety of Building.	IS-1694-1990
18	PVC insulated electric cable for working voltage up to and including 1100 volts.	IS-694-1990
19	Code of practice for electrical wiring and installation	IS-732-1989
20	PVC insulated (Heavy Duty) electric cables for working voltage up to and including 1100 volts.	IS-1554-1988 (Part-1)
21	Flexible steel conduits	IS-3480-1966
22	Accessories for rigid steel conduit for electrical wiring	IS-3837-1976
23	Boxes for the enclosure of electrical accessories	IS-5133-1969 (Part 1)
24	Guide for safety procedures and practices in electrical work.	IS-5216-1982 (Part-1)
25	Conductors for insulated electric cables and flexible cords	IS-8130-1984
26	Miniature Circuit Breakers	IS-8828-1996



27	Rigid steel conduits for electrical wiring (Second revisions)	IS-9537-1981
28	Methods of test for cables	IS-10810-1998
29	Earth Leakage Circuit Breakers.	IS-12640-1988
30	Moulded Case Circuit Breakers	IS-13947-1993
31	General requirement for switchgear and control gear for voltage not exceeding 1000 volts.	IS-13947-1993
32	1100 volt grade XLPE insulated armored cables	IS 7098
33	Specifications for hoist way door-locks	IS 7754-1975
34	Rules for design, installation, testing and operation of lifts, escalators and moving parts.	IS 1735-1975

In addition the relevant clauses of the following, as amended up to date shall apply.

- The Indian Electricity Rules 1956
- The Indian Electricity Act 1910
- Bombay Lift Act 1939
- Delhi Lift Rules
- Fire safety regulations pertaining to lifts

The tenderers shall also take into account local and State regulations as in vogue for the design and installation of lifts.

Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable. BIS certified equipment shall be used as a part of the Contract.

2. ELECTRIC SUPPLY

The available system of electric supply is 415 volts +10% -20%, -3 phase 4 wire AC 50 Hz system and 240 volts between phase and neutral. Any equipment /component operating at other than the above mentioned power supply shall be provided with necessary transformers/voltage stabilizers. The amount of power required for lifts shall be indicated in the tender. Power shall be provided at one point to be indicated by the tenderer. All subsequent electrical systems shall be deemed to be included in the scope of this contract.

3. TECHNICAL PARAMETERS

Technical parameters given in Annexure -I give requirement of passenger, Service & Goods lifts. Tenderers shall fill in their item wise confirmation/comments in the column provided for the purpose in this annexure. Deviations, if any, from tender requirements shall be clearly brought out in this annexure, failing which it shall be presumed that the offer conforms to the tender requirements fully. Tenders in which Annexure-I is not duly filled in by the tenderers are liable to be summarily rejected.

4. BMS COMPATIBILITY

All the elevators shall be hooked on to BMS. Necessary potential free contacts to be provided in the electrical system control panels. Elevator supplier shall be required to coordinate with BMS vendor for software compatibility between BMS & elevator system.

SECTION -1 GENERAL

1.1. SUMMARY

- This Section includes electric traction Passenger without Machine room (i.e. Machine room less - MRL).
- Scope includes following:
 - Supply and installation of MRL elevators as per specs below.
 - Lift Contractor shall work in co-ordination with civil contractor and other agencies in pre-construction and during construction phase.

1.2. SUBMITTALS

- Product Data:** Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
- Shop Drawings:** Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout (if any), coordination with building structure, relationships with other construction, and locations of equipment and signals. Indicate loads imposed on building structure at points of support, and maximum and average power demands.
- Samples:** For exposed finishes.



- D. **Manufacturer Certificates:** Signed by elevator manufacturer certifying that hoist way, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
- E. Operation and maintenance data.
- F. **Inspection and Acceptance Certificates and Operating Permits:** It shall be vendor's responsibility to obtain Licenses / approvals and NOC as required by local and statutory authorities having jurisdiction for normal, unrestricted elevator use.

1.3. QUALITY ASSURANCE

- A. **Regulatory Requirements:** Comply with ASME A17.1 or equivalent IS code and elevator design requirements for earthquake loads in ASCE 7 or equivalent Indian Institute.
 - a. Effective peak velocity acceleration (A_v) $A_h = 0.022$, for Project's location is seismic risk zones 3.
 - b. Design earthquake spectral response acceleration, short period (S_d) for Project is $S_a/g = 1.4$
 - c. Elevator importance factor is **1.0**
- B. **Accessibility Requirements:** Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." 407 in ICC A117.1 OR equivalent IS code.

1.4. WARRANTY AND OFFERS

- A. **Special Manufacturer's Warranty:** Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within 2 years. Vendor shall submit the comprehensive AMC offer from 3rd year to 8th year.
 - a. **Defect Liability Period:** Two years from date of Substantial Completion.

1.5. MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide two year's full maintenance service by skilled employees of elevator Installer as per OEM guideline. Vendor shall submit the comprehensive AMC offer from 3rd year to 8th year (as per OEM Guideline) offer from 3rd year to 8th year.

SECTION – 2 PRODUCTS

2.1. MANUFACTURERS

- A. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. KONE Inc.
 - 2. Schindler Elevator Corp.
 - 3. OTIS, India Ltd.
 - 4. ThyssenKrupp Elevator India Private Limited

2.2. SYSTEMS AND COMPONENTS

- A. **General:** Provide manufacturer's standard elevator systems, including standard components published by manufacturer as included in standard pre-engineered elevator systems and as required for complete system.
- B. **Elevator Machines:** At manufacturer's option, provide variable-voltage, variable-frequency, ac-type or variable-voltage, dc-type hoisting machines. Provide solid-state power converters.
 - 1. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
 - 2. Provide means for absorbing regenerated power when elevator system is operating on standby power-
- C. **Fluid for Oil Buffers:** If oil buffers are used, use only fire-resistant hydraulic fluid.
- D. **Guides:** Provide roller guides or polymer-coated, no lubricated sliding guides at top and bottom of car and counterweight frames.



2.3. OPERATION SYSTEMS

- A. **General:** Provide manufacturer's standard microprocessor operation system for each group of elevators as required to provide type of operation system indicated.
- B. **Group Auxiliary Operations and Emergency Operations- FOR PASSENGER ELEVATOR:**
 - 1. **Standby Power Operation- AUTOMATIC:** During emergency, on automatic activation of standby power, cars are returned, one at a time, to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. When all cars have been returned or removed from the system, one car can be put in service on standby power by a selector switch in control panel located at main lobby or fire command station, as per BMS recommendations.
 - 2. **Emergency Service:** Service is initiated by a key switch at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. Car is placed in operation by selecting a floor and pressing door close button or by operating key switch to put car in independent service. After responding to floor selected or being removed from independent service, car is returned to group operation.
 - 3. **Independent Service:** Key switch in car control station removes car from group operation and allows it to respond only to car calls.
- C. **Security Feature:** Security feature shall not affect emergency firefighters' service.

2.4. DOOR REOPENING DEVICES

- A. **Infrared Array:** Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.
- B. **Nudging Feature:** After car doors are prevented from closing for predetermined adjustable time, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.5. FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed or Indian equivalent.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled or Indian equivalent.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 or Indian equivalent.
- D. Stainless-Steel Bars: ASTM A 276, Type 304 or Indian equivalent.
- E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304 or Indian equivalent.
- F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063. or Indian equivalent

2.6. CAR ENCLOSURES

- A. **General:** Provide **Bare, steel-framed car enclosures with provision for accepting finishing wall panels, with car roof, access doors, power door operators, and ventilation.**
 - 1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1 or Indian equivalent.
 - 2. Wall Panels: As per design
 - 3. Stainless-Steel Doors: Flush, hollow-metal construction, with Satin steel finish, having vision panel of safety glass.
 - 4. Sills: Extruded aluminum, with grooved surface, 1/4 inch (6.4 mm) thick or as per standard manufacturer's offer, with finish as recommended and approved by DTAs.
 - 5. Luminous Ceiling: As per design.
 - 6. Load factor of 200 kgs shall be considered, exclusive of passenger carriage capacity.

2.7. HOISTWAY ENTRANCES

- A. **General:** Provide manufacturer's standard horizontal-sliding, door-and-frame hoist way entrances complete with track systems, hardware, sills, and accessories.
 - 1. Provide self-supporting frames with reinforced head sections, wherever required by manufacturer.



- B. **Materials and Fabrication:** Provide manufacturer's standards, but not less than the following:
1. Enameled-Steel Frames: Formed from cold-rolled or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Authority / Staffroom manufacturer's full range.
 2. Stainless-Steel Frames: Formed from Vandal proof (Scratch proof) SS Satin finished stainless-steel sheet.
 3. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction, with Vandal proof (Scratch proof) SS Satin steel finishes
 4. Sills: Extruded aluminum, with grooved surface, 1/4 inch (6.4 mm) thick, as per standard manufacturer's offer, with finish as recommended and approved by DTAs.
 5. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107 or equivalent IS code.

2.8. SIGNAL EQUIPMENT

- A. **General:** Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs, enough to achieve the required light for comfortable occupancy.
- B. **Car Control Stations:** Provide manufacturer's standard flushed / surface mounted car control stations. Mount in return panel adjacent to car door, as mentioned in clause 2.9/A/11/f.
- C. **Emergency Communication System:** Provide 3- Station Hands-free intercom with EPABX. On activation, System provides two way voice communication without using a handset. Passenger can communicate with two locations at once, one will be in the wall mounted controller and other location can be customer specific. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply. Emergency press button inside the car with external floor wise hooter shall alert during crisis.
- D. **Firefighters' Two-Way Telephone Communication Service:** Provide flushed / surface mounted cabinet or telephone jack in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified.
- E. **Car Position Indicator:** Provide digital-type surface mounted car position indicator, located above car door or above car control station or as indicated and as approved by DTAs. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
1. Include travel direction arrows if not provided in car control station.
- F. **Hall Push-Button Stations:** Provide hall flushed / surface mounted push-button stations at each landing as indicated.
- G. **Hall Lanterns:** Units with do illuminated arrows.
1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
 2. Units mounted in both jambs of entrance frame for each elevator.
- H. **Hall Annunciator:** With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
- I. **Corridor Call Station Pictograph Signs:** Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction.

2.9. ELEVATORS

- A. **Elevator Description: PLEASE REFER DRAWING & ANNEXURE -1 FOR THE FOLLOWING**
1. Elevator Number: 3 Nos.
 2. Machine Location: Machine room less elevators.
 3. Rated Load
 4. Rated Speed
 5. Operation System: Group automatic operation with demand-based dispatching.
 6. **Auxiliary Operations:**
 - a. Standby power operation.
 - b. Battery-powered lowering.
 - c. Automatic dispatching of loaded car.
 - d. Nuisance call cancels.



- e. Emergency service at all floors.
- f. Independent service for all cars in group.
- g. Loaded-car bypass.
- h. Distributed parking.
- 7. **Car Enclosures:** Vendor to provide Bare Cabin Shell, with provisions to accept the interior finishes as per design.
 - a. Inside Width: As per Vendor
 - b. Inside Depth: As per Vendor
 - c. Inside Height: As per Vendor
 - d. Front Walls (Return Panels): Vandal proof (Scratch proof) Satin finish Stainless steel, As per design.
 - e. Car Fixtures: Vandal proof (Scratch proof) Satin finish Stainless steel, As per design.
 - f. Side and Rear Wall Panels: Vandal proof (Scratch proof) Part Satin finish Stainless steel and part Vandal proof (Scratch proof) Mirror finish, As per design.
 - g. Door Faces (Interior): Vandal proof (Scratch proof) Satin finish Stainless steel, As per design.
 - h. Handrails: Vandal proof (Scratch proof) Satin finish Stainless steel, 1-1/2 inches (38 mm) round, one hand rail on rear side only of the car.
 - i. Floor prepared to receive the floor panels of STONE as per design.
- 8. **Hoist way Entrances:** As follows:
 - a. Width: Varies for all elevators clear usable from finished jambs.
 - b. Height: 2100mm clear from finished floor to Finished Lintel.
 - c. Type: Single-speed centre opening, as indicated on drawings.
 - d. Fire-Protection Rating: Minimum 1 hour or as required and recommended by IS code or Local approving authority or NFPA or NBC India (latest edition), as per most stringent of all.
 - e. Frames at All Floors: Vandal proof (Scratch proof) Satin finished stainless steel or as indicated on drawings.
 - f. Doors at All Floors: Vandal proof (Scratch proof) Satin finished stainless steel.
- 9. **Hall Fixtures at All Floors:** Vandal proof (Scratch proof) Satin finished stainless steel.
- 10. **Number of floors served:**
Passenger lifts/Service Lift Stops (Ground & First Floor)
- 11. **Additional Requirements:**
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from Vandal proof (Scratch proof) Satin finished stainless steel.
 - b. Provide blanket hooks in all cars and complete set(s) of full-height protective blankets.
 - c. Provide Sound Isolation with Mount rotating and vibrating equipment on vibration-isolating mounts designed to minimize transmission of vibrations to structure and thereby minimize structure-borne noise from elevator system.
 - d. Have provision for extending the floors served and integrating new floors, when Phase-2 of the projects starts.
 - e. Braille sign language to be incorporated, wherever applicable.
 - f. Two numbers of panels (signalization) inside the car lift on two sides on wall/door to be provided as per shop drawings approved by Authority / DTA.

SECTION -3 EXECUTION

3.1. INSTALLATION

- A. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and direction of travel.
- B. Set sills flush with finished floor surface at landing. Fill space under sill solidly with non-shrink, nonmetallic grout.
- C. Lift Contractor shall work in co-ordination with civil contractor and other agencies in pre-construction and during construction phase.



3.2. FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1 or equivalent IS code and by governing regulations and agencies.

3.3. PROTECTION TILL HANDOVER.

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
3. Engage elevator Installer to provide full maintenance service.
4. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.4. DEMONSTRATION, TRAINING AND POST INSTALLATION SUBMITTALS

- A. Engage a factory-authorized service representative to train Authority's maintenance personnel to operate, adjust, and maintain elevator(s). This training shall be focused for 1st hand emergency operations and day to day maintenance, cleaning, checkup required to be carried out over and above the routine maintenance carried out by lift supplier. This training shall be free of cost as same is part of scope of work and responsibility.
- B. As a part of documentation submittals Supplier shall provide 6 sets of the following documents consisting of documents and drawings in well bound hard copies with project name printed on top. These documents shall be in English. It shall be as follows:
- a. General description of the system
 - b. Technical specifications
 - c. Respective as built and working drawing sets
 - d. Circuit diagrams
 - e. Computerized catalogue numbers of each and every part and its details
 - f. Life of each part
 - g. Working temperatures and environments
 - h. Maintenance and operation handbook / Manual
 - i. Comprehensive list of recommended spare parts with specification for each inventory to be kept.
 - j. 5 no of sets of Lift operating keys for each lift. Keys shall be properly tagged. All keys shall be master suited as arranged with the employer.
 - k. General and specific instruction to users.



TENDER

OF

DEVELOPMENT OF SABARMATI TROPICAL GARDEN

FOR

"SABARMATI RIVERFRONT DEVELOPMENT CORPORATION LIMITED"



VRF System

1.0 Scope of HVAC System:

- 1.1** The scope of this section comprises the “**Design, engineering, manufacture, assembly, testing at manufacturer’s work, transportation to site, insurance, loading, unloading at site, site storage, handling at site, complete erection, site testing, commissioning of HVAC system**” as specified in tender spec & BOQs.

1.0 SPECIFICATION OF EQUIPMENT / MATERIAL AND INSTALLATION STANDARDS 1A VARIABLE REFRIGERANT VOLUME TYPE SYSTEM

The system shall be multi-split system with invertors driven scroll compressor for application with R410 OR R407 refrigerant and shall be composed of 4-way cassette type indoor units/ceiling type indoor units/2-way cassette type indoor units/wall type indoor unit/floor type indoor unit and outdoor unit with a distributed refrigeration cycle, electrical components and enclosing cabinets. Both indoor units and outdoor unit shall be properly assembled, internally piped and wired, thoroughly tested and charged with refrigerant at factory and shall be topped up at site after erection. Additional charge of refrigerant should be supported by engineering calculation. Each refrigeration cycle shall be equipped with scroll compressor, a solenoid valve, a heat exchanger, an accumulator, and a 4-way valve and flare connection parts.

CONDENSING UNIT

The compressor(s) shall be hermetically sealed scroll and designed for continuous operation even at high ambient temperatures of Ahmedabad. All condensing unit should have a combination of fixed speed and invertors driven scroll compressor. All invertors driven scroll compressor should have protection for electronic circuits and elimination of electromagnetic sound, which may interfere with the control function of the machine. The unit shall have safety device such as high-pressure switch, fan motor safety thermostat, invertors overload protector, fusible plugs and fuses for trouble free operation of the unit. The condenser shall be air cooled, made of Cu. tubes with extended aluminum fins. The condenser coil shall be multi-pass, cross-finned tube type, equipped with highly efficient aluminum fins, mechanically bonded to oxygen free copper tubes. The coil shall be cleaned, dehydrated and tested for leakage at the factory. The Cabinet shall be fabricated out of heavy gauge steel, properly formed for close fit and structural rigidity. All access panels shall be so constructed as to be quickly and easily removable. All outside surface shall be finished with powder coating for protection against humid weather. The condenser fans shall be step-less driven and designed to achieve low condensing temperatures & operate continuously and silently. One out-door unit should be capable to be connected up-to 16 nos. various indoor unit.

EVAPORATING UNIT

The cooling coils shall be made of Copper Tubing having extended aluminum fins. The evaporator coil shall be multi-pass, cross finned tube type, equipped with highly efficient aluminum fins, and mechanically bonded to seamless, oxygen free copper tubes. The coil shall be cleaned, dehydrated and tested for leakage at the factory. The cooling coils circuit shall be fed with liquid refrigerant through the expansion device and distributor. The indoor unit shall have two-speed fan motor. The blower shall be statically and dynamically balanced and designed for silent operation at required airflow rates against required static pressure. The filters shall be washable synthetic media type arranged for convenient cleaning and replacement. The drain pan shall be fabricated out of heavy sheet steel, insulated with 1/4" expanded polyethylene sheet. The casing shall be of heavy gauge G.I., duly powder coated for weather protection.

CONTROLS AND INTERLOCKING

All electrical control devices should be enclosed in the indoor and outdoor units. The compressor should be protected against breakdown by a quick response overcurrent relay, a high-

pressure switch, a wraparound type oil heater and a discharge gas thermistor. In addition to the compressor protection devices, the indoor / outdoor fan motor should be protected by an internal thermostat. The indoor fan motor shall be directly supplied with the power source from the control circuit. The functions of these control devices shall compose an electrical sequence of manual starting and stopping, automatic continuous operation whenever the room thermostat requires, and the protection devices allow the operation. The remote control switch should be designed to provide simple operation such as On/Off, temperature and fan speed only without trouble shooting functions. The remote control should be BMS compatible for centralized monitoring. All units/remote control shall have COM port for required interface with BMS. The required software with open protocol to transfer readings on the BMS shall be in your scope.

REFRIGERANT PIPING

The indoor and outdoor units shall be connected with refrigerant piping. All piping connections for the units should be performed inside the unit. The refrigerant piping should be insulated with **EPDM 19MM thickness**.

ALL exposed to atmosphere pipe insulation to be protected based paint or film.



DRAIN PIPING

Condensate from the evaporator unit shall be drained through properly installed drain piping designed to prevent any accumulation of condensate in the drain pan. Drain piping shall be made of 1.1/4" Ø / 2" Ø rigid PVC pipe of 6 Kg/Sq cm. pressure rating with water tight threaded connections, leading from the room unit to a suitable drain point. Complete drain piping shall be made leak proof and water tight by means of precise installation and the use of leak proof sealant/adhesives. Drain piping duly insulated with 6 mm thick nitrile rubber.

SCOPE

The scope of this section comprises the supply, erection testing and commissioning of Variable Refrigerant Flow System conforming to these specifications and in accordance with the requirements of Drawing and Schedule of Quantities.

TYPE

Units shall be air cooled, variable refrigerant volume air conditioner consisting of one outdoor unit and multiple indoor units. Each indoor units having capability to cool independently for the requirement of the rooms.

The indoor units on any circuit can be of different type and also controlled individually. Following type of indoor units shall be connected to the system:

- Ceiling mounted cassette type (Multiflow)
- Ceiling mounted Low static FCU
- Ceiling mounted Duct type
- Wall mounted type

Compressor installed in each modular outdoor unit shall be equipped with minimum 4 inverter compressors for higher reliability, improved life, better backup and duty cycling purpose. The system shall be capable of changing the rotating speed of inverter compressor by inverter controller to follow variations in cooling and heating load.

Outdoor unit shall be suitable for mix match connection of all type of indoor units.

The refrigerant piping between indoor units and outdoor unit shall be possible to extend up to 175m with maximum 50m level difference **without any oil traps.**

Both indoor units and outdoor unit shall be factory assembled, tested and filled with first charge of refrigerant before delivering at site.



1.1 OUTDOORUNIT

The outdoor unit shall be factory assembled, weather proof casing, constructed from heavy gauge mild steel panels and coated with baked enamel finish. The unit should be completely factory wired, tested with all necessary controls:

Each modular inverter outdoor shall be DC twin rotary compressor/ Scroll.

- In case of modular outdoor units, the outdoor unit shall have compulsorily at least 50% inverter compressors so that the operation is not disrupted with failure of any inverter compressor and if one inverter compressor malfunctions, other continues to provide emergency operation smoothly till repair is affected.
- It should also be provided with duty cycling for multiple inverter compressor switching starting sequence for better stability and prolonging equipment life.
- The outdoor unit shall be modular in design and should be allowed for side by side installation
- The unit shall be provided with its own microprocessor control panel.
- The outdoor units should have anti-corrosion paint free gal barium base plate for easy mounting of unit.
- The machine must have a sub-cool feature to use coils surface more effectively through proper circuit/bridge so that it prevents the flushing of refrigerant from long piping due to this effect thereby achieving energy savings.

The outdoor unit should be fitted with low noise, aero spiral design fan with aero fitting grill for spiral discharge airflow to reduce pressure loss and should be fitted with DC fan motor inverter type for better efficiency.

The condensing unit shall be designed to operate safely when connected to multiple fan coil units.

1.2 COMPRESSOR

The compressor shall be highly efficient Rotary/ Scroll type and capable of inverter control. The inverter compressor shall change the speed in accordance to the variation in cooling or heating load requirement:

- All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.
- Oil heater shall be provided in the compressor casing.
- The inverter compressor shall preferably be Reluctance DC inverter compressor for higher efficiency and improved reliability.



1.3 HEATEXCHANGER

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coil.

- The aluminum fins shall be covered by anti-corrosion resin film.
- The unit should be with e-pass heat exchanger to optimize the path of heat exchanger and for better efficiency of condenser.
- The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

1.4 REFRIGERANT CIRCUIT

The refrigerant circuit shall include liquid & gas shut-off valves and a solenoid valves at condenser end.

The equipment must have in built refrigerant stabilization control for proper refrigerant distribution.

All necessary safety devices shall be provided to ensure the safely operation of the system. Refrigerant should be R410a Only.

1.5 SAFETY DEVICES

All necessary safety devices shall be provided to ensure safe operation of the system. Following safety devices shall be part of outdoor unit; high pressure switch, fuse, fan drive overload protector, fusible plug, over load relay, overload protection for inverter.

1.6 OIL RECOVERY SYSTEM

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths.

The system must be provided with oil balancing circuit to avoid poor lubrication.

1.7 INDOOR UNIT

This section deals with supply, installation, testing, commissioning of various type of indoor units confirming to general specification and suitable for the duty selected. The type, capacity and size of indoor units shall be as specified in detailed Bill of Quantities



GENERAL

Indoor units shall be either ceiling mounted cassette type, or ceiling mounted ductable type or floor standing type or wall mounted type or other as specified in BOQ. Each unit shall have electronic control valve to control refrigerant flow rate respond to load variations of the room.

- a) The address of the indoor unit shall be set automatically in case of individual and group control.
- b) In case of centralized control, it shall be set by liquid crystal remote controller

The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing.

The cooling coil shall be made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Each coil shall be factory tested at 21 kg/sqm air pressure under water.

Unit shall have cleanable type filter fixed to an integrally molded plastic/aluminum frame. The filter shall be easily serviceable.

Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling or cooling and heating.

Each unit shall be with wired LCD type remote controller. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.

1.7.1 CEILING MOUNTED CASSETTE TYPE UNIT (MULTI FLOW TYPE)

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and DX-coil section. The housing of the unit shall be powder coated galvanized steel. The body shall be light in weight and shall be able to suspend from four corners. The fan shall be aerodynamically designed diffuser turbo fan type.

Unit shall have an external attractive panel for supply and return air. Unit shall have four-way supply air grilles on sides and return air grille in center.

Each unit shall have high lift drain pump, fresh air intake provision (if specified) Low gas detection system and very low operating sound.



All the indoor units regardless of their difference in capacity should have **same decorative panel size** for harmonious aesthetic point of view. It should have provision of connecting branch ducts.

1.7.2 CEILING MOUNTED DUCTABLE TYPE UNIT

Unit shall be suitable for ceiling mounted type. The unit shall include pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel. The unit shall have high static fan for Ductable arrangement.

Indoor unit should be with PM2.5 filter chamber

1.7.3 CEILING CONCEALED / SUSPENDED TYPE (LOW STATIC)

Unit shall be suitable for ceiling suspended arrangement below false ceiling.

The unit includes pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel.

Indoor unit should be with PM2.5 filter chamber

Unit shall have an attractive external casing for supply and return air.

1.8 CENTRALIZED TYPE REMOTE CONTROLLER WITH BILLING MANAGEMENT SYSTEM FOR INDIVIDUAL USER

A multifunctional compact centralized controller shall be provided with the system. It shall be able to control up to 64 groups of indoor units with the following functions: -

- a) Starting/stopping of Air-conditioners as a zone or group or individual unit.
- b) Temperature setting for each indoor unit or zone.
- c) Switching between temperature control modes, switching off fan speed and direction of airflow, enabling/disabling of individual remote controller operation.
- d) Monitoring of operation status such as operation mode & temperature setting of individual indoor units, maintenance information, and troubleshooting information.
- e) Display of air conditioner operation history.
- f) Daily management automation through yearly schedule function with possibility of various schedules.
- g) System should be capable of providing power consumption by each indoor unit in KWH along use time & user ratio.
- h) The output available should be in Microsoft Excel format.
- i) Data storage capacity of Power distribution shall be for at least 75 days.



2.1 DUCTABLE SPLIT UNIT

CONDENSING UNIT

The compressor(s) shall be hermetically sealed scroll and designed for continuous operation even at high ambient temperatures of 55°C. The condenser shall be air cooled, made of Cu. tubes with extended aluminium fins. Cabinets shall be fabricated out of heavy gauge steel, properly formed for close fit and structural rigidity. All access panels shall be so constructed as to be quickly and easily removable. All outside surface shall be finished with powder coating for protection against humid weather. The condenser fans shall be directly driven and designed to achieve low condensing temperatures & operate continuously and silently.

EVAPORATING UNIT

The cooling coil shall be made of Copper Tubing having extended aluminium fins. The tubes shall be mechanically expanded for positive bonding between tubes and fins. The cooling coils circuit shall be fed with liquid refrigerant through the expansion device and distributor. The blower shall be statically and dynamically balanced and designed for silent operation at required airflow rates against required static pressure. The filters shall be washable synthetic media type arranged for convenient cleaning and replacement. The drain pan shall be fabricated out of heavy sheet steel, insulated with 1/4" expanded polyethylene sheet. The casing shall be of heavy gauge G.I., duly powder coated for weather protection.

NOTE: ALL OUT-DOOR UNIT SHALL BE MOUNTED ON EXTENDED BALCONY TYPE M.S. ANGLE FRAME STRUCTURE. THE M.S. ANGLE FRAME STRUCTURE SHALL BE MADE AVAILABLE TO VENDOR BY CLIENT.

2.2 CONTROLS AND INTERLOCKING

All electrical control devices should be enclosed in the indoor and outdoor units. The compressor should be protected against breakdown by a quick response overcurrent relay, a high-pressure switch, a wraparound type oil heater and a discharge gas thermostat. In addition to the compressor protection devices, the indoor / outdoor fan motor should be protected by an internal thermostat. The indoor fan motor shall be directly supplied with the power source from the control circuit. The functions of these control devices shall compose an electrical sequence of manual starting and stopping, automatic continuous operation whenever the room thermostat requires, and the protection devices allow the operation. The remote control switch should be designed to provide simple operation such as On/Off, temperature and fan speed only without trouble shooting functions. The remote control should be BMS compatible for centralized monitoring. All units/remote control shall have COM port for required interface with BMS. The required software with open protocol to transfer readings on the BMS shall be in your scope.



REFRIGERANT PIPING

The indoor and outdoor units shall be connected with refrigerant piping. All piping connections for the units should be performed inside the unit. The refrigerant piping should be insulated with **Cross Cell Elastomeric nitrile tube of minimum 13 MM thick upto pipe dia of 22 mm OD & 19 mm thick for pipe dia more than 22 mm OD**. All refrigerant pipes and fittings shall be type 'L' hard drawn copper tubes and wrought copper fitting suitable for connection with silver solder. The copper thickness of wall shall be 20G/ 22G (0.7 to 1 mm). All joints in copper piping shall be swaged joints using low temperature brazing and/or silver solder. Before joining any copper pipe or fittings, its interior shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while construction of the joints. Subsequently, it shall be thoroughly blown out using nitrogen. Refrigerant lines shall be sized to limit pressure drop between evaporator and condensing unit to less than 0.2 kg per Sq.cm. After the refrigerant piping installation has been completed the refrigerant piping system shall be pressure tested using, Freon mixed with nitrogen at a pressure of 20Kg per Sq.cm. (High side) and 10Kg per Sq. cm (Low side). Pressure shall be maintained on the system for 24 hours. The system shall then be evacuated to a minimum vacuum of 70 cm. of mercury and held for 24 hours, during which time; change in vacuum shall not exceed 12 cm of mercury. All refrigerant piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment manufacturers.

ALL exposed to atmosphere pipe insulation to be protected based paint or film.

AIR MOVING EQUIPMENTS:

DOUBLE SKIN AIR HANDLING UNIT/s-

Air Handling Units shall consist of fan section, coil section, Pre-filter section, and Post-filter section & will have the construction as described below -

Air handling units will be in double skin construction fabricated out of Aluminum Extruded section and 43 mm/25mm thick Double skin panels.

Aluminum sections should have double walled rib having a groove for the gasket on the panel side face and plane surface on internal face. Panel side faces should also have additional plane face available for stick on type gasket to facilitate the fixing of additional gaskets in future if required. Units will be supplied with round gasket in solid / tubular construction fixed in the groove. Gasket will be made out of PVC/Synthetic rubber. Extruded section will be having scratch proof anodized finish. The extruded frame structure will be formed using couplers made out of glass filled nylon, (approx. 30% glass and 70% nylon).

AHU Casing-

Double skin panels will be fabricated out of best quality G. I. Powder coated sheet on outer side and plane G.I. Sheet on inner side. Polyurethane foam of density not less than 36 Kg./Cu.

M. will be sandwiched between inner and outer sheet. The panels will be fixed on Al. Extruded section in such a manner that fixing screw head does not project on outer face on the panel and sharp end of the screw does not project inside the unit through double walled rib. The screw hole on panel will be blocked with Nylon sleeve with cap. The panels shall be 43/25 mm thick. The screw cavity on panel will be blocked with nylon sleeve with cap.

Drain tray will be fabricated out of SS sheet having thickness not less than 1.2mm (18 G). The tray will have sufficient depth and proper size drain connection. The tray will be insulated from outside with nitrile rubber foam sheet having thickness not less than 19mm.

The rollers in nylon construction will be provided below the coil for easy removal of coils in the AHU of areas dealing with powder. Gasket sleeves at chilled water header outlet will be provided in such a design that the same does not obstruct the pulling of coil at the time of removal.

Filter section will have rigid construction filter frame fabricated out of GI sheet to house required size filters. The filters will be in flange type construction having GI casing.



Blower section will consists of extruded sections of proper size to facilitate the mounting of fan and motor bracket. Direct contact of fan base frame and AHU casing will be eliminated through vibration isolator. Also flexible connection will be provided at the fan outlet. Suitable panel of blower section will be provided with hole for cable entry with required arrangement to cover the sharp edge GI sheet. If required, a proper size box cover will be provided on cable entry location. A provision for earthing will be provided on mainframe near the cable entry hole.

Inspection doors at required location will be provided with elegant design hinges made out die cast Aluminum alloy. Two or more number of hinges per door will be provided

depending upon the size of the door to provide required rigidity to the door panel. One or more number of door handles will be provided with can type tightening arrangement. The handle and can will be made out of filled nylon having galvanized iron spindle. The inspection door for blower section will be provided at such a location that the motor and drive package and fan bearing can be assessed for easily maintenance. An additional guard made out of GI wire mesh of required strength will be provided at inner side of blower section inspection door. A limit switch / door switch covered electrical terminal will be provided to facilitate the door inter locking with fan operation. An inspection glass fitting having the transparent element on both side of the panel with a common gasket sleeve between two elements will be provided on blower section inspection door to facilitate inspection of drive package in running condition without opening the inspection door. The inspection doors of the sections accommodating filters will be of sufficient size to take care of filter removal.

Necessary arrangement with required plastic / nylon fittings will be provided at required locations to facilitate the mounting of temperature Humidity & pressure sensors as per requirement of BMS vendors.

Properly designed nipples will be provided at required location to facilitate the connection of manometer tubes / pressure transmitter.

The entire AHU assembly will be mounted on a common skid fabricated out of HDG MS channel of required size. The skid will be secured with AHU frame structure through threaded fasteners. The skid will be duly painted after fabrication with the best quality rust preventive primer followed by two coats of enamel paint.

All nut bolts, sheet metal screws, fasteners will be Zinc / Nickel plated having resistance against rusting.

Cooling Coils-

The cooling coils shall be fabricated out of copper tube having OD not less than 12.5mm and Aluminum fins spaced @ 12 fins / inch. Aluminum fins & copper tubes will have foam bond provided by hydraulic expansion method at the high pressure above yield point. The capacity of the coils shall be as required under the schedule of equipment. Velocity of air across coil face shall not exceed 500 FPM for 4 Row coil and 600 FPM for 6 Row coil. The bottle shaped steam humidifier along with sensors & solenoid valve & strip heater of capacity as mentioned in the BOQ shall be provided to meet inside conditions. The Coils & Fittings are suitable for 20kg/cm² Pressure.

Fan-

Fan wheels and scrolls shall be fabricated from best quality sheet steel. The fans should be EC type with controller.

The fan will be Nicotra / Kruger / Punker / Zeil-al Bag / EBM / Rosenberg Make.

The AHU shall be supplied with AHU blower fans with wall mounted EC Fans complete controller, fan wheel rotor mounted, and potentiometer for speed control. The fan shall be suitable for BMS connectivity. The single or multiple fans shall be considered depending upon the capacity of the AHUs (as mentioned below). AHU manufacturer should supply cover plate for Fans in sufficient quantity for maintenance purpose. EC fan incoming supply to be terminated with MCB / MCCB and shall be included in the power terminal box for electrical connection of EC fans and should be factory fitted on the AHUs. Potentiometer shall be provided in the marshalling box for manual operation of EC fans. Relay for AUTO/MANUAL operation should be a part of Marshalling box supplied by the AHU manufacturer.



Filters-

Pre-filters shall be HDPE washable types with 2" thickness with filtration level of mentioned indrgs. & efficiency of 90%. The pre-filter section will be located on suction side of the filters & Post-filters as per drawing.

Fan motors- (IE-4)

Fan motors shall be 3 phase, sq. cage, and T.E.F.C. induction type, together with starters, specified in "ELECTRICAL ITEMS" separately. The motors shall be capable of high initial starting torque requirement of fans & suitable for VFD application where ever specified.

Accessories-

Air Handling Units shall be complete with all accessories & shall also include the following-

- a. Shut-off valves, diverting valve, manual air vents, drain valves for cooling coils and drain piping.
- b. Vibration eliminators and flexible connections.
- c. Supply & return water with dial type thermometer having a range of 0 to 50°C.
- d. 100mm dia. pressure gauges (0 to 6 Kg/Cm²) with 10mm of Niddle valve at inlet and outlet.
- e. Automatic chilled water flow control with modulating valves.

(All the above specified accessories are quantified in BOQ and shall be measured separately).

The exterior surface of air handling unit/s shall be powder coated. Refer detail BOQ description for AHUs/TFAs.

Flame Free Jointing for HVAC & R Pipe

Fittings Specification:

Press fittings with press ends shall be manufactured from Copper (UNSC 12200) min 99.9% pure and be UL certified recognised component. Three-point press fitting (one before the seal, on the seal and after the seal towards the fitting end) available in sizes 1/4" to 1.3/8" compatible with copper tubes manufactured to ASTM B280/ JIS H 3300. The sealant HNBR O ring in the fitting shall be black in colour, with capacity to withstand temperatures -40 to +140 Degree Celsius. Press fittings shall be capable of withstanding maximum operating pressure of 48 bar (700 psig). Copper fittings shall be supplied with 10 years warranty and installers shall be trained and certified before installation and site supervised by the competent personnel from the manufacturer/ distributor

(Copper Fitting Brands: >B< MaxiPro / Parker)

DRAIN PIPING

Condensate from the evaporator unit shall be drained through properly installed drain piping designed to prevent any accumulation of condensate in the drain pan with U trap. Drain piping shall be made of rigid UPVC pipe of 6 Kg/Sq cm. pressure rating with water tight threaded connections, leading from the room unit to a suitable drain point. Complete drain piping shall be made leak proof and water tight by means of precise installation and the use of leak proof sealant/adhesives. Drain piping duly insulated with 6 mm thick nitrile rubber. All pipe to be used for condensate drain shall be UPVC pipe conforming to IS: 4985

- Class III & all joints should be Gluing or solvent cementing as per manufacturer recommendation.

UPVC Drain piping (IS4985 class III grade , 6kg/cm²) for the units with 9mm Thick Closed Cell EPDM Insulation and duly epoxy coated Black painted clamped to be considered.



2-STAGE EVAPORATING COOLING UNIT

TYPE

The Indirect Evaporative cooling system shall be a two airstream Indirection Evaporative Cooling system wherein "one airstream is called primary or supply air and the second airstream is called secondary or working air. The indirect cooling process evaporates water and removes heat from the secondary/working airstream and in the process cools down the supply air without addition of any moisture to the primary/supply air.

The Indirect Evaporative Cooling units are generally applied for 100% Fresh/Outdoor Air. However, the IDEC should have an inbuilt control setting for either configuration of 100% OA or a combination of OA and RA. The unit can also be configured as a stand alone air-conditioning unit or integrated into a variety of combinations.

CAPACITY

The Indirect Evaporative cooling system shall be of such capacities and static pressures as mentioned in the Bill of Quantities.

CASING

The units shall be made of extruded Aluminum hollow profile frames. The profile box size shall be of thermal break type. The unit should be devoid of any welded construction and should be of cabinet type. All the frames should be assembled using glass fiber reinforced nylon joints/corners to make a self-supporting frame.

The Casing shall be AHRI certified (As per AHRI 1350) for the following parameters -

1 Deflection

2 Leakage

3 Thermal transmittance

4 Thermal Bridging.

The panels shall be of double skin construction with both inner and outer steel sheets being minimum 0.63 mm thick. Outside sheet shall be pre coated & plasticized and inner sheet will be galvanized with PUFI insulation of 40 kg/m³ density. The thickness of the insulated panel should be 25mm

The Inspection and access panels shall be hinged type. The hinges shall be casted, powder coated Zinc alloy. Flushed Locks and Handles shall be of glass fiber reinforced polyamide. Other panels will be screwed onto the frame with sealant and soft rubber gasket thus making the joints airtight. All screws used for panel fixing shall be covered with PVC caps.

Special hollow gaskets and seals shall be used on inspection doors and to create separation between the air streams to ensure negligible air leakage and mixing

The entire casing shall be mounted on galvanized channel framework. Condensate drain pan shall be fabricated from 18g GI construction.

**UNIT CONSIST OF FOLLOWINGS**

The Unit supply of the following: Fan, Filter, DCM Core & ECM

EC DRIVE FAN (There will not be separate secondary fan for the Discharge air)

Plug type fan with EC Motor with inbuilt speed controller. The impeller and the fan casing shall be made of hot galvanized sheet steel. The impeller shall be mounted on a solid shaft supported to housing with angle iron frame and pillow block heavy duty ball bearing. The impeller shall be statically and dynamically balanced. The fan shall be selected such that unit noise level is less than shouldn't be more than 50 to 55 dBA at 3 meters from. Fan housing and motor shall be mounted on a common galvanized steel or aluminum block base which can be drawn out from side for ease of maintenance. A quarter pin lock arrangement between the slide and guide pin lock arrangement between Fan and Unit outlet should be provided.

MOTOR AND DRIVE

Fan motor shall be energy efficient and suitable for 415C 10% volts, 50 cycles, 3 phase squirrel cage, totally enclosed fan cooled with IP – 55 protections. Motor shall be designed for quiet operation. Drive shall be provided through belt – drive arrangement. Belts will be of oil resistant type.

FILTER

The units shall be provided pre filters with at least G4 & F7 as fine filter. The filter elements shall be mounted on metallic slide rails and shall be easily pulled out for replacement.

Indirect Evaporative Cooling

The units shall be provided with technology having Cooling ability of supply airstream below the ambient wet bulb temperature. Cooling module shall be made of engineered polymers material. The DCM is properly sealed with to ensure that their moisture transfer between the two airstreams.

Direct Evaporative Cooling Module

- The units shall be provided with Additional Module utilizing Direct Evaporative cooling pads.
- The Pads shall be 7mm flute size and 45/45 flute angle.
- The Pads shall be treated with anti-rot and rigidifying resins for longer life.
- The Pads shall have higher water holding capacity.
- The Pads shall have higher saturation efficiency – 90% and above.
- The Pads shall have cross-corrugated to maximize mixing of air and water and eliminate water carryover.
- The Pads shall have better water holding capacity.
- The Pads shall have ROHS certified.

Basic Control:

- PLC/Micro controller based control system



- Set point for Supply Air
- Temp. & Humidity for Outdoor & Supply Air
- Online Display of temp. & Humidity.
- Overload Protection for Axial Fan.
- Interlocking of Supply Air Fan, Water Pump & Axial Fan.
- Optional Differential Pressure Switches for indication of clogged/Dirty Filters.
- Optional potential free contacts for BMS Integration.
- Optional IP 54 Enclosure.
- Provision of earthing shall be given to the metallic body of the controlpanel.

All control cables shall be multi core,1100 V grade, PVC insulated and overall PVC sheathed with copper conductor manufactured and tested as per relevant IS and ISImarked

3.0 SHEET METAL WORK- SCOPE

The scope of this section comprises supply fabrication, installation and testing of all sheet metal / aluminum ducts.

GOVERNING STANDARDS

Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards – Metal and Flexible – Second Edition – 1995"-SMACNA)

RAW MATERIAL

Ducting

All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill Test Certificates.

Galvanising shall be of 120gms/sq.m. (Total coating on both sides)

In addition, if deemed necessary, samples of raw material, selected at random by owner's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.

The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross-section dimensions.

Duct Connectors and Accessories



All transverse duct connectors (flanges/cleats) and accessories/related hardware are such as support systems shall be zinc-coated (galvanized). The bolts for fixing of slip-on flange corners should be of SS.

FABRICATION STANDARDS

All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory-fabricated or by equivalent technology. Equivalency will require fabrication by utilizing the following machines and processes to provide the requisite quality of ducts and speed of supply;

Coillinestoensurelocationoflongitudinalseamsatcorners/foldededgesonlytoobtainthe required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.

All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines.

All edges to be machine treated using lockformers, flangers and roller for turning up edges.

Sealant dispensing equipment for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified.

SELECTION OF G.I. GAUGE AND TRANSVERSE CONNECTORS

Duct Construction shall be in compliance **with 1" (250 Pa) w.g. static norms as per SMACNA.**

All transverse connectors shall be the Rolamate 4 bolt slip – on flanges system or equivalent imported makes of similar 4-bolt systems with built-in sealant.

Non-toxic, AC-applications grade P.E. or PVC Gasketing is required between all mating Rolamate flanged joints. Gasket sizes should conform to flange manufacturer's specification. The sealant used at corner of the slip-on flanges & that sealant should withstand 100 °C & same should be non toxic.

DUCT CONSTRUCTION

The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.

Dimensional Tolerances: All fabricated dimensions will be within +/- 1.0mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be +/- 1.0 mm per metre.

Each and every duct pieces should be identified by color coded sticker which shows specific part numbers, job name, drawing number, duct sizes and gauge

Ducts shall be straight and smooth on the inside. Longitudinal seams shall be airtight and at corner only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness

Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence

Plenums shall be shop/factory fabricated panel type and assembled at site.

The deflection of transverse joints should be within specified limit for rectangular duct deflection as per SMACNA Standards.

Reinforcement of ducts shall be achieved by either cross breaking or straight beading depending



on length of ducts.

SUPPORT SYSTEM

A completely galvanized system consisting of fully threaded rods, slotted angles or Double-L bottom brackets (made out of 3.0mm M.S. sheet) nuts, washers and anchor bolts as supplied by supplier or generally conforming to SMACNA standards should be used.

Table 3 Support for Horizontal Duct-Rectangular

Sr. No.	Maximum Duct Size (mm)	Hanger Rod Diameter	Interval (mm)
1	Up to-700	6mm	2400
2	701-1200	8mm	2400
3	1201-2000	10mm	2400
4	Above 2000	12mm	2400

As an alternative, slotted galvanized brackets attached to the top two bolts of the Rolamate system may also be used as appropriate for the site condition.

To provide the required thermal brake effect, Neoprene or equivalent material of suitable thickness shall be used between duct supports and duct profiles in all supply air ducts not enclosed by return air plenums.

INSTALLATION

Tools and tackles for site work

The duct installation shall conform to SMACNA norms. For duct assembly and installation, the use of suitable tools and tackles should be used to give the required duct quality and speed of installation including (but not restricted to)

- Electric Pittsburgh Seamer – used for closing Pittsburgh joints
- Electric Slitting shear – to make cut-outs
- Drilling machine with drill bits – for drilling holes in sheet metalwork
- Hammer drill machine with drill bits – for drilling holes in building structures for anchors
- Hoisting system – for lifting the duct assembly up to mounting heights

Installation Practice

All ducts shall be installed as per tender drawings and in strict accordance with approved shop drawings to be prepared by the Contractor.

The Contractor shall provide and neatly erect all sheet metal work as may be required to out the intent of these specifications and drawings. The work shall meet with the approval of Owner's site representative in all its parts and details.

All necessary allowances and provisions shall be made by the Contractor for beams, pipes, other obstructions in the building whether or not the same are shown on the drawings. Where there is interference/fouling with other beams, structural work, plumbing and conduits, the ducts shall be suitably modified as per actual site conditions.

Ducting over false ceilings shall be supported from the slab above, or from beams. In no case

shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in



dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.

Where ducts pass through brick or masonry openings, it shall be provided with 25mm thick

appropriate insulation around the duct and totally covered with fire barrier mortar for complete sealing.

All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge.

DOCUMENTATION & MEASUREMENT FOR DUCTING

All ducts fabricated and installed should be accompanied and supported by following documentation:

1. For each drawing, all supply of ductwork must be accompanied by computer-generated detailed bill of materials indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct area by gauge and duct size range as applicable.
2. Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.
3. All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

TESTING

After duct installation, a part of duct section (approximately 5 % of total ductwork) may be selected at random and tested for leakage for class 12 as per SMACNA standards. The procedure for leak testing should be followed as per SMACNA-“HVAC Air Duct Leakage Test Manual” (First Edition)

All ductings must be fabricated at factory with SMACNA standard only, no site fabrication of ducts allowed except termination / connecting pieces.

FLEXIBLE DUCTWORK

The flexible ductwork shall have a liner and a cover of tough tear-resistant fabric equal in durability and flexibility to glass fibre fabric. The fabric shall be impregnated and coated with plastics. It shall be reinforced with a bonded galvanised spring of stainless steel or other approved wire helix between the liner and the cover. An outer helix of glass fibre cord or equal shall be bonded to the cover to ensure regular convolutions, flexible ductwork without a liner may not be used.

In no cases shall material containing asbestos fabric be used.

Alternatively, flexible ductwork shall consist of flexible corrugated metal tubing of stainless steel, aluminium, tin plated steel or aluminium coated steel. The metal surface(s) may be coated with a plastics material.

The leakage from any section of flexible ductwork shall not exceed 1% of the local design air flow rate at the local maximum static pressure.

flexible ductwork shall be suitable for an operating temperature range of -5° C to 90° C and shall comply with BS 476 Rating Class P; Part 6 having an index of performance not exceeding

12 of which not more than 6 should derive from the initial period of test; Part 7 Class 1 (surface of very low flame spread) unless otherwise indicated.



ROUND DUCT CONSTRUCTION-

MAX SIDE (MM)	THICKNESS OF SHEET (GSS)	REINFORCING	JOINTS & SEAMS
Up to 200	24G		Round duct sections are joined or by belling out one end of duct.
225 to 600	22G		
625 to 900	20G	32 mm x 32mm x 3mm	girth angle reinforcing spaced on 8' centers.
925 to 1200	20G	32 mm x 32mm x 3mm	girth angle reinforcing spaced on 6' centers.
1225 to 1800	18G	40 mm x 40 mm x 3mm	-----do-----
1825 to UP	16G	40 mm x 40mm x 3mm	girth angle reinforcing spaced on 4' centers.

KITCHEN EXHAUST DUCT

Kitchen Exhaust Duct shall be fabricated as specified below. The duct shall have welded construction with appropriate size of MS flanges, gaskets and supports with seismic restraints.

- 1 Fire rated ductwork constructed for kitchen extract system to be tested to BS476 Part 24(1987) and ISO 6944(1985) for two hours stability and two hours integrity for both fire inside (Type B test) and fire outside (Type A test). Duct to maintain a minimum of 75% cross-sectional area along its whole length when tested for two hours.
- 2 All fire rated ductwork to be black steel duct, constructed to tested standard and coated with fire rated material. The duct to be composite fire duct manufactured to Method 3 of BS5588 Part 9, factory produced. Once erected, to be pressure tested, if required by client or Engineer, to DW144 standard, in line with the pressure classification of the duct being installed.
- 3 The duct support system should be located at a maximum of 1500mm centres, the size of the hangers and bearers upgraded to account for reduction in tensile strength of steel, due to a two-hour fire from 430 Newton/mm² to 10 Newton/mm².
- 4 All gaskets and sealants to be non-combustible and installed as fire tested.
- 5 The duct shall be connected to the fans with the use of fire rated flexible connections. Flexible connectors shall be made of glass fabric, coated on both sides with flame retardant silver grey polyurethane rubber, tested to BS476 Part 20.
- 6 All access doors/inspection coves and test holes shall be suitably positioned in relation to the access provided by the false ceiling or other means of concealment supplied and fitted by the building contractor.

FABRICATION STANDARDS

The construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards – Metal and Flexible – Second Edition-1995"-SMACNA)

All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory-fabricated or by equivalent technology.

Kitchen Ventilation Ducting (Only for Exhaust)

Max. Size	Min. thick	Trans joints	Reinforcement	Hanger
-----------	------------	--------------	---------------	--------



All sizes	1.3mm(MS CRCA sheet), final ducting assembly to be completely fire sprayed from inside and outside to achieve the required fire rating	40x6 eq.angle	40x6 girth angle at 1250mm centre	12mm
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A good quality /expanded polyethylene / Food Grade Nitrile rubber of uniform thickness and width shall be used as gasket between flange joints. The gaskets shall be fixed by a suitable adhesive and holes made by passing a heated rod through.

The gasket used for the kitchen Exhaust Ducting shall be fire retardant type.

For transverse angle flanged joints, neoprene gasket (3mm uncompressed thickness and width equal to flange face) adhered to the flange face shall be used. The bolt holes in the gasket shall be the same as bolt diameter and shall be punched prior to insertion of gaskets.

Angle shall have welded corners and shall be riveted to the ducts at 300 mm centres maximum.

Wherever sheet metal duct connects to the intake or discharge of fan units, a flexible connection of fire retarding double layer of at least 150mm width shall be provided. The material shall be attached to the angle frames by means of steel band over the end of the flexible connections. The material shall be secured between the band and the angle frame by bolting. Sleeves shall be made smooth and the connecting duct work rigidly held by independent supports on both the ends. The flexible connections shall be suitable for fan intake and outlet pressure.

All bends, offset and branch connections shall be made for smooth and noiseless flow of air and minimum pressure drop. The contractor shall furnish the details of guide vanes i.e number of vanes and locations etc. in the construction drawings. The flow of air to the branch duct shall be regulated by a splitter damper or volume control damper.

SUPPORT SYSTEM

A completely galvanized system consisting of fully threaded rods, slotted angles or Double-L bottom brackets (made out of 3.0mm M.S. sheet) nuts, washers and anchor bolts as supplied by supplier or generally conforming to SMACNA standards should be used.

Support for Horizontal duct-Rectangular/Square

Sr.No.	Maximum Duct Size (mm)	Hanger Rod Diameter	Interval (mm)
1	Up to-700	6mm	2400
2	701-1200	8mm	2400
3	1201-2000	10mm	2400
4	Above 2000	12mm	2400



To provide the required thermal brake effect, Neoprene or equivalent material of suitable thickness shall be used between duct supports and duct profiles in all supply air ducts not enclosed by return air plenums.

QUALITY ASSURANCE

All kitchen exhaust ductings shall be neatly fabricated with appropriate type of gas welded or electric welded construction.

The installation of ductings shall be done with the suitable tools and tackle to get the required quality and speed of installation.

- a) Electric Slitting shear – to make cut-outs
- b) Drilling machine with drill bits – for drilling holes in sheet metalwork
- c) Hammer drill machine with drill bits – for drilling holes in building structures for anchors
- d) Hoisting system – for lifting the duct assembly up to mounting heights

SUBMITTALS

Bidding stage

1. Manufacturer test certificate for material composition and thickness.
2. Conformation of duct fabrication and installation standards.
3. Conformation of duct pressure testing procedure.

Post bidding

1. Duct layout drawing indicating various sizes and schedules showing the duct support and construction details.



2. Manufacturer test certificate for material composition and thickness for kitchen exhaust duct.
3. Supporting arrangements of rectangular, square, round ducting with seismic restraints.
4. Duct site pressure test report.
5. Revised Bill of quantity based on shop drawings and statement of variation for work beyond tender quality and rate.
6. The test certificate for the fire retardant coating carried out on the duct.

Post Commissioning and Handover

1. As built layout co-ordinated with all the other services.
2. Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

INSTALLATION

The Contractor shall provide and neatly erect all the ducting as may be required to carry out the intent of these specifications and drawings. The work shall meet with the approval of site representative in all its parts and details.

Where there is interference/fouling with other beams, structural work, plumbing and conduits, the ducts shall be suitably modified as per actual site conditions.

Ducting over false ceilings shall be supported from the slab above, or from beams. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.

Where ducts pass through brick or masonry openings, it shall be provided with 25mm thick appropriate insulation around the duct and totally covered with fire barrier mortar for complete sealing.

All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge.

TESTING

After duct installation, a part of duct section (approximately 5 % of total ductwork) may be selected at random and tested for leakage for class 12 as per SMACNA standards. The procedure for leak testing should be followed as per SMACNA-"HVAC Air Duct Leakage Test Manual" (First Edition)



Wire Rope Hangers & Supports:

Wire Hangers shall be used to suspend all static HVAC & Mechanical services.

- a. Wire Hangers should consist of a pre-formed wire rope sling with a range of end fixings to fit various substrates and service fixings, these include a ferruled loop, permanently fixed threaded M6 (or M8, M10) stud, permanently fixed nipple end with toggle, at one end or hook or eyelet, cladding hook, barrel, wedge anchor, eyebolt anchor or any other end fixture type or size as per manufacturer's recommendation and design. The end fixings and the wire must be of the same manufacturer with several options available. The system should be secured and tensioned with a Hanger self-locking grip at the other end. Once the grip is locked for safety purpose unlocking should only be done by using a separate setting key and should not be an integral part of the self-locking grip. Only wire and/or supports supplied and/or approved, shall be used with the system.
 - i. Wire Hangers should have been independently tested by Lloyds Register, APAVE, TUV, UL, CSA, Chiltern International fire, ADCAS, Intertek, ECA, and SMACNA, approved by ULC and CSA and comply with the requirements of DW/144 and BSRIA –wire
 - ii. Rope Suspension systems. Wire rope should be manufactured to BSEN 12385: 2002
 - iii. The contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum safe working load limit (which incorporates a 5:1 safety factor).
- b. The correct specification of wire Hanger required is determined using the following formula. Weight per meter of object suspended (kg) X distance between suspension points (m) = weight loading per Hanger suspension point (kg).
- c. Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations given in the manufacturer's handbook.
- d. The contractor shall select the correct length of wire rope required to support the service. Lengths from 1-10m lengths. Specials can be made, check with manufacturer. No in-line joints should be made in the rope.

Table. 1

Wire (Gripple) Hanger Safe Working Loads		
size	minimum breaking load of Wire Rope	working load limit (kg/lbs)
No. 1	80kg/176 lbs	0-10 kg / 0-22 lbs
No. 2	260kg/572 lbs	10-45 kg / 23-100 lbs
No. 3	580kg/1276 lbs	45-90 kg / 101-200 lbs
No. 4	1500kg/3300 lbs	90-225 kg / 210-495 lbs
No. 5	2160kg/4752 lbs	225-325 kg / 496-715 lbs
No. 6	2500kg/5500 lbs	325-500 kg / 715-1100 lbs

- e. The standard range of Hanger Kits should contain galvanized high tensile steel wire rope or stainless steel wire rope as per the application, the minimum specification is as above and



should be manufactured to BS 302 (1987), BSEN12385. Comply with manufacturer's load ratings and recommended installation procedures. Note the testing is done to the minimum breaking load of the wire thus giving a minimum safety factor of 5: 1.

HVAC Supports

Gripple Hanger Supports are suitable for: Rectangular duct, Spiral Duct, Oval Duct, Fabric Duct, Desertification fans, Air Conditioning Units, Plenum Boxes, Radiant Panels, Heaters, Fan Coil Units, Diffusers and Chilled Beams.

Ducting Supports:

All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with hangers formed of galvanized steel wire ropes and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel wire hangers under ducts, rigid supports may be provided at certain interval if need be. The spacing between supports should be not greater than 2.4 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates or Toggle end wire fixing left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the wire rope hanger shall be welded to the plates. Trapeze hanger formed of galvanized steel wire rope using Gripple shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Wire rope supports shall hang through the cleats or wire rope threaded studs can be screwed into the anchor fasteners.

- a. All horizontal ducts shall be adequately secured and supported. In an approved manner, with trapeze Hangers formed of galvanized steel wire rope in a cradle support method (refer to typical drawings) under ducts at no greater than 2000mm centre, for 2001-2250mm 50x50x5mm angle should be used under the duct (refer to typical drawings), above 2250mm appropriate size angle should be used with prior approval. All vertical duct work shall be supported by structural members on each floor slab. Duct support shall be through dash / anchor fastener driven into the concrete slab by electrically operated gun. Hanger wire shall then hang around the ducting. Rigid supports shall be used in conjunction with wire rope hangers to assist with alignment of services where recommended for by the manufacturer. Rigid support must also be used in conjunction with wire rope hangers with duct work at each change of direction or connection. Support ducting in accordance with Schedule I at the end of this Section. Any other Gripple solution can be used based on manufacturer's recommendation on site conditions after prior approval. In cases of Spiral ducting the wire can be wrapped directly around the ducting without the need for a spiral ducting clamp for sizes above 1100 a cradle support should be provided refer to manufacturer's recommendations.
- b. Ducting over furred ceiling shall be supported from the slab above or from beams after obtaining approval of Construction manager/consultant. In no case shall any duct be supported from false ceiling Hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other Contractor's work in the building. All supports of pipe shall be taken from structural slab/wall by means of fastener.
- c. Catenary Supports: Refer to manufacturer's recommendation on Catenary supports with C-clip, special care should be taken with tensioning of the wire and angles at which the installation of services are made.
- d. Stainless Steel Supports should be available for food, chemical and High Corrosion areas near coastlines.
- e. Any other Gripple solution can be used based on manufacturer's recommendation on site conditions after prior approval. Support ducting in accordance with Schedule I at the end of this Section.

METHOD OF MEASUREMENT FOR INSULATION:

Measurement of duct, piping, equipment, plant room and false ceiling insulation shall be taken as per following basis.



(mm)	NOT EXCEEDING (m)	(mm x mm)	(mm)
Up to 750	2.5	25 x 25 x 3	6
751 to 1500	2.5	40 x 40 x 3	6
1501 to 2250	2.5	50 x 50 x 3	10
Above 2250	2.5	50 x 50 x 3	12

SUPPORT SYSTEM

HVAC

- 1) Support from RCCslab
 - a) Ductsupport
 - b) PIPEsupport
 - c) Drain pipesupport
- 2) Support from PEBstructure
 - d) Ductsupport
 - e) PIPE support
 - f) Drain pipesupport
- 3) Support from buildingshaft
 - g) Ductsupport
 - h) PIPE support
 - i) Drain pipesupport
- 4) Support on terrace
 - j) Ductsupport
 - k) PIPEsupport
 - l) Drain pipesupport
- 5) Support from wall (I/O of building)
 - m) Ductsupport
 - n) PIPEsupport
 - o) Drain pipesupport



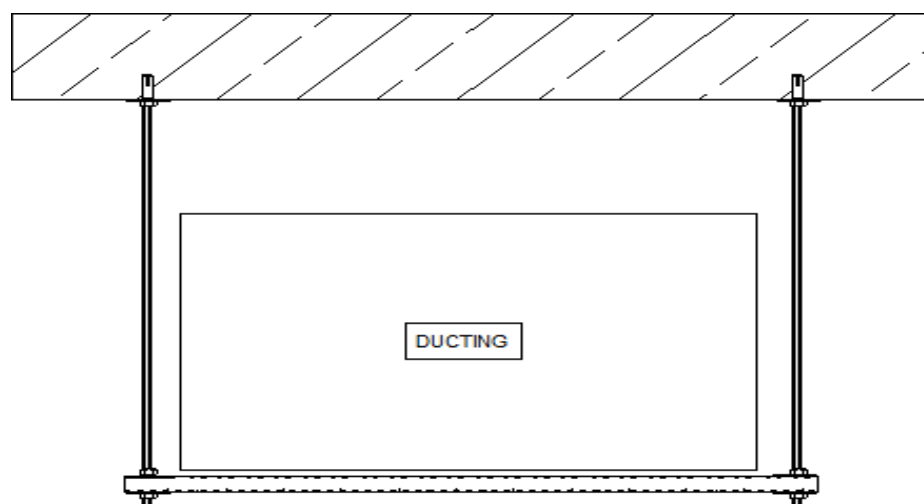
1) Support from RCC slab

a. DUCTSUPPORTS

Description			
The Duct should be simply supported by Support Channel made up of cold rolled steel of quality DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1. The Support channel should be hot dip galvanized with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail. The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to RAL - GZ 655-C.			
The Threaded Rods used for the suspension of the Duct should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.			
The Drop-in anchors used for the suspension of the rods should be ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.			
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.			
Supporting DETAILS for low pressure systems are given below			
Larger Side of Duct mm	Support Channel mm	Vertical Rod Dia mm	Maximum Spacing between supports mm
0-600	27x18x1.25	M8	2400
601-1250	38x24x1.75	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x3	M12	2400



Fig.A. Typical Arrangement for Duct Supports from RCC slab



b. PIPESUPPORT:

Description

The PIPEs should be simply supported by **Split Clamps with rubber support insert**.

Split Clamps should be as per **DIN 3567** hot dip galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with lock washers for non-slipping high load bearing capacity.

Rubber support insert should be made from **EPDM or NR/SBR Rubber**

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1**.

The Support channel should be **hot dip galvanized with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.



The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade **4.8 strength class and as per DIN 976 standard**.

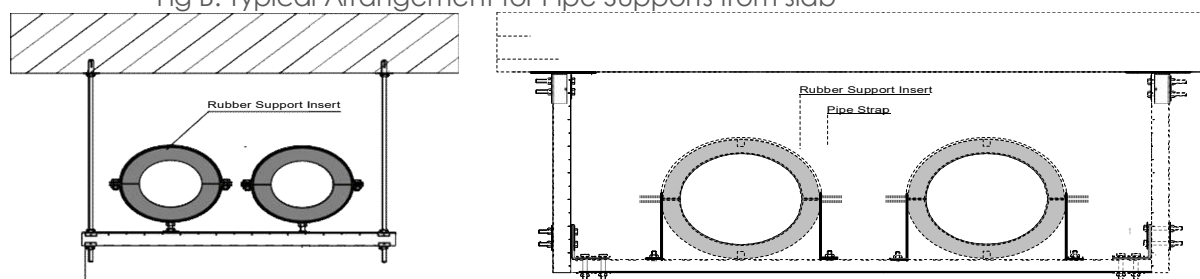
The Drop-in anchors used for the suspension of the rods should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)

Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	1.8	65	3.7	250	5.0
20	2.4	80	3.7	300	6.1
25	2.4	100	3.7	350	10.0
32	2.7	125	3.7	400	10.5
40	3.0	150	4.5	450	11.0
50	3.0	200	5.6	500	12.0

Fig B. Typical Arrangement for Pipe Supports from slab



C. Drain pipe support

Descripti

The Drain Pipes should be simply supported by **Split Clamps**.

Split Clamps should be hot dip galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

The Split clamp should have an **EPDM rubber lining** which will



contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.

The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

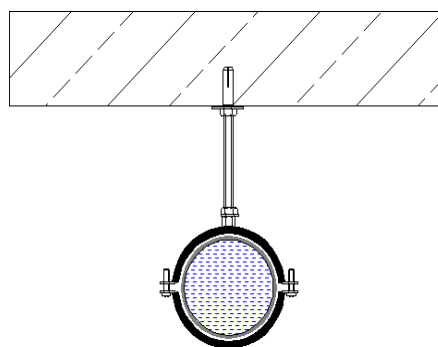
The Drop-in anchors used for the suspension of the rods should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

Maximum Support Spacing (m)

Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Fig C. Typical Arrangement for Drain Pipe Supports from slab





2) Support from PEBstructure



d. Ductsupport Description

The Duct should be simply supported by Support Channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Euro code 3) or DIN EN 1993-1-1**

The Support channel should be pre galvanized with minimum **GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes** on back of the rail.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

The Threaded Rods used for the suspension of the Duct should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

For parallel to beam application.

The Girder cleat for attachment of support channel to steel girder

Girder cleat should be **Vds approved**.

For perpendicular to beam application

The Girder clamp for suspension of threaded pins and threaded rods for support channels.

Girder clamps should be **FM and Vds Approved**.

The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.

Supporting DETA (European Technical Approval) ills for low pressure systems are given below

Larger Side of Duct mm	Support Channel mm	Vertical Rod Diam mm	Maximum Spacing between supports mm
0-600	27x18x1.25	M8	2400
601-1250	38x24x1.75	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x3	M12	2400

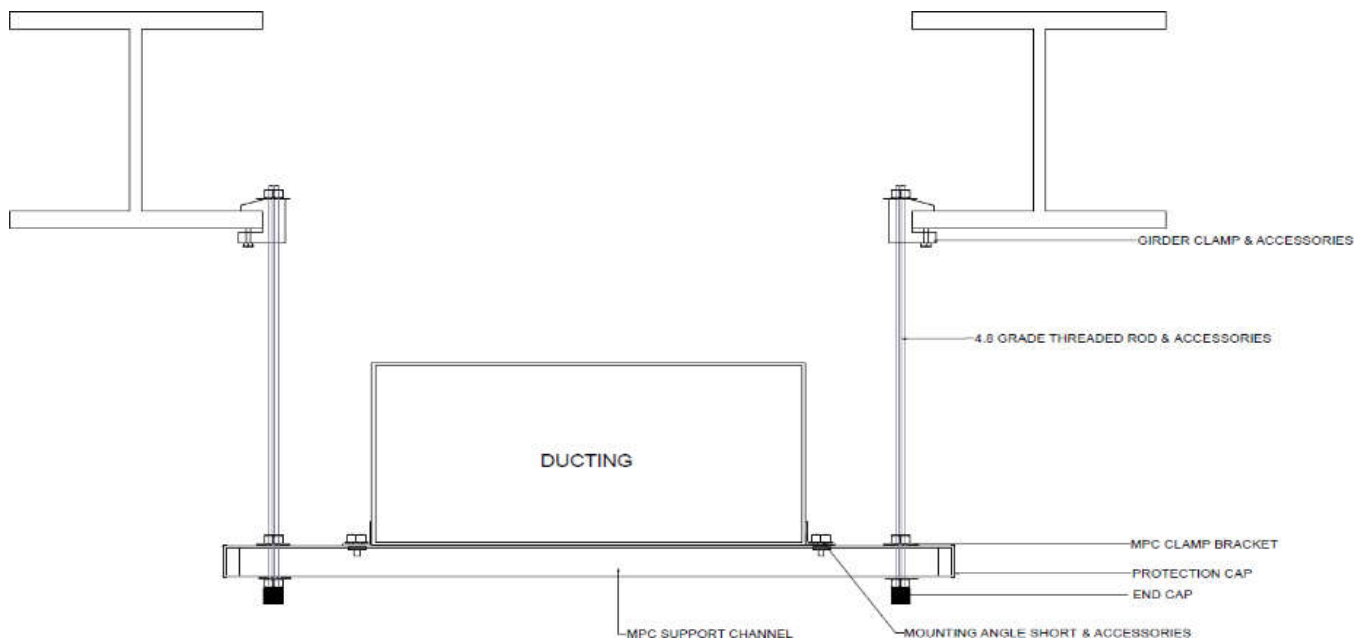


TROPICAL GARDEN,AHMEDABAD,GUJARAT

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Fig E. Typical Arrangement for Duct Supports from PEB structure.



e. CHW Pipesupport



Description

The CHW Pipes should be simply supported by **Split Clamps with rubber support insert**.

Split Clamps should be as per **DIN 3567** pre-galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

Rubber support insert should be made from **EPDM or NR/SBR Rubber**

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Euro code 3) or DIN EN 1993-1-1**.

The Support channel should be **pre galvanized with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

For parallel to beam application.

The Girder cleat for attachment of support channel to steel girder

Girder cleat should be **Vds approved**.

For perpendicular to beam application

The Girder clamp for suspension of threaded pins and threaded rods for support channels.

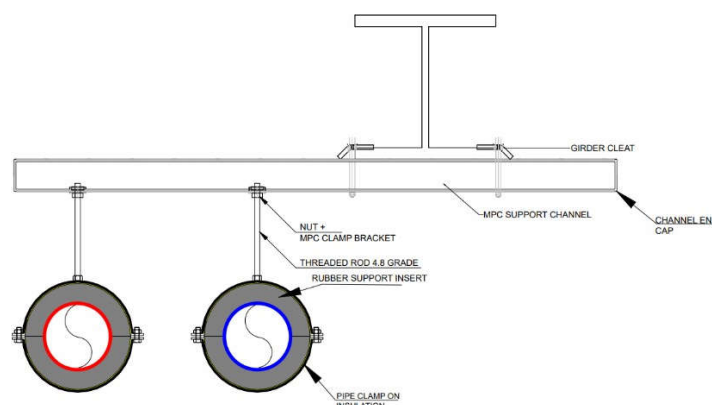
Girder clamps should be **FM and Vds Approved**.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)

Nominal Pipe Diam (mm)	Support Distance (M)	Nominal Pipe Diam (mm)	Support Distance (M)	Nominal Pipe Diam (mm)	Support Distance (M)
Up to 15	1.6	65	3	250	3
20	1.9	80	3	300	3
25	2.2	100	3	350	3
32	2.6	125	3	400	3
40	2.7	150	3	450	3
50	3	200	3	500	3

Fig E. Typical Arrangement for CHW Pipe Supports from PEB structure

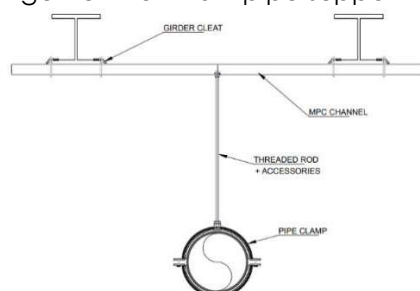


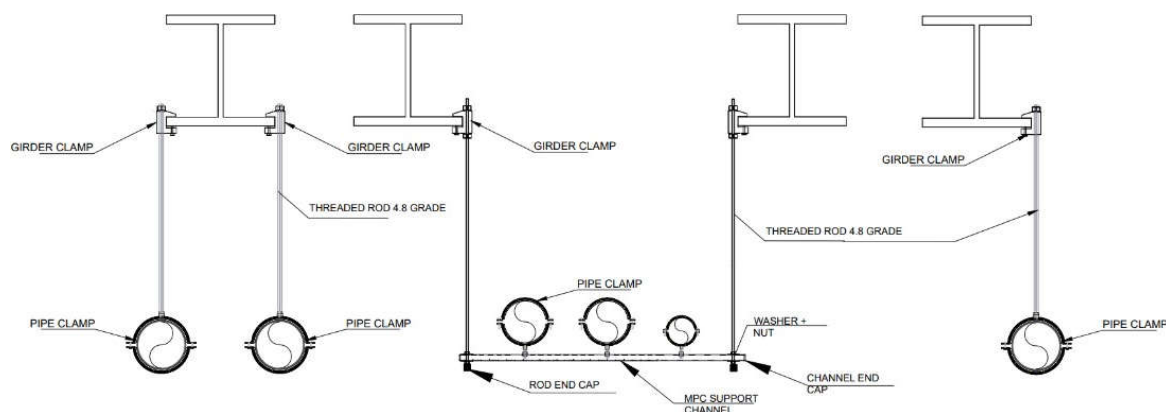


f. Drain pipesupport

Description					
The Drain Pipes should be simply supported by Split Clamps. Split Clamps should be pre-galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity. The Split clamp should have an EPDM rubber lining which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB. The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.					
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.					
The Drop-in anchors used for the suspension of the rods should be ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.					
Maximum Support Spacing (m)					
Pipe Diam (mm)	Support Distance (M)	Nominal Pipe Diam (mm)	Support Distance (M)	Nominal Pipe Diam (mm)	Support Distance (M)
Up to 15	0.3	32	0.35	65	0.65
20	0.3	40	0.40	80	0.9
25	0.3	50	0.55	90	1.1

F. Typical Arrangement for Drain pipe support from PEB structure





3) Support from building shaft

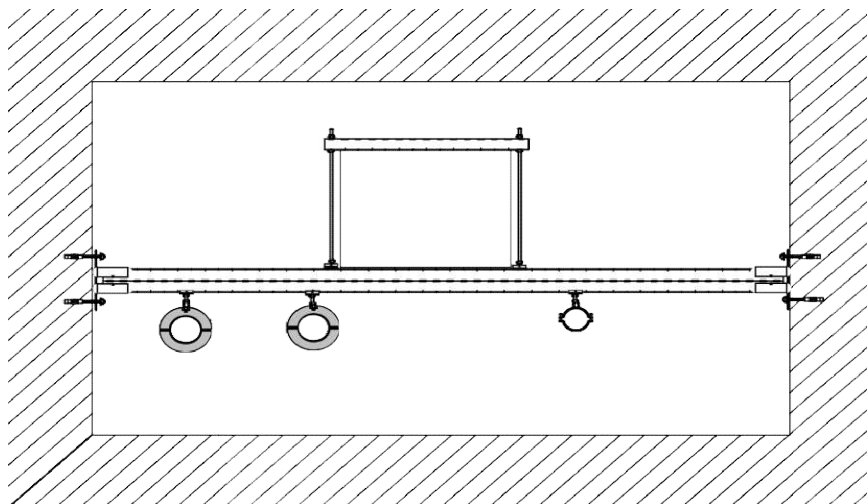
g. DUCTSUPPORTS

Description
The Duct should be simply supported by Support Channel made up of cold rolled steel of quality DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1 The Support channel should be hot dip galvanized with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail. The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to RAL - GZ 655-C.
The Threaded Rods used for the suspension of the Duct should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.
The Drop-in anchors or stud anchor used for the suspension of the rods should be ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.



Supporting DETA (European Technical Approval) ills for low pressure systems are given below			
Larger Side of Duct mm	Support Channel mm	Connecting Rod Dia mm	Maximum Spacing between supports mm
0-600	27x18x1.25	M8	2400
601-1250	38x24x1.75	M10	2400
1250-2100	38x40x2	M112	2400
2100 and above	40x60x3	M16	2400

Fig G. Typical Arrangement for Duct, PIPE and drain pipe support from building shaft



h.

PIPESUPPORT:

Descripti on
The PIPEs should be simply supported by Split Clamps with Split Clamps should be as per DIN 3567 hot dip galvanized and should have a two- piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, Rubber support insert should be made from EPDM or NR/SBR Rubber The Split clamp should have an EPDM rubber lining which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 10dB



degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be **hot dip galvanized with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail.**

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C.**

The Threaded Rods used for the fixing Pipe clamp with channel that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

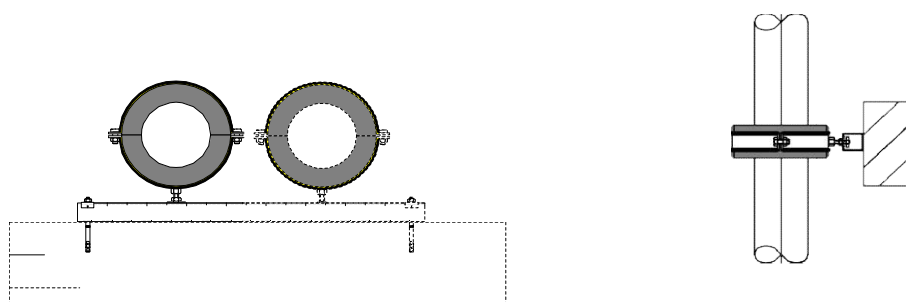
The Drop-in anchors or stud anchor used for the channel fixing with shaft that should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)

Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	2.5	65	3	250	3
20	2.5	80	3	300	3
25	2.5	100	3	350	3
32	2.5	125	3	400	3
40	2.5	150	3	450	3
50	2.5	200	3	500	3

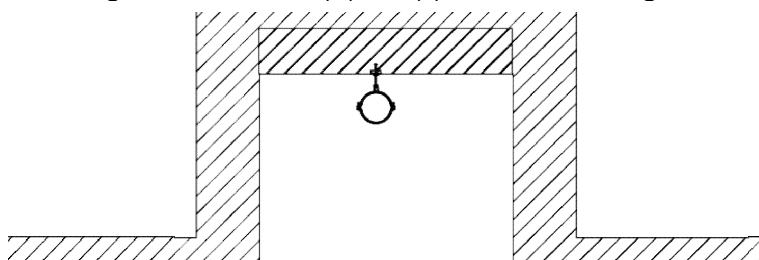
Fig H. Typical Arrangement for PIPE and drain pipe support from building shaft



i. Drain pipe support

Description					
The Drain Pipes should be simply supported by Split Clamps. Split Clamps should be hot dip galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity. The Split clamp should have an EPDM rubber lining which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18dB. The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.					
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.					
The Drop-in anchors or stud anchor used for the suspension of the rods should be ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.					
Maximum Support Spacing (m)					
Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Fig I. Typical Arrangement for drain pipe support from building shaft





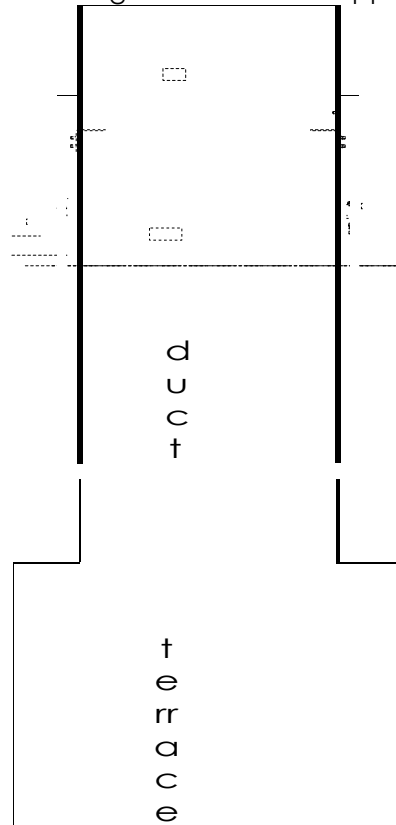
4) Support on terrace

j. DUCTSUPPORTS

Description			
The Duct should be simply supported by Support Channel made up of cold rolled steel of quality DX51 or greater and as per EC3(Eurocode 3) or DIN EN1993-1-1 The Support channel should be hot dip galvanized with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail. The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to RAL - GZ 655-C.			
The Threaded Rods used for the assembly of channel structure that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.			
The Drop-in anchors used for the fixing channel with terrace that should be ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.			
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.			
Supporting DETA (European Technical Approval) for low pressure systems are given below			
Larger Side of Duct mm	Horizontal Support Channel mm	Vertical Support Channel mm	Maximum Spacing between supports mm
0-600	27x18x1.25	38x24x1.75	2400
601-1250	38x24x1.75	38x24x1.75	2400
1250-2100	38x40x2	38x40x2	2400
2100 and above	40x60x3	40x60x3	2400



Fig J. Typical Arrangement for Duct support on terrace





k.

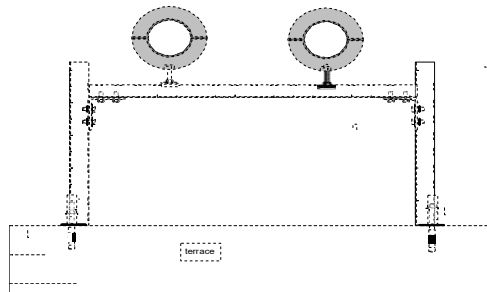
PIPESUPPORT:

Description					
The PIPEs should be simply supported by Split Clamps with rubber support insert. Split Clamps should be as per DIN 3567 hot dip galvanized and should have a two- piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity. Rubber support insert should be made from EPDM or NR/SBR Rubber The Split clamp should have an EPDM rubber lining which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18dB. The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius. In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1. The Support channel should be hot dip galvanized with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail. The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to RAL - GZ 655-C.					
The Threaded Rods used for the connecting clamp and channel that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.					
The Drop-in anchors used for the fixing channel with terrace that should be ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.					
The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.					
Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	2.5	65	3	250	3
20	2.5	80	3	300	3



25	2.5	100	3	350	3
32	2.5	125	3	400	3
40	2.5	150	3	450	3
50	2.5	200	3	500	3

Fig K. Typical Arrangement for CHW pipe support from on terrace



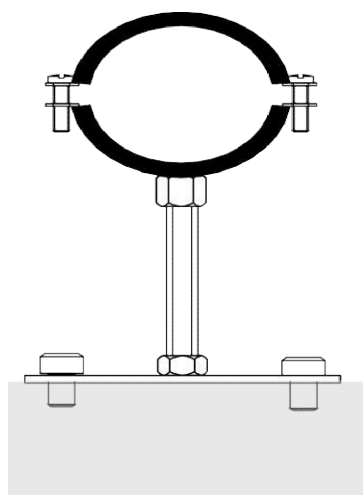
I. Drain pipe support

Description
The Drain Pipes should be simply supported by Split Clamps. Split Clamps should be hot dip galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity. The Split clamp should have an EPDM rubber lining which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18dB. The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.
The Drop-in anchors used for the Fixing base plate, should be ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.



Maximum Support Spacing (m)					
Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Fig L. Typical Arrangement for Drain pipe support from on terrace



5) Support from WALL

m. DUCTSUPPORTS

Description
The Duct should be simply supported by Support Channel made up of cold rolled steel of quality DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1 The Support channel should be hot dip galvanized with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail. The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to RAL - GZ 655-C.
The Threaded Rods used for the suspension of the Duct should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.



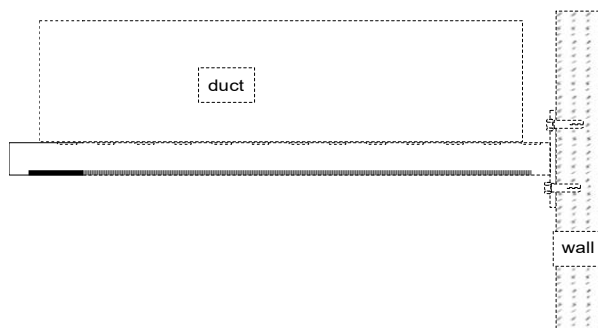
The Drop-in anchors or stud anchor used for fixing with wall that should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.

Supporting DETA (European Technical Approval) ills for low pressure systems are given below

Larger Side of Duct mm	Support Channel mm	45-degree bracket	Maximum Spacing between supports mm
0-600	27x18x1.25	27x18x1.2	2400
601-1250	38x24x1.75	38x24x1.75	2400
1250-2100	38x40x2	38x40x2	2400
2100 and above	40x60x3	38x40x2	2400

Fig M. Typical Arrangement for Duct support from wall



n. PIPESUPPORT:

Descripti on
The PIPES should be simply supported by Split Clamps with rubber support insert.
Split Clamps should be as per DIN 3567 hot dip galvanized and should have a two- piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.
Rubber support insert should be made from EPDM or NR/SBR Rubber



The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be **hot dip galvanized with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail.**

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C.**

The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard.**

The Drop-in anchors or stud anchor used for Fixing with wall that should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

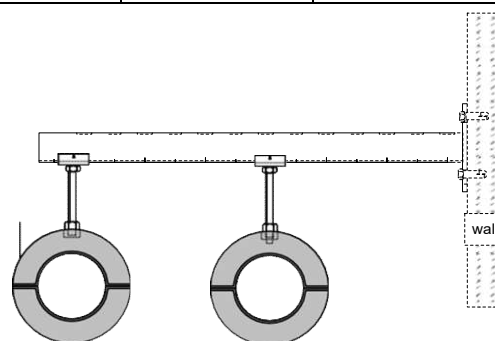
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)

Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	2.5	65	3	250	3
20	2.5	80	3	300	3
25	2.5	100	3	350	3
32	2.5	125	3	400	3
40	2.5	150	3	450	3
50	2.5	200	3	500	3

Fig N. Typical Arrangement for PIPE support from wall

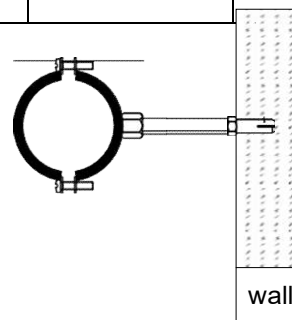




0. Drain pipe support

Description					
The Drain Pipes should be simply supported by Split Clamps. Split Clamps should be hot dip galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity. The Split clamp should have an EPDM rubber lining which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18dB. The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.					
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.					
The Drop-in anchors or stud anchor used for fixing with wall that should be ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.					
Maximum Support Spacing (m)					
Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1.1	80	1.5

Fig O. Typical Arrangement for Drain pipe support from Wall





4. GRILLES AND DIFFUSERS-

General

The grilles and diffusers shall be rated in accordance with ASHRAE standard 3672.

All grilles and diffusers shall have concealed fixing system and shall have quick release frame to facilitate cleaning.

All supply grilles and diffusers shall be mounted on substantial frame and shall be provided with soft rubber or felt joining ring inserted under the frame to prevent air leakage and the formation of condensate on the fitting.

All grilles and diffusers shall not be less than the size indicated; where no size is given, they shall be capable of handling the air flows and distribution indicated without producing unacceptable airflow noise. The Contractor shall select the supply air grilles and diffusers to achieve good air distribution and adequate air movement in the conditioned space.

In order for the ceiling grilles and diffusers to match with the false ceiling layout pattern, the actual size of the grilles and diffusers shall be confirmed by the Architect/consultant before ordering.

For all grilles and diffusers which are smaller than the ceiling tile on which they are installed, they shall be located in the center of the ceiling tile. The exact location of the ceiling grilles and diffusers shall be co-ordinate with other services. The Contractor shall confirm the exact location with the Architect/consultant before work commences.

Where grilles and diffusers are to be incorporated into false ceilings before any grilles or diffusers are installed into ductwork or fan coils, the Contractor shall ensure that the Building Contractor marks out the ceiling line on the adjacent plastered walls or columns and also indicates where ceiling tee bars line up or the ceiling joints occur in order that such datum can be worked to.

The finishing colour of the grilles and diffusers shall be approved by the Architect as different colours may be specified in different areas. The Contractor shall co-ordinate with the Building Contractor and other specialist Contractors especially the ceiling and electrical Contractor for the integration of the air diffuser into the ceiling and luminaire (for light troffer diffuser).

GRILLES

Grilles shall be of steel, aluminum, PVC or as otherwise indicated. Steel grilles shall be protected against rusting and supplied in fully finished stove-enamelled or otherwise specified condition.



Each supply air grille shall have two sets of separately adjustable louvres, one set horizontal and one set vertical, and shall be complete with an opposed blade multi-leaf damper. Alternatively, in lieu of the opposed blade multi-leaf damper a rhomboidal air controller may be provided; this air controller shall control both the volume of air passing and the distribution of air across the grille face. The louvers and the damper or air controllers shall be adjustable from the front of the grille.

Return air grille shall have either a single set of louvre or bars (either vertical or horizontal) or a lattice, egg crate or expanded metal frame.

Each return air grille shall be complete with/without an opposed blade multi-leaf damper or a rhomboidal air controller operable from the front as specified.

Where return air grilles are fitted for fan coil units, they shall be arranged such that the central core of the grille is hinged and demountable for access to the filter for cleaning.

Mounting frames for these grilles shall include provision for fixing the filter in position.

DIFFUSERS

Diffusers shall be of steel or aluminum. Steel diffusers shall be protected against rusting and shall be stove enameled/powder coated for finished colour approved by the Architect. Diffusers shall incorporate an edge seal, diffusers mounted on ceilings shall have anti-smudge rings. Pan type diffusers shall be provided except where cone type diffusers are indicated,

Diffusers shall be provided with volume control dampers of the iris, flap or sleeve type which shall be adjustable from the front of the diffuser. Where the length of a vertical duct to a diffuser is less than twice the diameter of the diffuser an equalizing deflector shall be fitted.

The design of the supply air diffuser shall be capable to induce adequate air movement and provide the throw to cover the entire air-conditioning space without causing air turbulence and cold draft.

Linear diffusers shall be constructed of extruded aluminium section and include a control damper at the rear of the vanes giving volume control down to complete shut off and operated from the face of the diffuser. Linear diffusers for supply air shall have adjustable blades to give directional control of air flow. The linear diffuser shall be capable of maintaining a horizontal discharge pattern at a turn down ratio down to 20% of the maximum specified air volume without air dumping.

The linear diffuser shall be complete with factory fabricated plenum with suitable inlet connection for flexible ductwork. The plenum and diffuser neck shall be constructed of galvanised steel sheets internally lined with 25 mm 48 kg/m glass cloth faced fiberglass insulation enclosed in galvanised perforated metal liner.



Where linear diffusers are mounted in a continuous line there shall be means of ensuring alignment between consecutive diffusers and of equalizing pressure behind the vanes. The dummy portion of the diffusers shall be internally covered by a demountable galvanized metal enclosure to block the view into the ceiling void from below.

The square face diffuser for VAV system shall be constructed of aluminium and with large turn down ratio.

The linear slot diffuser shall be constructed of extruded anodized aluminium, with multiple slot for the required air flow rate,

All the supply air grilles/diffusers will be provided with opposed blade volume control dampers fabricated from Al. anodized in matt black shade. The damper should be suitable for operation from front face of grille/diffuser. The Diffusers should have also removable core type fixing facility, constructed from the same material of the diffuser. The grilles / diffusers must be submitted to Architect/HVAC consultant/PMC/Client for prior approval before procurement and installation.

INSTALLATION-

A good quality expanded polyethylene/rubber of uniform thickness and width shall be used as gasket between flange joints. The gaskets shall be fixed by a suitable adhesive and holes made by passing a heated rod through.

All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angles of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing. All the joints shall be made tight and all interior surfaces shall be smooth. Bends shall be made with radius not less than one half the width of the duct or with properly designed interior curved vanes where metal ducts or sleeves terminate in woodwork, brick or masonry openings, tight-flanged collars. Ducting over false ceiling shall be supported from the slab above or from beams.

In case a duct shall be supported from the false ceiling hangers or to be permitted to rest on a hung ceiling. All holes in concrete, masonry etc. made by contractor for fixing supports etc. shall be made good and restored to original finish by him.

Air handling units and fans shall be connected to duct work by inserting at air inlet and air outlet a double canvas sleeve. Each sleeve shall be minimum 100mm long, securely bolted to duct and units. Each sleeve shall be made smooth and the connecting ductwork rigidly held in the line with unit inlet or outlet.

TESTING-

All the test readings shall be furnished for peak summer and monsoon outside conditions.

After completion all such system shall be tested for leakage.



The entire air distribution system shall be balanced to supply the air quantities as required in various zones and rooms to maintain the specified room conditions. The final readings shall be recorded and submitted to the Consultant for approval before acceptance and taking over of the entire system by the Employer.

PAINING-

Angle iron flanges, stiffeners, hangers and support shall be painted with 2 coats of anti-rust primer and those remaining uncovered shall be further painted with 2 coats of synthetic enamel paints of black colour.

DOUBLE DEFLECTION ADJUSTABLE BLADE GRILLE:

To be constructed from high quality aluminium alloy extrusions with cleated & mitred frames. Vanes should be in double banks and individually adjustable. Shape of vane should be teardrop and are held in position with stainless steel spring wire for long life.

Finish of grille should be epoxy polyester powder coated & shade should be as per Architect / interior designers choice.

LINEAR GRILLES

To be constructed from extruded aluminium sections fabricated in to modular assemblies. Frames are mitred & cleated.

Finish of grille should be epoxy polyester powder coated & shade should be as per Architect / interior designers choice.

AIR TRANSFER GRILLES

Should be suitable for mounting indoors, partitions and wall. Should have no sight feature. To be constructed from aluminium extrusions sections fabricated in tube cores and mitred, cleated frames.

Finish of grille should be epoxy polyester powder coated & shade should be as per Architect / interior designers choice.

SLOT DIFFUSER

Liner slot diffusers shall be fabricated from high grade aluminium alloy extrusions fixed or clipped stays allowing easy removal of internal flow control vanes and pattern control elements should have fully adjustable air pattern from horizontal to vertical.

Finish of diffusers should be epoxy polyester powder coated & shade should be as per Architect / interior designers' choice.

DAMPERS – GENERAL

The respective functions, types and general constructional requirements of dampers shall be in accordance with the HVCA ductwork specification unless otherwise indicated, sufficient dampers shall be provided to regulate and balance the system. Dampers on grilles or diffusers shall be used for line control only.

All dampers shall be of flanged type for connection to ductwork and shall be sufficiently rigid to prevent fluttering. Air leakage rate for dampers shall be tested according to EN 1751 Section 3 when the damper is in the closed position. For dampers installed for shut-off purpose, the maximum air leakage rate shall be tested according to EN 1751 Section 4.



LOW LEAKAGE DUCT DAMPER

Air volume control dampers shall be of the aerofoil, double skin, opposed blade type with low pressure drop and noise regeneration characteristics. Damper blades in rectangular ductwork shall not exceed 225mm in width and 1500mm in length. Blades shall be of hollow section constructed from the same material of the ductwork or of stainless steel encapsulating an internal double contoured stud longitudinal reinforcing bar, mounted on square section steel spindles. Bearings shall be of nylon material and the units shall be of low-leakage design by incorporation of synthetic trailing edge seals and a peripheral gasket which shall be tested according to BS476. All manually and automatically operated dampers shall include a means for indicating externally the position of the blades. Manual dampers shall include a device for positioning and locking the damper blades. The positions of all dampers 'as-set' after final regulation shall be indelibly marked at the adjusting device.

Each air volume control damper in the ductwork shall be fitted with a non-corrodible label stating the actual air flow in m^3/s when in the fully open position, its overall cross-sectional area, and the degree to which the damper has been closed in order to achieve the design or actual air flow.

Unless otherwise indicated, quadrants and operating handles shall be of die-cast aluminum or other material approved by the Architect with the words 'OPEN' and 'SHUT' marked on the quadrant. Quadrants shall be securely fixed and the damper spindles shall be closely fitted in the quadrant hubs to prevent any damper movement when the damper levers are locked.

Access openings with readily removable air sealed covers shall be provided adjacent to all dampers. Subject to limitations of ductwork size the dimensions of access openings shall not be less than 300mm x 300mm and shall be located so as to afford easy access for inspection and maintenance.



BUTTERFLY & BIFURCATING DAMPERS

Butterfly dampers shall each consist of two plates, edge seamed, of at least the same thickness as the material from which the associated ductwork is made, and rigidly fixed to each side of a mild steel operating spindle, the ends of which shall be turned and housed in non-ferrous bearings.

Bifurcating dampers shall be of 2 mm thick sheet for sizes up to 450 mm square, for larger sizes the thickness shall be as specified. The damper blades shall be rigidly fixed to square section mild steel spindles, the ends of which shall be turned and housed in non-ferrous bearings,

Each leaf of a multi leaf damper shall consist of two plates of material of the same thickness as the associated ductwork and rigidly fixed to each side of an operation spindle, the ends of which shall be housed in brass, nylon, oil impregnated sintered metal, PTEE impregnated or ball bearings. The ends of the spindle shall be linked so that on movement of the operating handle shall move each leaf for an equal amount. The mechanism shall be located outside the airstream.

For system static pressure below 1000 Pa or ductwork velocity below 12 m/s, blade of at least 50 mm wide shall be used. For static pressure at or above 1000 Pa at least 100 mm wide blade shall be used. Central blade reinforcement bar shall be provided for dampers span longer than 1500 mm. Single module of a damper shall not exceed 2000 mm width and 1000 mm height.

FIRE, SMOKE AND COMBINED FIRE SMOKE STOP DAMPERS FIRE AND SMOKE STOP DAMPERS

Fire or Smoke dampers shall be provided in ductwork in the following locations: -

- (a) Wherever a ductwork passes through a floor slab or a fire resisting wall which is expressly built for the purpose of preventing the spread of fire
- (b) Other locations where requirements of compartmentalization are stipulated in the Code of Practice for fire under the latest edition of the NBC.
- (c) Other locations as required by the Particular Specification and the Drawings.

Fire or Smoke dampers used singly or in combinations shall have an overall fire rating not less than that indicated and certainly not less than that for the wall or floor slab in which they are situated.

In all cases, evidence of fire rating in accordance with ISO 10294 Classification H (RS 476 part 8) or NFPA 90A with 90 Mins UL-555 certified fire damper label shall be provided by an independent testing organization approved by the Architect.

Fire or Smoke damper blades of proprietary make shall be constructed to the approved and recognized testing authority and possess a rating equivalent to the fire resistance of the structure it protects.



Local made fire or smoke damper blades shall comply with the requirements of NBC. These blades shall be housed in a corrosion resistant casing constructed to avoid distortion due to stress in fire conditions. Stainless steel spring tempered flexible gasket shall be inserted between the blade and the casing for elimination of closing friction and retardation of smoke. Provision shall be made to accommodate expansion of the damper blades within the casing in fire conditions to prevent jamming and to retard the spread of smoke. A Fire or Smoke damper installation frame supplied by same manufacturer shall also incorporate provision for expansion within the surrounding structure together with masking flange for building into the structure.

Fire or Smoke damper assemblies for installations in corrosive environments shall be fabricated from suitable materials resistant to the corrosive substances and environments indicated. Alternatively, the material may be coated with a protective finish to produce the same effect.

Power fail-safe remote electromagnet release shall be provided to explosion hazardous areas. The electromagnet shall normally not consume more than 10mA by 220V AC supply or 120mA by 24V AC/DC supply. The Contractor shall be responsible for the power fail-safe fire dampers to the fire control relay at the fire service control panel.

Each Fire or Smoke damper casing shall be airtight, continuously welded and clearly marked with a permanent indication of the direction of air flow and the side at which the access/maintenance opening is located.

The folded continuous interlocked blade type of damper may be used for vertical or horizontal ductwork applications. The closing force for these type of dampers shall be provided by stainless steel spring or springs. An automatic locking device shall be provided to ensure that the blades are held in the closed position after release.

Spring actuated pivoted single-bladed or multi-bladed dampers may be used for vertical or horizontal ductwork applications.

Multi-bladed dampers shall be provided with a means to ensure that all the blades close simultaneously.

Gravity operated multi-bladed fire dampers shall not be used in vertical ductwork

Gravity operated single bladed dampers may be used for horizontal ductwork provided means are incorporated which ensure reliable and positive closure when operating in maximum air flow rate conditions.

Locally fabricated gravity fire dampers shall be provided with a casing or casing of the same material and shall be physically bolted to the structure through which the ductwork penetrates.



Fire or Smoke dampers shall be rated in accordance with the fire rating of the wall, ceiling or floor etc. as shown in the drawings and the Particular Specification, to the requirements of the Fire Services Department and acceptable by the Architect.

For locally fabricated fire dampers, the thickness of metal for the dampers shall comply with the National Building Code for Fire. Where gravity acting off-centre pivoted dampers incorporate spindle bearings long term corrosion effects shall be minimised by the choice of suitable materials. Bearings shall be sealed or capped to exclude dirt and dust. Damper blades shall close to comply with the stability and integrity requirements of ISO 10294 Classification E (BS 476 Part 8).

For high velocity air systems, fire/smoke dampers shall provide 100% free area when damper blades are in the open position to give minimum interference to the air flow,

Unless otherwise indicated, each fire or smoke damper shall be held in the open position by a corrosion resistant retaining device incorporating a fusible element which shall operate at a temperature of 70 °C, unless otherwise indicated.

Fire or Smoke dampers shall be located in a position and be of a type which could facilitate periodic one-handed manual release and re-setting for test purpose,

Proprietary access doors shall be installed adjacent to each fire or smoke damper and, in the case of conditioned air or kitchen exhaust ductwork, the access doors shall be encapsulated and pre-insulated.

COMBINED FIRE AND SMOKE STOP DAMPERS

The dampers shall be of stainless steel, aerofoil bladed construction with the blades held in stainless steel bearings and framed in stainless steel spring tempered flexible gasket. The blades shall have trailing forming an interlocking metal to metal seal when the blades are closed, providing tight, low leakage closure of the air path and maximum impedance to the passage of smoke and products of combustion from either flow direction.

The blades shall be driven by externally mounted and totally enclosed stainless steel gearbox and drive mechanism providing accurate blade control with minimum torque and without accumulative backlash.

The damper casing shall be of double-skin galvanized steel construction with continuously welded corners and integral spigot connections. The dampers shall be supplied complete with the manufacturer-installed frames.

Each damper shall have an externally replaceable combination thermal actuator and fusible link completely exposed to the air stream.

In addition to the thermal actuation/fusible link, the damper shall be normally held by electromagnetic device with power rating of not more than 3.5W, the damper shall be released to the closed, or fail-safe position within 1 second by an independent closure spring on loss of power supply, either by genuine power failure or by the fire signal actuated by the smoke detection system.

The damper shall be automatically reset on resumption of power supply by built-in motor of 220V AC or 24V AC/DC.

The whole control mechanism and actuation shall be of the same manufacturer and mounted inside a totally enclosed casing for protection against airborne contamination and to ensure unique reliability.

For smoke extraction at 250°C for 1 hour application, damper control actuator shall be totally shielded by a proprietary thermal insulation jacket. The whole damper assembly shall have undergone a high temperature operation test followed by a leakage test at 1500Pa differential pressure.

Leakage rate shall be tested in accordance with UL555S class I.

Fire rating shall be to BS 476 and the whole damper assembly shall have undergone a temperature exposure test by an independent laboratory in accordance with the temperature and duration as indicated in BS 476. Test report shall be submitted to the Architect/Consultant for reference.

TERMINAL DAMPERS

Grilles and air diffusers with rectangular neck connections shall be provided with an opposed blade damper, screwed or riveted to the neck connection and designed specially to facilitate final balancing of the system.

Damper frames, blades and operating mechanism shall be constructed from an aluminium alloy or, alternatively, formed mild steel suitably finished to give protection to the material during the design working life,

Blades shall be made of solid section material and shall be firmly held in position by a spring steel retaining mechanism. The blade setting mechanism shall be accessible through the grille or diffuser blades and shall be suitable for operation with an "Alien" key. Where dampers are visible through the grille or diffuser they shall be finished with a matt black paint.

AIR INTAKE LOUVERS

The Louvers must be suitable for intake or Exhaust system where space is at a premium. The design must be compact and construction will be made from lightweight aluminium extrusion section with suitable bird screen for protection.



EXHAUST VALVES FOR TOILET EXHAUST

Are to be constructed from steel spinnings & to be protected by white powder coated finish.

Volume control dampers (Duct mounted) Frames and blades are to be constructed from high quality extruded aluminium section. Blades are pivoted on PVC bushes and operate through PVC gear system which should be enclosed within the damper frame. Volume control dampers should have following features.

Stainless steel side seal gaskets opposed blade operation.

Aerofoil blade sections.

Fully enclosed blade linkage mechanism PVC gear operation.

Manually operated knob lockable / removable type Blade position indicator.

SOUND ATTENUATORS

The sound attenuators have been designed to avoid noise interference between inter connected areas.

The casing shall be manufactured from galvanized sheet metal 1.00mm thick to BS 2989 grade with spot welded seams or lock for formed seams, with a mastic sealant the construction complies with DW 142 Class – B code. Attenuating splitters are constructed from a press formed frame of G.I. sheet and incorporate high density & highly absorbent fiber glass insulation material with fiber glass tissue covering with 26 SWG perforated aluminum sheet.

The Acoustic lining complies with class – O building regulations & has a class tissue facing for erosion protection. The splitters have flared entry and exit noses to minimize pressure drop. The Splitters are radiused at both ends to minimize air Pressure loss and regenerated noise.

VOLUME FLOW CONTROLLER

Either Pneumatic or electronic Suitable for supply or extract Air Volume flow range approximately 5:1 High accuracy of set volume even under unfavorable inlet conditions, due to use of pressure differential sensor Operating temperature range 10 to 50°C



MATERIALS OF CONSTRUCTION

Casing, Shafts, and roads in galvanized iron, Blades and differential pressure sensor consist of extruded aluminum sections. Gearwheels' antistatic plastic (ABS) heat resistant upto 50⁰ C.

GRILLES AND DIFFUSERS

All grilles (SA&RA), diffusers (SA&RA) will be made from heavy gauge extruded Aluminum sections / M.S. (As specified in the BOQ) duly powder coated to match the interior requirements of Architect / Client.

All the supply air grilles/diffusers will be provided with opposed blade volume control dampers fabricated from Al. anodized in matt black shade. The damper should be suitable for operation from front face of grille/diffuser. The grilles / diffusers must be submitted to Architect / HVAC consultant / PMC / Client for prior approval before procurement and installation.

INSTALLATION

A good quality expanded polyethylene/rubber of uniform thickness and width shall be used as gasket between flange joints. The gaskets shall be fixed by a suitable adhesive and holes made by passing a heated rod through.

All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angles of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing. All the joints shall be made tight and all interior surfaces shall be smooth. Bends shall be made with radius not less than one half the width of the duct or with properly designed interior curved vanes where metal ducts or sleeves terminate in woodwork, brick or masonry openings, tight-flanged collars. Ducting over false ceiling shall be supported from the slab above or from beams.

In case a duct shall be supported from the false ceiling hangers or to be permitted to rest on a hung ceiling.

All holes in concrete, masonry etc. made by contractor for fixing support etc. shall be made good and restored to original finish by him.

Air handling units and fans shall be connected to duct work by inserting at air inlet and air outlet a double fire rated canvas sleeve. Each sleeve shall be minimum 100mm long, securely bolted to duct and units. Each sleeve shall be made smooth and the connecting ductwork rigidly held in the line with unit inlet or outlet.



TESTING-

All the test readings shall be furnished for peak summer and monsoon outside conditions.

1. After completion all such system shall be tested for leakage.
2. The entire air distribution system shall be balanced to supply the air quantities as required in various zones and rooms to maintain the specified room conditions. The final readings shall be recorded and submitted to the Consultant for approval before acceptance and taking over of the entire system by the Employer.

PAINTING-

Angle iron flanges, stiffeners, hangers and support shall be painted with 2 coats of anti-rust primer and those remaining uncovered shall be further painted with 2 coats of synthetic enamel paints of black color.

❖ CONTROLS & INSTRUMENTS:

1. CONTROL VALVES AND ACTUATORS

PRESSURE INDEPENDENT CONTROL VALVE ASSEMBLY

The 2-way type control valves with modulating actuator shall be of dynamic self-balancing control valve installed in the chilled water piping at the outlet of each AHU and shall operate based on the Space Return Air temperature. The valve shall be with screwed ends up to 40 mm NB size; starting 50 mm NB size, the valves shall be of CI body with flanged ends. Valves shall have 100% authority & site adjustable maximum flow rate features; Separate auto/manual balancing valve shall not be installed in the system where ever above valves are installed.

The offered package shall comprise of standalone site programmable Single loop controller with RTD sensor one each for control valve and shall be integrated with valve assembly at site. The controller and valve protocols should match as required.

2/3 wire RTD sensor shall be installed on the return air path and shall be wired up to the single loop controller to provide temperature feedback. The controller shall provide 4-20 mA or 0-10V analog output to the valve modulating actuator as per offered actuator protocol.



VARIABLE AIR VOLUME BOX

GENERAL

VAV terminal box for variable volume supply air systems with flow range 10 to 1890 l/s or 21 to 4005 CFM shall be suitable for connecting to pneumatic, electronic or DDC control circuits.

Each VAV box shall be tested and the desired volume flow rates shall be set in factory & necessary test report shall be submitted with material.

Sensing of the volume flow rate shall be by averaging differential pressure grid. The minimum and maximum volume flow rates shall be set at the factory and shall be capable of being site monitored and adjusted. Casing shall be lined with acoustic insulation, erosion resistant up to 20 m/s.

VAV Inlet shall be Circular / Rectangular high pressure duct spigot connection & outlet shall be low pressure duct connection angle flange or side on flange. Casing air leakage rate shall comply to class A, DW 142. The equipment shall conform with clean room class 100, US- standard 209b.

VAV Static differential pressure range shall be 20 to 1500 Pa & volume flow turndown to 10:1.

DESIGN CRITERIA

While designing VAV system room comfort criteria & indoor air quality is given importance in air conditioned areas, where economic operation of air conditioning systems is taken into account. This is achieved by using variable volume flow systems. Cabins/Conference rooms or zones receive exactly the airflow rate required to maintain the necessary comfort criteria.

The VAV unit will be fitted with electrical controls capable of communicating with Building Management system on Open protocol like Lonmark / Bacnet.

The room unit supplied with VAV controller will sense room temperature & modulate VAV controller based on room load requirement to achieve room comfort.

Every VAV unit will be factory calibrated for minimum & maximum air flow for each zone.

The energy-savings potential can be fully utilised with demand-based fan speed control. The static duct pressure at a reference point is used as a control variable.

CONSTRUCTION

Casing from galvanised sheet steel, mineral wool lining in the attenuator and damper section shall have density of 30 to 40 Kg/m³ with marginal facing suitable for velocities of up to 20 m/s (Fire rating BS 476 class 1), Control damper from sheet steel with tip seal, aluminium sensor tubes, polyurethane plain bearings. VAV box shall be supplied with step down transformer of 230 V to 24 V AC.



VAV controller shall be electronic communicable controller with open protocol (Lonmark / Bacnet MSTP).

VARIABLE AIR VOLUME DAMPER WITH ACTUATOR:

DAMPER

Air Tight, duct cross section of 0.04 m^2 (leakage rate $< 10 \text{ M}^3/\text{hr. m}^2$ damper cross section at a pressure differential of 100 Pa, Replaceable sealing elements & Enclosed Internal Gear wheels.

VOLUME FLOW CONTROLLER

Either Pneumatic or electronic Suitable for supply or extract Air Volume flow range approximately 5:1 High accuracy of set volume even under unfavorable inlet conditions, due to use of pressure differential sensor

Operating temperature range 10 to 50°C

MATERIALS OF CONSTRUCTION

Casing, Shafts, and rods in galvanized iron Blades and differential pressure sensor consist of extruded aluminum sections Gear wheels antistatic plastic (ABS) heat resistant up to 50°C .



5. INSULATION

The scope of this section comprises the supply and application of insulation conforming to these specifications.

1. Duct Thermal Insulation: (Within the false ceiling)

- Insulation Materials Technical Specifications - **Closed Cell elastomeric foam made up of EPDM rubber with AluFoil.**
- Recommended Adhesive by manufacturer of Elastomeric foam
- Summary of Duct Insulation Thickness

Insulation Materials Technical Specifications – Anti-bacterial and anti-fungal Closed Cell Elastomeric Foam made from EPDM rubber with Alu Foil

- Thermal conductivity of elastomeric foam shall not exceed $0.035 \text{ W/(m}^2\text{K)}$ at an average mean temperature of 24°C (Tested acc. To ASTM C177)
- Material shall be **anti-fungal** and shall pass resistance to Fungus test in accordance with UL181.
- Material shall be **anti-Bacterial** and shall pass bacterial resistance test in accordance with **ASTM E2180-01**.
- Material shall have **fire class A (Flame spread: 20 & Smoke developed index 150)** in accordance with **ASTM E 84**. It shall pass **smoke and toxicity** in accordance with IMO res. MSC 61 (67) ann.
- It shall pass **rate of burning** (horizontal position) test in accordance with part-2 ASTM D635-06.
- Material shall have **flammability class V-0** in accordance to **UL94**.
- Material shall be **non-corrosive** for copper and stainless steel in accordance with DIN 1988.
- Material shall be complying with **RoHS (Restriction of Hazardous Substances)** Directive 2002/95/EC amended upto 2011/65/EU.
- The material shall be Dust and Fibre Free
- Unlike other generic materials it should be self-extinguishing, does not drip fire balls and does not spread flames
- Moisture Diffusion Resistance Factor or ' μ ' value shall be minimum **7,000** per EN 12086 without any outer facing
- Material shall be **CFC/HCFC free** and shall be tested in accordance with **USEPA 5021A/USEPA 8260C**
- Density of material shall be 40-60 Kg/m³ in accordance to ASTM-D-1667.



- Material should have service temperature range -50°C to +125°C.
- Material Color: Black

Summary of Duct Insulation Thickness

	Insulation Thickness(mm)	Material to be used
Supply Air Duct	19	Closed cell anti-fungal & anti-bacterial elastomeric foam made from EPDM rubber with Alu foil
Return Air Duct	13	Closed cell anti-fungal & anti-bacterial elastomeric foam made from EPDM rubber with Alu foil

2. Duct Thermal Insulation: (Exposed –within the building)

- Insulation material technical specification – **Closed Cell elastomeric foam made up of EPDM rubber** with Grey Glass Cloth as outer cover and good quality adhesive.
- Summary of Duct Insulation thickness

Insulation Material Technical Specification – Anti-bacterial and anti-fungal Closed Cell Elastomeric Foam made from EPDM rubber with Grey GC layer covering

- Thermal conductivity of elastomeric foam shall not exceed 0.035 W/(m*K) at an average mean temperature of 24°C (Tested acc. To ASTM C177)
- Material shall be **anti-fungal** and shall pass resistance to Fungus test in accordance with UL181.
- Material shall be **anti-Bacterial** and shall pass bacterial resistance test in accordance with **ASTM E2180-01**.
- Base material shall have **fire class A (Flame spread: 20 & Smoke developed index 150)** in accordance with **ASTM E 84**. It shall pass **smoke and toxicity** test in accordance with IMO res. MSC 61 (67) ann.
- It shall pass **rate of burning** (horizontal position) test in accordance with part-2 ASTM D635-06.
- Material shall have **flammability class V-0** in accordance to **UL94**.
- Material shall be **non-corrosive** for copper and stainless steel in accordance with DIN



1988.

- Material shall be complied with **RoHS (Restriction of Hazardous Substances)** Directive 2002/95/EC amended upto 2011/65/EU.
- The material shall be Dust and fiber Free
- Unlike other generic materials it should be self-extinguishing, does not drip fire balls and does not spread flames
- Moisture Diffusion Resistance Factor or '**μ**' value shall be minimum **7,000** per EN 12086 **without any out-facing**
- Material shall be **free from ozone Depleting substances (CFC/HCFC free)** and shall be tested in accordance with **USEPA 5021A/USEPA 8260C**
- Density of material shall be 40-60 Kg/m³ in accordance to ASTM-D-1667.
- Material should have service temperature range -50°C to +125°C.

Specifications for Woven treated Glass Fibre as Outer covering of Insulation Material

- Adhesive type: Acrylic-PSA
- Density: 214-235 GSM

Summary of Duct Insulation Thickness

	Insulation Thickness (mm)	Material to be used
Supply Air Duct	19	Closed cell anti-fungal & anti-bacterial elastomeric foam made from EPDM rubber with Grey GC layer as outer cover.
Return Air Duct	13	Closed cell anti-fungal & anti-bacterial elastomeric foam made from EPDM rubber with Grey GC layer as outer cover.

3. Duct Acoustic Insulation: EPA approved Open Cell Nitrile Rubber Material with Anti-fungal and Anti-bacterial Properties

- Acoustic Insulation material Properties
- Sound Absorption Coefficient; tested as per **IS: 8225/ISO: 354/ASTM 423C**, shall be minimum as per enclosed chart



- Recommended Thickness for Ducts
- Application Procedure

Acoustic Material Properties

Material: Open cell nitrile rubber sheet Density:
180-220 Kg/m³

- Insulation material should be sustaining to the temperature in the range of -20°C to 85°C.
- Insulation material should be dust and fiber free.
- **Noise Reduction Coefficient (NRC)** value of insulation material should not be less than **0.55** as per testing standards in accordance to **ISO: 354/ASTM 423C**.
- Material shall have **fire class 1 in accordance with BS 476 part 7**.
- Material shall be EPA approved and shall be Anti-Fungal & Anti-bacterial in accordance with ASTM G21 & ASTM E2180.
- Thickness of the material shall be as specified for the individual application.
- The insulation shall be installed as per manufacturer's recommendation.

 Sound Absorption Coefficient of the material at 1/3 Octave Frequency in accordance with IS: ISO: 354/ASTM 423C is given below.

Freq(Hz)	800	1000	1250	1600	2000	2500	3150	4000	5000
Absorption Coefficient	0.63	0.82	0.93	0.95	0.92	0.89	0.84	0.82	0.83

Recommended Thickness for Ducts

For Duct sizing lesser than 600 mm X 600 mm: **10 mm thick**

Application Procedure:

-  ▪ Clean the surface to be insulated
- Providing & Fixing Open cell nitrile rubber sheet having thickness of 10 mm inside the duct with the help of adhesive.



4. **AHU Room Acoustic Insulation: EPA approved** Open Cell Nitrile Rubber Material with Anti-fungal and Anti-bacterial Properties

- Acoustic Insulation material Properties
- Sound Absorption Coefficient; tested as per **IS: 8225/ISO: 354/ASTM 423C**, shall be minimum as per enclosed chart
- Recommended Thickness
- Application Procedure

Acoustic Material Properties

Material: Open cell nitrile rubber sheet Density: 180-220 Kg/m³

- Insulation material should be sustaining to the temperature in the range of -20°C to 85°C.
- Insulation material should be dust and fiber free.
- **Noise Reduction Coefficient (NRC)** value of insulation material should not be less than **0.55** as per testing standards in accordance to **ISO: 354/ASTM 423C**.
- Material shall have **fire class 1 in accordance with BS 476 part 7**.
- Material shall be EPA approved and shall be Anti-Fungal & Anti-bacterial in accordance with ASTM G21 & ASTM E2180.
- Thickness of the material shall be as specified for the individual application.
- The insulation shall be installed as per manufacturer's recommendation.

Sound Absorption Coefficient of the material at 1/3 Octave Frequency in accordance with IS: ISO: 354/ASTM 423C is given below.

Freq(Hz)	800	1000	1250	1600	2000	2500	3150	4000	5000
Absorption Coefficient	0.63	0.82	0.93	0.95	0.92	0.89	0.84	0.82	0.83

Recommended Thickness

20 mm thick Application

Procedure:

- Clean the surface to be insulated
- Providing & Fixing Open cell nitrile rubber sheet having thickness of 20 mm over the surface with the help of adhesive.



5. VRV/Refrigerant Piping Insulation (within the building):

- Insulation Materials Technical Specifications
- Selection of Insulation Thickness

Insulation Material Technical Specification – EPA Approved Anti-microbial Closed cell Class O Nitrile Rubber Plain:

- Insulation material shall be **EPA approved Closed Cell Elastomeric Nitrile Rubber with Anti-microbial**
- Thermal conductivity of elastomeric nitrile rubber shall not exceed **0.035 W/(m.K)** at mean temperature of 10 deg C. (Tested acc. To ASTM C518)
- Material shall be **EPA approved anti-microbial** and shall be **anti-bacterial** in accordance to ASTM E2180.
- Material shall be Anti-fungal in accordance with ASTM G21. It shall also **pass fungal & bacterial resistance** test in accordance with **ISO846**.
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame, also pass Fire Propagation requirement as per BS476 Part 6 to meet the **Class 'O'** Fire category requirement as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990
- Material shall have **flammability class V-0** in accordance to **UL94**.
- Unlike other generic materials it should be self-extinguishing, does not drip and does not spread flames.
- Moisture Diffusion Resistance Factor or 'μ' value shall be **minimum 7,000 for the insulation material without any outerfacing**.
- Density of material shall be 40-60 Kg/m³ in accordance to ASTM-D-1667.
- Material should have service temperature range -40°C to +105°C.

Recommended Insulation Thickness: 19 mm thick



6. VRV/Refrigerant Piping Insulation (Exposed- withinbuilding)

- Insulation material Properties
- Selection of Insulation Thickness

Insulation Material Technical Specification – EPA Approved Anti-microbial Closed cell Class O Nitrile Rubber Plain with Self bonded olefin (HDPE) for Outer covering :

- Insulation material shall be **EPA approved Closed Cell Elastomeric Nitrile Rubber** with Anti-microbial
- Thermal conductivity of elastomeric nitrile rubber shall not exceed **0.035 W/(m.K)** at mean temperature of 10 deg C. (Tested acc. To ASTM C518)
- Material shall be **EPA approved anti-microbial** and shall be **anti-bacterial** in accordance to ASTM E2180.
- Material shall be Anti-fungal in accordance with ASTM G21. It shall also **pass fungal & bacterial resistance** test in accordance with **ISO846**.
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame, also pass Fire Propagation requirement as per BS476 Part 6 to meet the **Class 'O'** Fire category requirement as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990
- Material shall have **flammability class V-0** in accordance to **UL94**.
- Unlike other generic materials it should be self-extinguishing, does not drip and does not spread flames.
- Moisture Diffusion Resistance Factor or 'μ' value shall be **minimum 7,000 for the insulation material without any outerfacing**.
- Density of material shall be 40-60 Kg/m³ in accordance to ASTM-D-1667.
- Material should have service temperature range -40°C to +105°C.

Specifications Self bonded olefin (HDPE) for Outer covering of Insulation Material

- ☐ It is HDPE fiber cloth bonded with moisture control metal foil film.
- ☐ It has good UV resistance and water resistance property.
- ☐ It has high water vapour diffusion resistance and low thermal conductivity.

Recommended Insulation Thickness: 19 mm thick



7. Under Deck Insulation:

- Insulation Material Properties-20 mm thick **Rigid PIR boards with both side company bonded FSK**
- Application Procedure

Insulation Material Technical Specification

- PIR insulation boards shall have **density of 45 kg/m³** with tolerance as per **IS:11239 (Part 2)**.
- Thermal conductivity (**k-value**) of insulation material shall not exceed **0.023 W/mK at 10°C mean temperature** as per testing standards in accordance to **ASTM C518**.
- Thermal resistance (**R-value**) of insulation material shall not exceed **5.01 °F ft² hr/BTU at 10°C mean temperature**.
- Insulation material shall have **dimensional stability** up to **0.17%** at 100°C for 24 hours as per testing standards in accordance to **IS:11239 (Part 3) / IS:12436**.
- **Water Absorption** shall be **0.61%** as per testing standards in accordance to **ASTM D2842**.
- **Compressive strength** shall be minimum **115 kN/m²** as per testing standards in accordance to **IS:11239 (Part 11) / IS:12436**.
- **Water vapour permeability** shall be **0.017 ng/Pa.s.m** as per testing standards in accordance to **ASTM E96**.
- It shall Confirm Standards: **IS:11239 (part 11) / IS:12436**

Recommended Thickness: 20mm

- Clean the surface to be insulated.
- Providing and fixing **20 mm thick PIR boards with both sides FSK (Foil - Scrim - Kraft) foil** with the help of adhesive, G.I. cross wire, screw- washers & complete as per guidelines given in application manual.



8. False Ceiling Insulation (Thermo-Acoustic):

- Insulation Material Properties
- Application Procedure

✚ **Product Technical Specifications:** Resin Bonded wool packed in black thermo -acoustic cloth which is stitched from three sides and openable from one side with hook and loop fastener. (Encapsulated)

Material: Encapsulated (Acoustic Pad)

Density: 80 Kg/M³

Insulation Thickness: 50 mm

Covering: Packed in Black acoustic cloth

- Thermal Conductivity of Resin Bonded slab shall be 0.038 W/m. K at an average mean temperature of **35 deg C** (As per ASTM C518)
- It shall have **R Value of 7.47 hr*ft²*°F/BTU** (Thermal Resistance Value) – calculated for mean temperature of 35 degC
- **It should have NRC (Noise Reduction Co-efficient) value of 0.90** at one third octave frequencies – with 25mm Airgap As per IS: 8225-1987, "Measurement of Sound Absorption Coefficient in Reverberation Room" Equivalent to ISO: 354-2003 & ASTM 423-90

Frequency (Hz)	Sound Absorption Coefficient (α)
500	1.00
1000	1.00
2000	1.00
4000	1.00

- The insulation material (Resin Bonded slab) shall have **Class A** Fire Performance Grade
- This is developed especially for an acoustical application
- Confirming Standards: IS 8183
- The insulation material should be Incombustible (**AS PER IS:8183/IS:3144**) and moisture resistant & also it should not cause or accelerate any type of corrosion

✚ Application Procedure:

- Clean the surface to be insulated
- Put an acoustic pads above the false ceiling framing where ceiling has to be done



1.6 NOISE AND VIBRATION CONTROL

a. GENERAL

This section of the Specification intends to direct the Contractor to select the appropriate and sufficient noise and vibration control measures on the plant/equipment, the interconnected piping, ductwork and conduits so that when the installed plant/equipment are put into operation, the resulting noise and vibration levels at locations within the building and at the adjacent or nearby buildings shall not exceed the acceptable limits.

The Corrected Noise Level at potential Noise Sensitive Receiver in the adjacent or nearby building, if so identified in the Particular Specification and/or Drawings, shall not exceed the Acceptable Noise Level stipulated in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites issued by the Environmental Protection Department when the plant/equipment installed by the Contractor are put into operation.

b. EQUIPMENT BASES

GENERAL

Floor mounted equipment shall be installed on 100 mm high concrete housekeeping pads provided by the Building Contractor covering the whole floor area requirements of the equipment bases plus a minimum of 150 mm further on each side or on inverted beams at the roof. Vibration isolators shall be mounted on this concrete pad or inverted beams.

c. WELDED STRUCTURAL STEEL BASES

Bases shall be constructed of adequate T or channel steel members reinforced as required to prevent the bases from flexing at start-up and from misalignment of drive and driven units.

All perimeter members shall be of steel sections with a minimum depth equal to 1/10th of the longest dimension of the base but need not exceed 350 mm provided that the deflection and misalignment are kept within acceptable limits as determined by the equipment manufacturer.

Height saving brackets shall be employed in all mounting locations to provide a base clearance of 50 mm.

d. CONCRETE INERTIA BASES

Concrete inertia bases shall be formed within a structural steel beam or channel frame reinforced as required to prevent flexing, misalignment of the drive and driven units or transfer of stresses into equipment. The bases shall be completed with height saving brackets, concrete reinforcement and equipment bolting down provisions.



In general, the thickness of concrete inertia bases shall be of a minimum of 1/12th of the longest dimension of the base but never be less than 150 mm. The base depth needs not exceed 300 mm unless specifically required.

As an indication of the standards required, minimum thickness of the inertia bases shall generally comply with the following table or be 1/12th of the longest dimension of the base, whichever is the larger:-

Minimum Thickness of Inertia Base

Motor Size (KW)	Minimum Thickness
3.7- 11	150mm
15- 37	200mm
45- 55	250mm
75 - 185	300mm

Base forms shall include minimum concrete reinforcement consisting of 13 mm bars or angles welded in place on 150 mm centers running both ways in a layer of 40 mm above the bottom, or additional steel as is required by the structural conditions.

Unless otherwise specified, concrete inertia bases shall weigh from 2 to 3 times the combined weight of the equipment/plant to be installed thereon.

Base forms shall be furnished with drilled steel members and with anchor-bolt sleeves welded below the holes where the anchor bolts fall in concrete locations.

Height saving brackets shall be provided in all mounting locations to maintain a base clearance of 50 mm.

e. VIBRATION ISOLATORS

The following types of vibration isolation mountings or suspensions are not exhaustive but serve to cover the main types that shall be applied as appropriate unless otherwise stated in the Particular Specifications.

f. FREE STANDING SPRING MOUNTS

These shall be free standing and laterally stable without any housing and complete with a minimum of 6.0 mm neoprene acoustical friction pads between the base plate and the support.

All mountings shall have leveling bolts that must be rigidly bolted to the equipment.



Spring diameters shall be no less than 80% of the compressed height of the spring at rated load with horizontal spring stiffness 1.1 times the rated vertical spring stiffness.

Springs shall have a minimum additional travel to 'solid' (fully compressed) equal to 50% of the rated deflection.

Springs shall be so designed that the ends of the springs remain parallel.

The springs selected for any given application shall be non-resonant with the equipment's or support structure's natural frequencies. This shall apply to all springs hereafter described.

g. RESTRAINED SPRINGMOUNTS

Equipment with operating weight different from the installed weights such as chillers, boilers etc. and equipment exposed to the wind such as cooling towers and other roof mounted plants shall be mounted on spring mountings but a housing shall be used that includes vertical limit stops to prevent spring extension when some of the weight is removed, i.e. when the system is drained or lifted by abnormal wind pressure.

h. DOUBLE DEFLECTION NEOPRENE MOUNTS

These mountings shall have a minimum static deflection of 8.5 mm. All metal surfaces shall be neoprene covered to avoid corrosion and shall have friction pads on both the top and the bottom so that they need not be bolted to the floor. Bolt holes shall be provided for applications where bolting down is required.

i. NEOPRENE PADS

These mountings shall consist of 'waffle' form neoprene pads of 8.0 mm thickness. Where required these shall be adhesive cemented to 3 mm steel plate of similar area so as to form a sandwich.

The area of pad to be used and the number of layers shall be determined for each application in accordance with the manufacturer's recommendations.



7. AIR DISTRIBUTION EQUIPMENT -

DOUBLE DEFLECTION ADJUSTABLE BLADE GRILLE -

To be constructed from high quality aluminum alloy extrusions with cleated & mitred frames Vanes should be in double banks are individually adjustable shape of vanes should be teardrop and are held in position with stainless steel spring wire for long life.

Finish of grille should be epoxy polyester powder coated & shade should be as per Architect / interior designer's choice.

LINEAR GRILLES -

To be constructed from extruded aluminum sections fabricated in to modular assemblies' frames are mitred & cleated.

Finish of grille should be epoxy polyester powder coated & shade should be as per Architect / interior designer's choice.

AIR TRANSFER GRILLES -

Should be suitable for mounting in doors, partitions and wall should have no sight feature to be constructed from aluminum extrusions sections fabricated in tube cores and mitred, cleated frames.

Finish of grille should be epoxy polyester powder coated & shade should be as per Architect / interior designer's choice.

SLOT DIFFUSER -

Linerslotdiffusersshallbefabricatedfrom highgradealuminumalloyextrusionsfixedorclipped stays allowing easy removal of internal flow control vanes and pattern control elements should have fully adjustable air pattern from horizontal tovertical.

Finish of diffusers should be epoxy polyester powder coated & shade should be as per Architect / interior designer's choice.

DAMPERS – GENERAL -

The respective functions, types and general constructional requirements of dampers shall be in accordance with the HVCA ductwork specification unless otherwise indicated, sufficient dampers



shall be provided to regulate and balance the system. Dampers on grilles or diffusers shall be used for line control only.

All dampers shall be of flanged type for connection to ductwork and shall be sufficiently rigid to prevent fluttering. Air leakage rate for dampers shall be tested according to EN 1751 Section 3 when the damper is in the closed position. For dampers installed for shut-off purpose, the maximum air leakage rate shall be tested according to EN 1751 Section 4.

LOW LEAKAGE DUCT DAMPER -

Air volume control dampers shall be of the aerofoil, double skin, opposed blade type with low pressure drop and noise regeneration characteristics. Damper blades in rectangular ductwork shall not exceed 225 mm in width and 1500 mm in length. Blades shall be of hollow section constructed from the same material as the ductwork or of stainless steel encapsulating an internal double contoured stud longitudinal reinforcing bar, mounted on square section steel spindles. Bearings shall be of nylon material and the units shall be of low-leakage design by incorporation of synthetic trailing edge seals and a peripheral gasket which shall be tested according to BS 476. All manually and automatically operated dampers shall include a means for indicating externally the position of the blades. Manual dampers shall include a device for positioning and locking the damper blades. The position of all dampers as set after final regulation shall be indelibly marked at the adjusting device.

Each air volume control damper in the ductwork shall be fitted with a non-corrodible label stating the actual air flow in m^3/s when in the fully open position, its overall cross sectional area, and the degree to which the damper has been closed in order to achieve the design or actual airflow.

Unless otherwise indicated, quadrants and operating handles shall be of die-cast aluminum or other material approved by the Architect with the words 'OPEN' and 'SHUT' marked on the quadrant. Quadrants shall be securely fixed and the damper spindles shall be closely fitted in the quadrant hubs to prevent any damper movement when the damper levers are locked.

Access openings with readily removable air sealed covers shall be provided adjacent to all dampers. Subject to limitations of ductwork size the dimensions of access openings shall not be less than 300 mm x 300 mm and shall be located so as to afford easy access for inspection and maintenance.

EXHAUST VALVES FOR TOILET EXHAUST -

Are to be constructed from steel spinning & to be protected by white powder coated finish.

Volume control dampers (Duct mounted) Frames and blades are to be constructed from high quality extruded aluminum section. Blades are pivoted on PVC bushes and operate through PVC gear system which should be enclosed within the damper frame. Volume control dampers should have following features.

Stainless steel side seal gaskets opposed blade operation.



Aerofoil blade sections. Fully enclosed blade linkage mechanism PVC gear operation. Manually operated knob lockable / removable type Blade position indicator.

VOLUME FLOW CONTROLLER -

Either Pneumatic or electronic Suitable for supply or extract Air Volume flow range approximately 5:1 High accuracy of set volumes even under unfavorable inlet conditions, due to use of pressure differential sensor Operating temperature range 10 to 50°C

Three Stage Indirect Direct DX Coil Evaporative Cooling System

Technical Specification

1.0 SCOPE

The scope of this section comprises of the supply of double-skin "The New Generation (G3) Indirect Evaporative cooling system conforming to the following specifications. The manufacturer or their principals shall have **at least 10 years of designing and manufacturing experience directly in the product i.e. evaporative cooling devices, in India. The Evaporative Cooling Heat Exchanger module and box Shall be from the same manufacturer.**

2.0 TYPE

The Indirect Direct Evaporative cooling system shall be Double Stage Evaporative Cooling Unit. In Indirect Stage at two airstream Indirect Evaporative Cooling system wherein "one airstream is called primary or supply air and the second airstream is called secondary or working air. The indirect cooling process evaporates water and removes heat from the secondary/working airstream and in the process cools down the supply air without addition of any moisture to the primary/supply air.

The Indirect Direct Evaporative Cooling units are generally applied for 100% Fresh/Outdoor Air. However, the IDEC should have an inbuilt control setting for either configuration of 100% OA or a combination of OA and RA. The unit can also be configured as standalone air-conditioning units or integrated into a variety of combinations.

3.0 CAPACITY

The Indirect Evaporative cooling system shall be of such capacities and static pressures as mentioned in the Bill of Quantities.



4.0 CASING

The units shall be made of extruded Aluminium hollow profile frames. The profile box size shall be of thermal break type. The unit should be devoid of any welded construction and should be of cabinet type. All the frames should be assembled using glass fibre reinforced nylon joints/corners to make a self-supporting frame.

The Casing shall be AHRI certified (As per AHRI 1350) for the following parameters - 1

Deflection

2 Leakage

3 Thermal transmittance

4 Thermal Bridging.

The panel shall be of double skin construction with both inner and outer steel sheets being minimum 0.8mm thick. Outside sheet shall be pre coated & plasticized and inner sheet will be galvanized with PUF Insulation of 40 kg/m³ density.

The Inspection and access panels shall be hinged type. The hinges shall be casted, powder coated Zinc alloy. Flushed Locks and Handles shall be of glass fiber reinforced polyamide. Other panels will be screwed on to the frame with sealant and soft rubber gasket thus making the joints air tight. All screws used for panel fixing shall be covered with PVC caps.

Special hollow gaskets and seals shall be used on inspection doors and to create separation between the air streams to ensure negligible air leakage and mixing

The entire casing shall be mounted on galvanized channel frame work. Condensate drain pan shall be fabricated from 18g GSS/SS construction.

5.0 UNIT CONSIST OF FOLLOWINGS

The Unit supply of the following: Fan, Filter, DCM Core, ECM Core & Cooling Coil

5.1 AC DRIVE FAN (Primary and Secondary)

The fan shall be centrifugal forward curved or backward curved, double inlet double width type. The impeller and the fan casing shall be made of hot galvanized sheet steel. The impeller shall be mounted on a solid shaft supported to housing with angle iron frame and pillow block heavy duty ball bearing. The impeller shall be statically and dynamically balanced. The fan shall be selected such that unit noise level is less than 85 db. Fan housing and motor shall be mounted on a common galvanized steel or aluminum block base which can be drawn out from side for ease of maintenance. A quarter pin lock arrangement between the slide and guide pin lock arrangement between Fan and TFA outlet should be provided.



MOTOR AND DRIVE

Fan motor shall be energy efficient EFF1 and suitable for 415C10% volts, 50 cycles, 3 phase squirrel cage, totally enclosed fan cooled with IP – 55 protections. Motor shall be designed for quiet operation. Drive shall be provided through belt – drive arrangement. Belts will be of oil resistant type.

5.2 FILTER

The units shall be provided pre filters with atleast G4. The filter elements shall be mounted on metallic slide rails and shall be easily pulled out for replacement.

5.3 Indirect Evaporative Cooling DRI Cooling Module(DCM)

The units shall be provided with "Patent Pending" technology having Cooling ability of supply airstream below the ambient wet bulb temperature. The DRI Cooling Module also known as DCM. The DRI cooling module shall be made of engineered polymers material. The DCM is properly sealed with to ensure that their moisture transfer between the two airstreams.

5.4 Direct Evaporative Cooling Module

The units shall be provided with Additional Module Utilizing Made in India Direct Evaporative cooling pads. The Evaporative Cooling pads shall be of EcoCool brand. EcoCool Brand Cellulose Paper Pads manufactured in India for Harsh Indian Conditions & Exported Worldwide.

The Pads shall be 7mm flute size and 45/45 flute angle.

The Pads shall be treated with anti-rot and rigidifying resins for longer life. The Pads shall have higher water holding capacity.

The Pads shall have higher saturation efficiency – 90% and above.

The Pads shall have cross-corrugated to maximize mixing of air and water and eliminate water carryover.

The Pads shall have better water holding capacity.

The Pads shall have ROHS certified.

6.0 Basic Control:

PLC/Micro controller-based control system Set point for Supply Air

Temp. & Humidity for Outdoor & Supply Air

Online Display of temp. & Humidity.

Overload Protection for Axial Fan. Interlocking of

Supply Air Fan & Water Pump.

Optional Differential Pressure Switches for indication of clogged/Dirty Filters.

Optional potential free contacts for BMS Integration.

Optional IP 54 Enclosure.

Provision of earthing shall be given to the metallic body of the control panel.

All control cables shall be multi core, 1100 V grade, PVC insulated and overall PVC sheathed with copper conductor manufactured and tested as per relevant IS and ISI marked.

7.0 INSPECTION

The unit shall be fully factory assembled and tested at Factory prior to shipment.

FRESH AIR / EXHAUST AIR FAN -

Air Handling Units shall consist of fan section; Pre-filter section & will have the construction as described below -

Air handling units will be in single skin construction fabricated out of Aluminum Extruded section.

Aluminum sections should have walled rib having a groove for the gasket on the panel side face. Units will be supplied with round gasket in solid / tubular construction fixed in the groove. Gasket will be made out of PVC / Synthetic rubber. Extruded section will be having scratch proof anodized finish. The extruded frame structure will be formed using couplers made out of glass filled nylon, (approx. 30% glass and 70% nylon).

a. Unit Casing-

SingleskinpanelswillbefabricatedoutofbestqualityG.I.Powdercoatedsheetonouterside. Sheet will be of 16 G. The panels will be fixed on Al. Extruded section in such a manner that fixingscrewhead does notprojectonouterfaceonthepanelandsharpendofthescrewdoes notprojectinsidetheunitthroughdoublewalledrib.Thescrewwholeonpanelwillbeblocked with Nylon sleeve withcap.

Filter section will have rigid construction filter frame fabricated out of GI sheet to house required size filters. The filters Efficiency as specified will be in flange type construction having Extruded aluminum casing.



Blower section will consists of extruded sections of proper size to facilitate the mounting of fan and motor bracket. Direct contact of fan base frame and AHU casing will be eliminated through vibration isolator. Also flexible connection will be provided at the fan outlet. Suitable panel of blower section will be provided with hole for cable entry with required arrangement to cover the sharp edge of sheet. If required, a proper size box cover will be provided on cable entry location. A provision for earthing will be provided on main frame near the cable entry hole.

Inspection doors at required location will be provided with elegant design hinges made out of die cast Aluminum alloy. Two or more number of hinges per door will be provided depending upon the size of the door to provide required rigidity to the door panel. One or more number of door handles will be provided with can type tightening arrangement.

The handle and can will be made out of filled nylon having galvanised iron spindle. The inspection door for blower section will be provided at such a location that the motor and drive package and fan bearing can be accessed for easy maintenance.

An additional guard made out of GI wire mesh of required strength will be provided at inner side of blower section inspection door. A limit switch / door switch covered electrical terminal will be provided to facilitate the door inter locking with fan operation.

The entire unit assembly will be mounted on a common skid fabricated out of HDG MS channel of required size. The skid will be secured with AHU frame structure through threaded fasteners. The skid will be duly painted after fabrication with the best quality rust preventive primer followed by two coats of enamel paint. All nut bolts, sheet metal screws, fasteners will be Zinc / Nickel plated having resistance against rusting.

b. Fan-

Fan wheels and scrolls shall be fabricated from best quality sheet steel. The fan wheels shall be of the forward / backward curved type enclosed in housing and mounted on a solid shaft. Fan scrolls shall be fitted with die formed side sheet streamlined inlet and to ensure smooth airflow into the fan. For low static units there will be single blower and for medium static units there will be twin blower construction.

c. Filters-

Pre-filters shall be HDPE washable types with 2" thickness with filtration level of 20 micron & efficiency of 90%. The pre-filter section will be located on suction side of the filters.

d. Fan motors-

Fan motors shall be 3 phase, sq. cage, and T.E.F.C. induction type, together with starters, specified in "ELECTRICAL ITEMS" separately. The motors shall be capable of high initial starting torque requirement of fans.

The exterior surface of Air Handling Unit/s shall be Pre coated.



HOT AIR EXHAUST UNIT -

SISW centrifugal type fan for kitchen hot air exhaust along with drive package and base frame and of should be of following specifications.

Casing: All welded construction with all sizes. All sides' plates are braced for rigidity and strength with heavy steel angle. On higher pressure type fans, class 2 and class 3, extra heavy gauge side plates and reinforcing angles provide the rigidity required for trouble free operation.

Bearings & Bearing Supports: Self-aligning, anti-friction ball bearings stand on fans. Special applications will have special consideration. Sleeve bearings can be used for sizes from 17/16" and larger, for extremely quiet installations. Bearing supports should be designed for adequate stiffness to prevent vibration and with minimum obstruction to air flow. Fabricated steel plate independent bearing pedestals are to be furnished on class 3 arrangement fans.

Shafts: Supplied from ground and polished steel, held to close tolerances, with diameters selected for speeds well in excess of the maximum rated speed of each fan size.

Outlet & Inlet Connections: Slip joints should be supplied as standard for class 1 fans and for class 2 and 3 fans have flanged outlet as standard with optional flanged inlets.

SINGLE SKIN CABINET TYPE UNIT (FOR EXHAUST & FRESH AIR)

Construction -

Floor mounted exhaust unit will consist of blower section with return air cut out and ventilation units will consist of filter section and fan section with S.A. cut-out. Units will have the construction as described below-

Casing -

Units will be in single skin construction with all the features similar to double skin construction units. Units will be fabricated out of Aluminum Extruded section and GI panels.

Extruded aluminum profiles will be duly anodised as per industrial standards (15 to 18 Micron anodising). The panels will be in 1.8mm thick GI construction duly coated with pure epoxy powder / liquid polyurethane paint for the highest production against humid or polluted weather. The panels will be secured properly on the frame structure providing proper gasket between panel and frame.

Filter section (for ventilation units) will have rigid construction filter frame fabricated out of GI sheet to house required size filters. The filters will be in flange type construction having GI casing. Threaded inserts / nuts duly nickel-plated will be pre-fixed on filter frame for securing the filters.



Blower section will consists of fan base frame made out of extruded sections of proper size to facilitate the mounting of fan and motor. Vibration isolators will be provided to eliminate direct contact of fan base frame and AHU casing. Also flexible connection will be provided at the fan outlet. Suitable panel of blower section will be provided with hole for cable entry with required fitting. If required, a proper size box cover will be provided on cable entry location. A provision for earthing will be provided on main frame near the cable entry hole.

Inspection doors at required location will be provided with elegant design hinges made out diecast Aluminum alloy or glass filled nylon. Two or more number of hinges per door will be provided depending upon the size of the door to provide required rigidity to the door panel. One or more number of door handles will be provided with cam type tightening arrangement. The handle and cam will be made out of glass filled nylon having galvanised iron spindle.

The inspection door for blower section will be provided at such a location that the motor and drive package and fan bearing can be assessed for easily maintenance. An additional guard made out of GI wire mesh of required strength will be provided at inner side of blower section inspection door. A limit switch/door switch with covered electrical terminal will be provided to facilitate the door inter locking with fan operation.

The entire unit will be mounted on a common skid fabricated out of Hot Deep Galvanised MS channel of required size. The skid will be secured with AHU frame structure through threaded fasteners. The skid will be duly painted with the best quality rust preventive primer followed by two coats of enamel paint.

All nut bolts, sheet metal screws, fasteners will be Zinc / Nickel-plated having resistance against rusting.

Fan -

Fan wheels and scrolls shall be fabricated from best quality GI sheets. The fan wheels shall be of the forward curved type enclosed in housing and mounted on a solid shaft. The fan shaft will be coated with suitable rust preventives after the final assembly. Backward curved impellers (wherever required) will be galvanised iron or epoxy painted construction. Fan scroll shall be fitted with die formed streamlined inlet to ensure smooth air flow into the fan.

Filters-

Flanged type filters shall be HDPE washable types with required thickness and filtration level as per requirement.

Fan motors -

Fan motor shall be 3 phases, sq. cage, and T.E.F.C. induction type, together with starters. The motors shall be capable of high initial starting torque requirement of fans.



10 CEILING SUSPENDED (INLINE FAN) TOILET EXHAUSTFANS

Plastic flush mount housing for installation in chute walls and lightweight walls without requirements on fire resistance duration and in suspended ceilings.

- With conical blow-out nozzle (DN 75 to DN 80) and airtight relief valve
- Installation of flush mount housing with blow-out nozzle to left, top or right possible, adjustment of relief valve to mounting position via simple plug-in
- All fan inserts of Solvent series can be used (page 30)
- Static pressure available: 233 Pa
- With plaster protection lid for protection against dirt during shell construction phase
- Installation depth 90.5 mm incl. assembly accessories and sound absorbers

❖ Multiple switching-

- Nominal and / or basic load operation possible
- Can be regulated manually to 30 m³/h and / or 60 m³/h
- 230 V ~ 50 Hz
- Power consumption of 4.9 W and 10.5 W (36.5 W at 100 m³/h)
- Sound pressure level 24 and 35 dB(A)
- Filter change display in front screen

Description:

V 30/60, Order No. 039 217

❖ Multiple with motion detector-

- Nominal and/or basic load operation possible
- Nominal load can be triggered via motion detector
- 230 V ~ 50 Hz
- Power consumption of 4.9 W and 10.5 W (36.5 W at 100 m³/h)
- Sound pressure level 24 and 35 dB(A)
- Filter change display in front screen

Description:

V 30/60 B, Order No. 039 225

❖ Multiple switching with time tag -

- Switchable nominal and continuous basic load possible



- Nominal load can be regulated manually (60 m³/h) with time lag function
- Time lag with activation delay, time lag, interval and inverse operation
- 230 V ~ 50Hz
- Power consumption of 4.9 W and 10.5 W (36.5 W at 100m³/h)
- Sound pressure level 24 and 35dB(A)
- Filter change display in frontscreen

Description:

V 30/60 Z11,	Order No. 039 233 V
30/100 Z11,	Order No. 039 292 V
60Z11,	Order No. 039268
V 100Z11,	Order No. 039314

SCRUBBER (WATER SPRAY TYPE AIR WASHER):

1.0 SCOPE:

The scope of this section comprises the supply, erection, testing and commissioning of Air washers conforming to these specifications and in accordance with requirement of drawings and of the schedule of quantities.

2.0 CASING:

Air washer casing shall be made out of single skin, 18 G.G.I sheet and M.S. frame work construction finished with epoxy paint inside & outside.

3.0 TANK:

Air washer tank shall be made out of 18 G thick stainless steel with 250 mm height to maintain water level of 200 mm. The tanks shall be provided with 20 mm dia make up connection (with float valve and ball valve). 50 mm dia drain connection with drain valve 12 mesh brass suction screen with G.I frame.

4.0 WASHER SECTION:

Cellulose fill with cross fluted configuration assembled in self supporting pads made of cellulose paper impregnated with insoluble Anti-rot salts, rigidifying saturates and wetting agents, with built in eliminators.

Cellulose fill shall be divided into two parts. Thickness at air inlet shall be 50 mm with additional water flow. Remaining fill shall be installed in alignment with initial fill to ensure clear air passage through fill.

The air velocity across the pads shall not exceed 500 FPM and shall provide minimum 90% saturation efficiency at 200 mm thickness of pads.

5.0 FAN:



Forward curved dynamically balanced heavy duty centrifugal blower with 18 G. scroll mounted on shaft and self-aligning ball bearings.

6.0 MOTOR & DRIVE:

Totally enclosed 3 phase 415 + 10% volts motor with belt driven arrangement of adjustable type. Motor for each blower shall be TEFC, IP-55, dip proof, squirrel cage induction type.

7.0 PUMP:

Pump shall be mono block self priming pump set operating at 415 + 10% volts, 3 Phase or 220 + 6% volts single phase power supply.

8.0 DISTRIBUTION SYSTEM:

25 mm G.I. 'B' class perforated pipe impinging on 3 mm FRP distributor to distribute on the 50 mm distribution pad of similar construction as Glacier Cor/Celdek to get even wetting of media. Bleed off arrangement with 6 mm wheel valve shall be provided to adjust the requisite rate. All internal and external interconnecting G.I. 'B' class piping including 'Y' strainer on the suction of the pump with necessary valves.

9.0 FILTER:

50 mm thick, 5 layer wire mesh viscous type filters with aluminum frame shall be provided. Maximum velocity across the filters shall be 400 FPM.

High Output UVC Emitter Ultraviolet Disinfection

For IAQ & Heat Transfer Efficiency: HVAC Pathogens -Mould, Viruses, Bacteria

GENERAL

Specification requirements of germicidal UVC Emitters to achieve the restoration of heat transfer, reduced maintenance costs, reduction in chemical on Air Handling Unit Cooling Coils and Drain Pans.

Requirements and performance for UVC Energy Fields on Cooling Coils for the destruction of pathogenic microorganisms within an airstream and on designated irradiated surfaces within HVAC equipment i.e. AHU coil or Duct along with removal of Biofilm and prevention of formation of Biofilm from forming.



QUALITY ASSURANCE & SAFETY COMPLIANCE:

UL Compliance: Comply with UL Standard 1995, 153, 1598 as applicable to usage of UVC Emitters in HVAC Equipment.

CE Certification

ISO Certification: Fixtures must be manufactured in an ISO 9001:2015 and ISO 14001:2015

registered facility. Supplier must submit both of the Manufacturer's ISO

certifications along with Certificate of Membership for Indoor Air Quality Association (IAQA) EMC Testing to Standard CISPR 15

Acceptable Manufacturers: Steril-Aire Inc. and Trimed.

UVC EMITTER PERFORMANCE & EQUIPMENT DESIGN REQUIREMENTS:

Dose On the Down Stream Coil Face At Extremities: The UVC dose at the extreme edges of the coil shall not be less than $1225 \mu\text{W}/\text{cm}^2$ and end of life intensity on the coil face shall exceed $750 \mu\text{W}/\text{cm}^2$ at the end of the 18000 hours of operation period measured in 2.5

m/s airflow at 13 Deg C. (Necessary to remove and prevent Biofilm from forming)

Supplier to demonstrate with the Calibrated UVC radiometer, In case of failure to demonstrate above product shall be rejected.

Units shall be high output, HVAC-type, germicidal UVC light sources and tested. Components shall include a high efficiency electronic power source, Emitter sockets and Emitter tube, all constructed to withstand HVAC environments.

High efficiency electronic power sources shall be 115, 208/230 and 277 V, 50/60 Hz. They shall be UL listed to comply with UL Standard 1995 and capable of igniting each Emitter at temperatures from $1^\circ - 70^\circ \text{C}$ in airflow velocities common to HVAC systems. They shall be Programmed Start and equipped with RF, line noise suppression and end of Emitter Life circuit protection.

Emitter tube shall be of the high output, hot cathode, T5 (15mm) diameter, and medium bi-pin type. They shall produce 95% of their energy at 254 nm and be capable of producing the specified output at airflow velocities common to HVAC systems and at temperatures of $1^\circ -$

70°C . UVC Emitters shall produce no ozone or other secondary contamination.

WARRANTY:

Fixture and Emitter shall be 100% warranted to be free from factory defects for a period of 18000 hours of Operation.

The Power Supplies/electronic Ballasts shall have a lifetime warranty.



The Coil shall be substantially free of Mould at the end of the manufacturer's Emitter Warrantee period, or 18000 of operational hours, whichever is longer.

VERIFICATION:

Provide Cooling Coil UVC Energy Field selection drawings showing irradiance on all parts of the cooling coil measured in 2-2.5 m/s airflow at 10-13 degrees C.

Supplier must submit earlier case studies of Manufacturer for Agar Petri Dish test to depict visible results before and after UV installations.

DESIGN REQUIREMENTS:

Irradiation - Emitters are to be installed downstream of the coil horizontally across the full face of the coil without the use of reflectors in sufficient quantity and in such an arrangement so as to provide an output as specified in this document and equal distribution of UVC energy on the coil and in the drain pan. To maintain energy efficiency, the UVC energy produced shall be of the lowest possible reflected and shadowed losses.

INSTALLATION OF UVC EMITTERS:

Coordinate with installation of HVAC equipment and install Emitters as indicated after such equipment is properly installed.

Provide an interlock switch on the access to the UVC Emitters to turn the lights off when the access is opened.

Provide a view port to enable the maintenance technician to view Emitters to determine that they are operating.

Install provided Caution Labels on all accesses to the Emitters.

Provide control for cycling the Emitters with the AHU run times if not 24/7 operation. If specified (optional) install an on/off indicator capable of informing BMS if there is an Emitter failure, operational status, Emitter Replacement.



Air Purification System Part

1 – GENERAL

1.1 DESCRIPTION OF WORK

A. This section describes the design, performance and installation of an Dielectric Barrier Discharge (DBD) Bi-Polar Ionization System air purification system for removal of Odour along with removal of PMs, VOCs, Molds, Bacteria, Viruses and pathogens intended for use as part of the air handling unit / VRF/ductables or mounted on the duct as shown on the plans, details, and equipment schedules.

1.2 REFERENCED CODES AND STANDARDS

- A. Bipolar ionization system must have:
1. UL 2998 Ozone Free Compliance
 2. UL 867-2013 Ozone Standard for Electrostatic Air Cleaners including ozone chamber test
 3. IP66 Enclosures
 4. UL 1995 Heating and Cooling Equipment.
 5. UL 2043 Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.
 6. OPA 2807-10, OPA 2808-10
 7. ASHRAE 62.1

1.3 QUALITY AND INSURANCE

- A. The plans and specifications for the air purification system, and the sizing of the systems, have been based on bipolar ionization air purification system. Systems and Solutions only to be considered for acceptance provided that the substituted equipment is equal in every respect to the operational characteristics, capacities, and intent of descriptions specified herein. Bidders shall not substitute any equipment covered under this section without written permission from the Engineer and Owner three weeks prior to bid date.
- B. Air purifier shall be fabricated by companies whose primary business expertise is the manufacture of commercial and industrial-quality bipolar ionization air purifiers. The manufacturer shall have been in continuous operation for a minimum of ten (10) years. All products shall be manufactured in the USA and a certificate of origin be provided if requested.
- C. Manufacturer must furnish a two (2)-year manufacturer's warranty against manufacturing defects for all systems and components. Warranty period shall initiate upon final acceptance of systems by owner.
- D. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.
- F. All technologies that do not address gas dissociation which is required for Odour and VOCs



reduction shall not be considered.

- G. Projects designed using ASHRAE Standard 62.1 IAQ Procedure shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1- 2013 to validate acceptable indoor air quality at the quantity of outside air scheduled with the technology submitted. Test must be stamped by a licensed professional engineer prior to submission. Results must be submitted to engineer validating performance reductions versus contaminants of concern.
- H. The Air Purification Technology shall have been tested to prove conformance to UL867-2013 including the ozone chamber test and peak ozone test for all electronic air cleaning devices.
- I. System commissioning shall include ion level measurements to ensure that these design increase levels have been achieved. The acceptable air ionization level increase in such areas shall be between 500 and 1,500 ions per cubic centimeter as measured by an Alpha Labs air ion counter model AIC2.
- J. All units must have IP66 certifications.

1.4 SUBMITTALS

Submit manufacturer technical product for each bipolar ionization air purifier, including the following:

Specification sheets for each type of bipolar ionization system and accessories indicating construction sizes and mounting details; schedule of bipolar ionization systems indicating: model number, quantity of each system required for each unit, tube quantity, rated CFM, system served, space type; IOM; Performance data; Installation drawings; Electrical Requirements; ASHRAE 62.1 IAQ calculations.

1.5 PERFORMANCE SPECIFICATIONS

The bipolar ionization air purifiers shall have been independently tested by a third-party to ANSI/AHAM AC-1-2002 and provide a minimum Clean Air Delivery Rate (CADR) performance of 125 Dust CADR and 190 Mold CADR. Any bipolar ionization system not tested or rated above a 100 CADR is not allowed.

Each bipolar ionization air purifier shall be capable of effectively reducing and/or agglomerating microorganisms throughout the ductwork and interior occupied spaces served by the bipolar system (including mold, bacteria, vapors, viruses and other airborne particulates), controlling gas-phase contaminants including Volatile Organic Compounds (VOC's) generated from human occupants, building structure and furnishings, and reducing static space charges.

Each bipolar ionization manufacturer must have third party laboratory testing results proving contaminant and pathogens reductions against COVID thru ASTM Test Method (> 99.9% efficiency), VOCs and TVOC (90% efficiency), MS2 (>95% efficiency), Staph (>95%



efficiency), E. Coli (>95% efficiency), Dust-Particulate Matter 0.3 (>86% efficiency), Mold (>90% efficiency), and C. Difficile (>95% efficiency). Manufacturers shall furnish these reports on request.

Manufacturer must provide third party ozone testing from 10 locations where technology is installed. Manufacturer must provide third party proof that there is no measurable increase in ozone levels within the space.

Each bi polar ionization system must have a dynamic ion switch giving the owner the ability to increase or decrease bipolar ionization levels. Each system must have five ionization settings.

Field Performance. The Bi Polar Ionization system manufacturer shall produce five documented installation references including client contact information with the following criteria.

Systems shall have operated continuously for a minimum of 3 years.

Installations must be greater than 10,000 CFMs.

Systems shall have a documented ability to reduce Total volatile organic compound (TVOC levels), particulate (PM) levels, and not increase ozone (O3) in both before and after installation results from air testing completed within the occupied space. Results must include real-time performance results on Particulate Matter 2.5 (PM2.5), Total Volatile Organic Compounds (TVOC), and ozone (O3).

Ionization tubes must be constructed from durable, shatterproof composite material, not glass. Composite tubes must be able to last for 17,600 hours or more. Glass tubes are not be permitted due to potential of shatter caused by vibration. Tube must retain 90% of ion output efficiency at 17,600-hour mark.

Tube Quantity. A 21" bi polar ionization tube must meet certain CFM requirements for different building descriptions:

One (1) 21" bi polar ionization tube per 938 CFM of supply air.

System must be tied into the BMS to show on/off functionality.

1.6 CONTROL PERFORMANCE SPECIFICATIONS

Control: These units are required to have an automatic Air Ionization Controller for each independent air handler.

Real time IAQ sensor and controller must measure at a minimum: Carbon Dioxide, Temperature, Relative Humidity, ozone, particulate matter (PM2.5), and total volatile organic compounds (TVOC).



The air ionization sensors and controller shall automatically adjust to changes in indoor air quality, make-up air quality, system flow, supply air humidity and ozone levels.

The controller must communicate to building management system (BMS) using BACnet.

The controller must have capability that will allow access for both instantaneous readout and data-logging of the ionization system's operating performance via the building management system (BMS).

The controller is also required to monitor and adjust to varying humidity conditions to maintain optimum ionization performance. The air ionization shall automatically be increased when the air gets moist and when the air is dry the intensity shall be decreased.

1.7 INDOOR AIR QUALITY MONITORING PERFORMANCE SPECIFICATIONS

Room level IAQ sensor must measure at a minimum: Carbon Dioxide, Temperature, Relative Humidity, particulate matter (PM2.5), and total volatile organic compounds (TVOC).

Room level sensors must be remotely monitored and accessed via a web portal and phone application.

The sensor must communicate to building management system (BMS) using BACnet. The sensor must be RESET certified.



11 ELECTRICAL WORKS

1.0 MOTORS & MOTOR CONTROL CENTERS

1.1 General-

These specifications cover all types of motors used for chillers, pumps, air handling units, etc. The motor installation, wiring, control shall be carried out strictly in accordance with the specification herein after laid down.

1.2 MOTORS-

a) Rating-

The ratings of the motors shall be as required to meet the duty conditions of the appliance to which it is connected but in no case shall be less than that indicated in schedule of quantities. The rating shall be selected on the basis of ambient temperature & allowable maximum temperature rise as specified.

b) Standards & Codes-

Unless otherwise specified, the induction motors shall conform to the latest edition of relevant Indian, IEC or British Standards. The relevant Indian Standards are-

- | | |
|--|---------|
| 1. Induction motors - Three Phase. | IS-325 |
| 2. Measurement and evaluation of vibration of Rotating Electrical machine. | IS-4729 |
| 3. Code of Practice for climate proofing. | IS-3202 |
| 4. Degree of Protection provided by enclosures for Rotating Electrical Machinery. | IS-4691 |
| 5. Classification of hazardous area for electrical equipment. | IS-5572 |
| 6. Flame proof enclosure of electrical equipment. | IS-2148 |
| 7. Method of determination of efficiency of rotating Electrical Machines. | IS-4889 |
| 8. Specification for rotating electric machine. | IS-4722 |
| 9. Construction and testing of electrical apparatus with Type of protection "E". | IS-6381 |
| 10. Designation for types of Construction & Mounting Arrangements of Rotating Electrical machines. | IS-2253 |
| 11. Terminal Marking for Rotating Electrical Machinery. | IS-472 |



- | | |
|---|---------|
| 12. Designation of Methods of Cooling for Rotating Electrical Machines. | IS-6362 |
| 13. Guide for testing three phase induction motors. | IS-4029 |
| 14. Dimensions of Slide Rails for Electrical Motors. | IS-2968 |
| 15. Industrial Platinum Resistance thermometers sensors. | IS-2848 |
| 16. Method of marking for identifying electrical equipments for explosive atmosphere. | IS-8241 |

All motors shall comply with IS- 325, in respect of general requirements and performance. Motors shall also confirm to IS- 1231, for foot- mounted motors.

- c) In general all the motors above 1 hp. shall be 3 phases unless otherwise specified. motors may be either 3 phases or single phase as required.
- d) Motors shall run at all loads without appreciable noise or hum. Motors shall be one of the following design and as more specifically specified in equipment schedule-
 - i. Squirrel cage,
 - ii. Wound Rotor
 - iii. Totally enclosed
 - iv. Totally enclosed, fan cooled (T.E.F.C).
 - v. Screen Protected Drip Proof (S.P.D.P.).

Winding of motors shall be class "B" insulated and fully tropicalised.

- e) Motors shall be rated for continuous duty as defined in IS-325. All motors shall have suitable torque characteristics as required by the duty of driven equipment. Motors shall be suitable for operation on 400 +/- 10% V, 3 phases, 50HZ, AC supply (or 230V single phases 50HZ, AC supply if required).
- f) Motors shall be provided with ball/roller bearings. Bearings shall have ample capacity to deal with any axial thrust. Suitable grease nipples shall be provided for re-greasing the bearing.
- g) Motors shall be provided with a cable box to suit the required number of runs of aluminium conductor, PVC insulated, PVC sheathed and steel wire armoured cables.
- h) Motors shall be designed to operate successfully under the following conditions of voltage and frequency variation.
- I) Where the voltage variation does not exceed ten percent (10 %) above or below normal.



- J) Where the frequency variation does not exceed five percent (5 %) above or below normal.
- K) Where the sum of voltage and frequency variation does not exceed ten percent (10%) provided the frequency does not exceed 5% above or below normal.

MEASUREMENTS-

The cables will be measured in meters, as laid up length, including any wastage or cuts. The unit rate shall include supply, installation, connection, termination, testing and commissioning of cables, as per the size indicated in relevant drawings or BOQ. The unit rate shall include installation material and labour.

CABLE INSULATION-

Polyvinyl Chloride (PVC) rated 70-degree Centigrade extruded insulation as per IEC- 502. Cables with rated voltages up to and including 3.3 KV shall have type "A" insulation and cables with rated voltage above 3.3 / 3.3 KV shall have Type "B" insulation. Heat resisting insulation shall be of Type "C" PVC compound conforming to relevant Indian Standards.

CORE IDENTIFICATION-

Two Cores	-	Red and Black.
Three Cores	-	Red, Yellow and Blue
Four Cores	-	Red, Yellow, Blue and black.
Five Cores	-	Red, Yellow, Blue, black and gray.
Single cores	-	Green yellow for earthling.

ARMOURING-

- (A) Armouring shall be one of the following-
1. Galvanized round steel wire.
 2. Galvanized steel strip.
 3. Any metallic non-magnetic wire/strip.
- (B) The galvanized steel wires / strips shall comply with requirements of relevant Indian Standards.
- (C) Double layers of armouring shall be provided, if specified in data sheet.



- (D) Where the diameter below armour does not exceed 13 mm, the armour shall consist of galvanized round steel wires. Where the calculated diameter below armouring is greater than 13mm, the armour shall consist of either galvanized round steel wires or galvanized steel strips.
- (E) In case of single core A.C. cables, the armouring shall be of non-magnetic material.
- (F) The joints in armour wires or strips shall be made by brazing or welding and any surface irregularities shall be removed.

JOINT IN CABLES-

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

JOINTING BOXES FOR CABLES-

Cable jointing boxes shall be of appropriate size suitable for PVC insulated cables of particular voltage ratings, and shall be of specified make.

TERMINATION FOR CABLES-

Cable termination shall be done in terminal box or cable end box. Terminations are to be made with mechanical gland and of the tinned nickel plated, anti-corrosive, three-piece improved pattern, which is to grip inner and outer PVC sheaths as well as the armour of the cable. The cable ends or the core conductors are to be connected by solderless lugs or sockets using crimping tool of approved make for all cables above 4.0 MM² size.

TEST CERTIFICATES-

Testing of PCCs & MCCs shall be carried out at factory and at site as specified in Indian Standards in the presence of Clients representatives. The test results shall be recorded on prescribed forms. The test certificates for the test carried out at factory and at site shall be submitted in duplicate to the Consultants for approval.

BUS BARS-

The busbar shall be air insulated & made of high quality, high conductivity, and high strength copper. The bus bars shall be of three phases and neutral system with separate neutral and earth bar. The size of neutral busbar in all main panels shall be equal to half the size of phase busbar. The bus bars & interconnection between busbars & various components shall be of high conductivity, copper. The bus bar shall be of rectangular cross section designed to withstand full load current for phase bus bars and 2/3 rated current for neutral bus bars in case of MCC panels only and shall be extensible on either side. The bus bar shall be rated for the frame size of the main incoming breaker, but in any case not less than 200 Amp. Capacity.



The bus bar shall have uniform cross section throughout the length with current density of $1\text{mm}^2 = 1.6\text{ Amp}$.

The bus bars and interconnections shall be insulated with heat shrinkable PVC sleeve and be color coded in red, yellow, blue and black to identify the three phases and neutral of the system. The bus bars shall be supported on unbreakable, non hydroscopic SMC insulated supports at sufficiently close intervals to prevent bus bars 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.

The bus bars shall be housed in a separate compartment. The bus bar shall be isolated with 3 mm thick Bakelite sheet to avoid any accidental contact. The bus bars shall be arranged such that minimum clearances between the bus bar are maintained as per below and it is possible to approach and open / tighten all the bolted terminations from the front face.

Between Phases	20 mm minimum.
Between Phases & Neutral	20mm
Between Phases & Earth	20 mm
Between Neutral & Earth	15 mm minimum.

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

All connections between bus-bars and circuit breakers / switches and between circuit breakers / switches and cable terminals shall be through copper strips of proper size to carry full rated current. These strips shall be insulated with insulating tapes.

ELECTRICAL POWER & CONTROL WIRING CONNECTION-

- [A] Terminal for both incoming and outgoing cable connections 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 drawings for the PCC / MCC.
- [B] Power connections for incoming feeders of the main PCC shall be suitable for 1100 V grade aluminum conductor (AYFY) cables.
- [C] Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.



[D] Both control & power terminals shall be properly shrouded.

TERMINALS-

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

Terminals shall be shrouded. Terminal blocks shall be grouped depending on the circuit voltage. Different voltage groups of terminal blocks shall be segregated.

A minimum 100 mm clearance between two sets of terminal blocks shall be kept.

Terminals shall be adequately rated to carry the current of associated circuits. The minimum rating of the terminal block shall be 10A. Minimum of 20% spare terminal shall be provided. Terminal shall be numbered as per the wiring diagram.

EARTHING-

Copper earth bar of 40mm x 6mm shall be provided in the PCCs & MCCs for the entire length of the panel. The framework of the PCCs & MCCs shall be connected to this earth bar. Provision shall be made for connection from this earth bar to the main earthing bar coming from the earth pit on both side of the PCCs & MCCs.

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, & the clamp shall be ultimately bonded with the earth bar.

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.

NAME PLATE-

[A] A nameplate with the PCC / MCC designation in bold letters engraved on it shall be fixed at top of the central panel. Similarly a separate nameplate giving feeder details (ampere rating and feeder designation) shall be provided for each feeder module door.

[B] Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc. shall suitably be identified by providing stickers.

FUSE SWITCH UNITS-



The fuse switch units shall be 3-pole double break type heavy duty suitable for load break duty (AC 23), quick make and break action. Separate neutral link shall be provided in the switch. All fuse switch units shall be provided with hinged doors duly interlocked with operating mechanism so as to prevent opening of the door when the switch is in "ON" position and also prevent closing of the switch when the door is not properly secured. All contacts shall be silver-plated & all live parts shall be shrouded.

The incoming and outgoing terminals of switch shall be adequately sized to receive proper size of cables. High rupturing capacity (HRC) fuse links shall be provided with switch fuse units and shall be in accordance with IS-2208-1962 and having rupturing capacity of not less than 35 MVA at 415 volts. HRC fuse links shall be provided with visible indicators to show that they have operated. The switch fuse unit shall be manufactured in accordance with IS- 4047 -1967 as amended to date.

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 shall be so chosen that the fuse does not operate on starting of motors / equipment.

CONTACTORS-

The contactors 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 AC3 & 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.

Motor starter contactor shall be of the electromagnetic type rated for uninterrupted duty unless otherwise specified, and shall have silver plated copper contacts. Each motor starter contractor shall be with 2 NO and 2 NC auxiliary contacts.

Contacts shall be of double break, non-gravity, and non-welding type.

Minimum motor starting contactor rating shall be 16 Amps. For all motor feeders, the component ratings shall be as per the selection chart attached with this specification.

VOLTMETER-

Voltmeters shall comply with BS-90. The dial of the meters shall be square in shape of 9.6x9.6 cm or 14.4x14.4 sizes. The voltmeters shall be moving iron type, flush pattern, with dust and moisture proof enclosure.



The voltmeter selector switch shall be arranged to provide line-to-line voltage reading and line to neutral voltage reading.

AMMETER-

Ammeter shall comply with BS-89. The dial of the ammeter shall be square in 9.6 x 9.6 cm or 14.4 x 14.4 cm size. The Ammeter shall be moving iron type, flush pattern with dust and moisture proof enclosure. The range of the Ammeter shall be in accordance to 1.5 times the feeder full load current. Separate current transformer shall be provided for all Ammeters.

[1] PUSHBUTTONS-

The push button unit shall comprise of the contact element, a fixing holder, and a 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 standard type and color as per its usage for ON, OFF and TRIP.

[2] INDICATING LAMPS-

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

Color shade for the indicating lamps shall be as below-

ON indicating lamp	-	GREEN
OFF indicating lamp	-	RED TRIP
indicating lamp	-	AMBER
PHASE indicating lamp	-	RED, YELLOW, BLUE

CONSTRUCTION-

- [A] The control panel shall be made of 16 G cold rolled sheet steel.
- [B] The capacitor bank, if located in the control panel, shall be segregated from the other control equipments/accessories.
- [C] The control panel shall be free standing floor-mounted type.
- [D] The control panel shall be indoor type. It shall be dust and vermin proof with a degree of protection of at least IP4X.
- [E] Control panel shall be provided with hinged door with neoprene gaskets all around.
- [F] The panel shall be provided with removable gland plate at the bottom.
- [G] The control panel shall be epoxy coated/ Powder Coated.
- [H] Two earthing terminals of adequate size shall be provided on the sides of the cubicle to connect Purchaser's earthing conductor.



INSPECTION AND TESTING-

- [A] Tests and inspection shall be carried out in accordance with relevant standards of latest edition.
- [B] Contractor shall be furnishing all Type of Test Certificates during the supply.

PROFORMA FOR MOTOR TESTING-

- | | | | | |
|----|---------------------|---|--------------------------|---|
| A. | Nameplate's details | - | Voltage HP
Frame size | KW. Mounting
Current (Rpm)
makes, Sr.No.

Others. |
|----|---------------------|---|--------------------------|---|
- B. Insulation test (before cable connection)
1. between phase and earth -Mega ohms
 2. between each phase -Mega ohms.
- C. Insulation test (after cable connection)
1. between phase and earth -Mega ohms
 2. between each phase Mega ohms.
- D. No load current.
- | | |
|---------|-------|
| R phase | Amps. |
| Y phase | Amps. |
| B phase | Amps. |
- E. Full load current.
- | | |
|---------|-------|
| R phase | Amps. |
| Y phase | Amps. |
| B phase | Amps. |
- F. Temperature rise after 3 Hours running.
- On no load Deg. cent.
- On full load Deg. cent



Ambient temperature during test Deg. cent.

G. Operation of thermal overloadrelays.

i. At normal FL current of motor.

ii. At twice FL current of motor.

Trip in seconds.

[The Consultant / Consultants representative and the contractor in duplicate shall jointly sign this Performa.]



PLC SPECIFICATIONS

PLC HARDWARE SPECIFICATIONS	
Sr No	Description
1.	General
1.1	The Control panel with PLC processor & IO modules will be installed at different location as per requirement
1.2	Power Supply Voltage: Single phase 230VAC supply will be provided for PLC processor panel,
1.3	Internal power supply modules Internal Powersupply module (Which is in the Scope of Supply of Bidder) shall be of ample capacity to supply all modules in a panel. The I/O's shall be distributed in Rittal panels and each shall have 2 no. of SMPS Power Supply of 24V DC, 20 A (Ampere rating to be confirmed by the bidder) load sharing type connected in a redundant manner.
1.4	In addition 20% spare capacity for each panel for future expansion shall be provided. All the loads shall be switched ON/OFF through 24V DC coupling relays to be provided in panels. The exact 24V DC power supply scheme shall be as approved by the engineer in charge during detailed Engineering stage.
1.5	Ambient temperature:
	The system hardware shall work in the temperature range up to 55 ° C Relative Humidity: Up to 95%
2.	FUNCTIONAL SPECIFICATIONS FOR PLC:
2.1	I/O summary are to be develop by the bidder for ventilation fan , jet fans Share for approval with considering 20 % spare



2.2	Spare Slots: The Controls system panel shall each have 25% spare slots to take care of future expansions. Prior to execution of job, the bidder shall discuss the configuration of the racks for the modules and the wiring of all slots in consultation with the Purchaser before submitting final GA drawing for approval.
2.3	The front side of the system panel shall house the CPUs, I/O Modules and Power Supplies. Field terminations shall be done on the front side of the panel. All the backplanes housing the I/O terminations shall be connected through solid cabling and connectors. The communication failure in PLC & SCADA software should not cause any disturbance in process control system, however, data interruption or updating on SCADA display terminal is acceptable.
3.	Central Processing Unit (CPU):
3.1	Make and Model number to be specified here
3.2	Processor Family:
A	CPU shall be a Power processor of the latest category. The bidder shall mention the processor family type.
B	There shall be two processors working in Primary and redundant manner.
C	There must be exact tracking of control, logic and sequence databases amongst the two processors.
D	In case of failure of primary CPU, the transfer of control to the secondary CPU should be bump less and an alarm/indication should be generated.
E	All modules (except processor and power supply modules) are hot-swappable separately, i.e. each of them can be inserted and removed alone while powered up. There must be a locating device for the modules, and automatic checking of conformity with the system software configuration to ensure that errors are avoided during module replacement.



	All modules have a display block for identifying module and channel faults: input, output, bus device, axis, etc. These diagnostics are performed without using any special tools. The modules are fully configurable by setting parameters in the development and runtime software. The parameters are stored in the PLC application and are automatically reloaded by the CPU if a module is exchanged.
F	In case of primary CPU failure, the new CPU must take up application execution from precisely the same point as original processor. The primary and secondary controllers should continuously monitor communications to the external nodes and local I/Os.
3.3	CPU loading The loading of the CPU should be only 60% of its total capacity.
3.4	Changeover to secondary processor must take place in case of • Failure of Internal healthchecks • Removal of primary processor • In case of observance of fault in internal / external communications • Manual request by a user • Dual power supply connection to the set of Primary and secondary processors shall be ensured. In the event of a single power supply failure, both processors are still supplied allowing uninterrupted redundant processor operation
3.5	Real time Clock:
a	The processor shall have a real time clock. A NTP server must be provided within the CPU. Each processor should have a savable real-time clock which manages: • The current date and time • The date and time of the last application shutdown
b	The PLC time should be synchronized automatically with the Server Operator Stations and Fast data Acquisition System time available in the network to ensure correct timestamping applications such as Alarms
3.6	Sampling times: For all I/O modules
	For Digital signals: 10 msec. or better



3.7	Memory:
A	System program: E ² PROM type preferably
b	User's program: The memory should be enough to run more than 2000 function blocks simultaneously or 16 MB. Additional memory cartridge of up to 4 Go capacity can be added
c	The system must be compliant with IEC – 62443 standard The system MUST be Achilles level 2 certified The system must have passed successfully the CSPN test The system must have passed successfully the CitSec test The system must be able to secure communication between PLC and engineering workstation providing authentication and integrity of data The system must be able to secure communication between PLC and SCADA providing authentication and integrity of data The system must be able to log any PAC security events into any SYSLOG database The internal firmware of the CPU must be digitally signed and encrypted The integrity of the firmware must be checked before any application download and at start up of the system
3.8	Communication:
A	PLC processor panel & PLC I/O Modules will be in the substation. CAT-6 A cable laid from control panel to network switch, max length for CAT-6 cable to be limit to 80 mtrs. 6 core fibre optic Arm. Cable shall be routed through HDPE DWC conduit
	PLC shall have suitable standard high speed Ethernet control network, communication bus interfaces for peer communication to Server. Changes in the PLC program shall be possible without interrupting SCADA communication. The communication between CPU and Server shall be Ethernet.



b	Bidder shall specify the speed of communication between remote I/O bins and CPU pairs. Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 30% spare capacity shall be available for each panel for future expansion.
c	The database shall be coherent. The data at any node shall be accessible to data at any other networked element allowing complete flexibility in strategy interconnection. The data at control nodes shall be accessible seamlessly to all configuration and operator stations.
4.	Input (I/P) & Output (O/P) module Specifications:
a	General requirements Digital Inputs as non-changeover /change over type of contact, 24 V DC output signals for energizing interface relays, etc. are to be provided by the Bidder. In addition, 20% spare capacity space for future shall be provided. All modules shall be individually enclosed in rugged industrial enclosures housed in free-standing panels/racks. These Input/ Output modules shall meet the technical requirements as mentioned in the above clauses. The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.
b	All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply.
c	Further these I/O modules shall be designed to work under the environment expected to be encountered in assigned areas without any air-conditioning support.
d	All modules shall be hot swappable.
4.1	Digital Inputs
a	Make and Model number to be specified here
	These are required for sensing DC proximity switches, push buttons, limit and selector-switches from panel. The Input circuitry must have Input filtering circuit to eliminate the effect of voltage transients caused by contact bounces



b	and/or electrical noise. Each Input should have LED indicator to indicate healthy and faulty state of operation.
c	Maximum no of digital inputs per DI module should not exceed 16 -32 inputs per module
d	Input voltage: Biasing supply voltage shall be 24V DC
e	Input voltage range for Digital State 1: > 10V to 30 V
f	Input voltage range for Digital State 0: < 5 V
g	Input impedance: 6000 Ohm or higher
h	Response time: ≤10ms
i	Indication: LED for status of each Input
j	System Isolation: Preferably 250V AC between inputs and PLC.
k	Module type: Hot-Swappable
l	Ambient Temperature for operation: up to 60 ° C
m	Max Relative humidity for operation: 95% without condensation
4.2	Digital Outputs:
a	Make and Model number to be specified here
b	The digital O/P modules shall be of Relay type. The modules shall have LED for status indication.
c	Maximum number of digital outputs per module should not exceed 16-32 digital outputs per module
d	Digital output type: Relay type with contact rating: 1A /channel or better
e	Indication: LED for status of each O/P



f	System Isolation: 250V AC (RMS) between outputs and PLC Bidder shall provide the necessary details
g	Response Time: Better than 10 msec.
h	Module type: Hot-Swappable
i	Ambient Temperature for operation: up to 60 ° C
j	Maximum no of digital inputs per DI module should not exceed 16 -32 inputs per module
k	Input voltage: Biasing supply voltage shall be 24V DC

Table 4: SOFTWARE FEATURES

Sr.No	Description
1	PLC programming software:
1.1	An industry standard Windows graphical configuration Package shall be used to configure the processor in a choice of IEC 61131-3 configuration languages.
1.2	It should integrate, configure & set the I/O Parameters & control them in real time when PLC is connected to the process. The engineering software must be able to do a complete or partial import/export of the project in XML.
1.3	The instrument programming must support Functional blocks, Instruction lists, Structural text, Sequential Charts & Ladder type of programming tools as per IEC 61131-3.
1.4	A wide selection of function block libraries shall be available to provide different mathematical calculation, control algorithms, alarms, and other blocks required for the advanced control. Mathematical functions and trigonometric functions shall be available for application in control programs.
1.5	The engineering software must allow user to open, build and save a project which was designed in a previous version (multiple project versions compatibility inside the same software tool).



1.6	It should have standard control modules for PID, Boilerdrum level control, motors, valves, etc.
1.7	The required function blocks are placed on a graphical work sheet and the I/O simply needs parameterizing.
1.8	Relay Ladder editors provide combinational logic and sequencing while Sequence Function Charts can program more advanced sequencing.
1.9	The engineering software must include a built-in controller logic simulator for testing and debug purposes.

Table 5: SOFTWARE FEATURES

Sr.No	Description
1.10	On line configuration: Modifications like add/deleting function blocks and logical connections in the running process strategy shall be possible. Before finalizing the strategy, suitability to the process shall be confirmed.
1.11	The engineering software provides a set of data relative to input and outputs, modules, devices, system data and status without any additional programming.
1.12	Changes in the PLC program should be possible
1.13	The system should have on-line monitor & on line configuration facility to enable users to view and interact with control and sequence strategies running in remote instruments.
1.14	With the database monitor and the necessary security clearance, remote instrument databases shall be accessed and blocks shall be modified on screen.
1.15	The on-line monitoring facility should be available to allow users to observe databases and function blocks for commissioning and fault finding purposes.
1.16	The configuration software shall be in the form of software blocks. It shall be capable of acquiring and control data received from various sensors and instruments via Analog and Digital I/O boards, serial port etc. Easy integration of additional instruments shall be possible.



PLC OPERATIONAL LOGIC FOR JET & AXIAL FAN PANEL

The PLC panel can be operated in 2 main modes of operation

- 1) AutoMode
- 2) ManualMode

1. AUTOMODE:

This mode works only when the PLC Auto / Manual selector switch is in Auto. In Auto Mode the panel works on the programmed Programmable Logic Controller (PLC) and there are further 3 modes of operation

Modes	Description	Fan Operation Schedule
Normal mode OR Cyclic Mode	CO level below 30ppm	In half an hour all jet fan in Low Speed + All FA fans + EA fans of Normal mode only shall run for 5 mints
Pollution mode	When CO level increases above 30ppm	Jet fan associated with the CO sensor which has detected Co level above 30 ppm runs in Low speed + All FA fans + EA fans of Normal mode only till the ppm level goes below 30 ppm
Emergency mode	When we received signal from Fire alarm/FFTG	All jet fan in high speed + All FA fans + EA fans of Normal & Fire mode shall run till the fire signal is active

Normal Mode: In case the CO sensors have not sensed any rise in the CO levels for Half an hour (time can be changed) then the fans shall run for 5 mints (time can be changed) as per the table above. This mode can also be called as Cyclic mode.

Pollution Mode: In this mode the operation will be controlled by CO Sensors connected to that particular zone. These CO Sensors are connected to the PLC to activate the particular zone fans. These fans shall keep running in Low speed till the CO ppm levels reduces and goes below 30 ppm

Emergency Mode: is when the PLC panel receives signal from firefighting system. In this mode all the JET fans shall run on High Speed. The Fire signal is a high priority signal which will overwrite all the modes in which the panel is operating. After the fire signal becomes inactive the fans will stop running in fast speed and panel will operate in the mode in which it was previously operating.

One Non-Potential Contact Normally open which shall close in case of fire in Emergency Mode shall be provided which shall be hooked up with the Exhaust air fans.

2. MANUALMODE

Operation will be always in Auto mode. Manual mode is only for maintenance purpose only.



8.0 LIST OF APPROVED MAKES

Item Description	List of Approved Makes (These are preferred list of Make. Client may select any one or combination as per the project requirement & contractor is bound to supply the same)
VARIABLE REFRIGERANT SYSTEM	Daikin/Bluestar/Mitsubishi Electric/Toshiba/Carrier/Hitachi /Mitsubishi heavy
Drain Pipe & Fittings	Astral/ Ashirwad/ Supreme/Finolex/Prince/ HULIOT
Controls	Johnson / Honey Well / Siemens / Sauter Race / AZBIL
Air Handling Units	Zeco / Citizen/ Edgetech/Daikin / SystemAir/ Stulz
Heat Recovery Units	DRI /ASTBERG/ Citizen/ ZECO / Edgetech/Daikin / SystemAir/ Stulz
Air washer	DRI/ HMX/ Roots Cooling / Zeco /Edgetech / Citizen/ Royal Aircon
Pre/fine/ filters	Frudenburg/Dyna/Camfill/Spectrum/AAF /Airtech/Mechmark/Greencon
Air handling unit fan	Nicotra / Kruger / Punker/Zeil-al Bag / EBM.
Precision unit	Vertive/Schneider Electric /Stulz
Variable Air Volume Boxes	Trox / Carryaire/Cosmos
Grilles / Diffusers	Dynacraft / Cosmos / Flaktwoods/ Carryaire / Systemair/ Titus
Al. Aerofoil VCD	Dynacraft / Cosmos / Flaktwoods/ Carryaire / Citizen/ Systemair/ Ruskin
G. I. Aerofoil VCD	Dynacraft / Cosmos / Flaktwoods/ Carryaire / Citizen / Systemair/ Ruskin
Fire/smoke damper (UL Listed)	Trox / Ruskin / Systemair/Cosmos/Caryaire/Greenheck
Fusible link fire damper (UL Listed)	Trox / Ruskin / Systemair/Cosmos/Caryaire/Greenheck
Louvers (Intek/exhaust)	Systemair/Caryaire/Fairflow/cosmos/ Ruskin
FACTORY FABRICATED DUCTS	Rolastar / Zeco / Daysun
G.I. Sheets	Sail / Nippon / National / Ispat / Jindal
COPPER TUBES	Rajco / Hariom metal /MEXFLOW
COPPER PIPE FITTING	>B< MaxiPro / Parker
ANCHOR FASTENER	Fischer / Hilti / Mupro
Supporting system	Mupro/Hilti/Fischer/Diamond hira
EC FANS	Nicotra / Kruger / Punker/Zeil-al Bag / EBM/Rosenberg Make
Tube/van axial fan	Kruger / Nicotra / Greenheck / System Air /Airflow/Humidin/Dynair/Elta
Jet fan	Systemair / Kruger / Wolter/ Flaktwood/ ELTA/MICO/Nicotra-Caryaire/Humidin/Airflow
Centrifugal Fan	Nicotra / Kruger / Wolter / Nadi/ Air-o-vent/



	ELTA/MICO/Humidin
Exhaust Air Units (Single Skin)	Flaktwoods/ Citizen /ZECO/ Suvidha Saiver / Ciat / Clivet / ELTA/ York / Nicotra
VFD	ABB / Danfoss / Siemens /Fuji
Smoke Spill Fan	Systemair / Kruger / Nicotra/ELTA/MICO/Humidin/Airflow
Propeller Fans	GEC / Marathon (Alstoon) / Khaitan/Airflow/Crompton/ELTA / Havelles
Cassette & mixed flow Inline Fans	Kruger/Systemair/Airflow/ELTA
Factory Fabricated ducting	Rolastar / Zeco / Ductofab / Daysun
Pre insulated duct	URSA/PAL/ASAWA/ZECO/TWIGA
Dry Scrubber	Rydaire/ Espaire/ MICO/ Trion / Citizen / Zeco / Edgetech
Fire Damper	Trox / Flaktwoods / Raskin / Systemair/ Cosmos/Caryaire
Volume Control Damper	Cosmos / Systemair / Citizen / Royal Aircon
BTU METER	Kamstrup / Sontay / Schenitech / Landis & Gyr / Dwyer/Siemens/ Schneider / AZBIL
Closed cell Nitrile rubber/EPDM	ALP Aeroflex/Armaflex/Aerocell/INNER flex
Open cell Nitrile rubber	Armaflex/ ALP Aeroflex/ INSOUND
Closed cell Nitrile rubber with Antimicrobial	ALP Aeroflex/Armaflex/Aerocell/INNER flex
Resin Bonded Slab/Mattresses	Roxul / INROCK / Rockwool / Inner
Adhesive	Pidilite / ALP Aerostick / INBOND/INNER
Self-adhesive tape	3M / INSEAL / Inner/Abro
Spun bonded olefin (HDPE-Covering layer)	INNER/ 3M/ INFIX PROTECK
Glass Cloth	INFIX GC/INNER/Pidilite
MOTORS	ABB/ Crompton / Siemens
POWER CABLES	ICC/CCI/Gloster/Finolex/ Ploycab
CONTROL CABLES	ICC/CCI/Gloster/Finolex/ Ploycab
CIRCUIT BREAKERS	Siemens/English-E. /L&T/C & S
SWITCHES	Siemens/ English-E. /L&T/C & S
STARTERS / CONTRACTOR	Siemens / L&T / T. C.
PUSH BUTTONS	Siemens / Tecnic / L&T
OVERLOAD RELAY	Siemens / Tecnic / L&T
VOLTMETER / AMMETER	A/E – Imp/ Enercon / Rishabh
MCB	Hager / MDS
MCCB	L & T / Lingrant / ABB / C & S
SIGNAL, COMMUNICATION, LOCAL AREA NETWORK CABLES	Fine Core / CCI
G.I. Threaded Rods	Hi tech / Rolastar / Mupro/Hilti/ fisher.
Insulation / Adhesives / Accessories	
CLOSED CELL CROSS LINK POLYTHENE	Armaflex / ALP
EPDM NITRILE RUBBER INSULATION	Armaflex/ ALP



Acoustic Insulation for Duct & AHU room	Armaflex / ALP
Rockwool slab Acoustic insulation	Rockseal/Inrock/Twiga
Self-Adhesive Nitrile Tap	3M/Armaflex/Hira / Inseal / Paramount.
XPS	Supreme(Petrocam)/ Owens Corning /Ovencurning/ Inner Engg. / Insulpro.
PLANTROOM WALL INSULATION	Roxul / Rockwool /INROCK / Insulpro.
OVERDECK/UNDERDECK INSULATION	SUPREME/INSU BOARD / Styrofoam/ Insulpro.
Adhesive for Duct Insulation	Armacell 520/ Pedilite SR 998/ INNER/INBOND
Adhesive for Pipe Insulation	Armacell / Pedilite/ Polygrip/Hira/ Paramount.
FLEXIBLE PIPE	Armaflex / Aeroflex / Dunlop / Resistoflex / Kanwal/INFLEX/INNER
ADHESIVE FOR PIPE	Armaflex 520/Pedilite SR 998/ INNER/INBOND
ANCHOR FASTENER	Fischer / Hilti/INNER
Anti-Vibration Mounting & Flexible Connections	Cori / Dunlop / Easyflex / Flexionics / Resistoflex/INNER
Fire Sealant	BTMH Engineering / Birla 3 M / Hilti/ Promat
Paint	Asian Paints / Berger / Nerolac
Welding electrodes	Advani / Maruti / Cosmos
Mechanical Seal	Burgmann / Sealol
Anti-Corrosive Bitumastic Paint	Asian Paints / Berger / Nerolac/J&N
Epoxy Paint	Asian Paints / Berger / Nerolac/J&N
C.I. /S&S Double flanged fittings	Kartar / National / Kesoram / Sant.
Pipe Clamp & Support	Chilly / Euroclamp / Mupro/ Diamond walraven /fisher/Hilti
Passive Fire Protection	Hilti / Promat/ 3M /INNER
M.S Sheet	Jindal / Nippon / National / Ispat
Modular Supporting system	Chilly / Euroclamp/INNER(INTEK)



TECHNICAL SPECIFICATIONS OF IP BASED CCTV SYSTEM TROPICANA GARDEN

A) DESCRIPTION IN GENERAL

The IP based CCTV system is proposed for all the floors of Tropicana Garden.

The purpose of CCTV system is to monitor & supervise the entire area for security purposes, as well as the record and inform officials on unwanted, untoward incidents. It is also essential to have recorded images to be stored at least for 30 days of all critical area's to facilitate investigations of a reported case.

The Hardware required for the System including servers, workstations, monitors, cables, connectors, conduits, power supplies etc. will be in vendor's scope.

If required Further, the CCTV system shall be seamlessly integrated with the IBMS system for Direct interface with other security systems such as the Access Control Systems.

This shall be achieved either by offering a unified database for the IBMS, or by suitable middleware solution to enable the seamless transfer of data between disparate systems.

It is expected that the Bidder provides a system configuration wherein Main Directory shall be loaded on one of the Primary Server hardware provided.

It is expected that the Bidder provides a system configuration wherein Main Directory shall be loaded on Server hardware provided.

Strategically placed video surveillance cameras shall enhance security by providing continuous monitoring of all parts of the premises.

- A. All equipment and materials used shall be standard components that are regularly manufactured and used in the system.
- B. All systems and components shall have been thoroughly tested and proven in actual use.

B) APPLICABLE STANDARDS

Original Equipment Manufacturer Standard

C) APPROVALS

All the cameras should be

- A. CE Compliant
- B. UL Listed
- C. FCCB Approved

D) AREAS TO BE COVERED BY CCTV SYSTEM

1. All Entry & Exit points, strategic Locations & corridors of Mall , parking & Office Areas.

E) SPECIFIC REQUIREMENTS:-

- All the vendors must attach the point by point compliance for below specification in their technical bid. **Offers without the compliance will not be considered.**
- The product described in this specification is (IP) based Network Video Management (NVR) System.
- The proposed solution shall not require proprietary computer, server, network or storage hardware.



- The proposed system shall be of a manufacturer with as minimum of five (5) years of experience and offerings in the IP network video software market, the letter stating the same should be submitted by the manufacturer.
- The NVR database and video storage shall be based on Inbuilt recording with sufficient number of HDD slots with RAID compatibility if required for recording on motion based / continuous based or better
 - a) Failover directory should be a basic feature of the NVR all the related licenses should be included in offer.
 - b) Failover recording capabilities shall be a basic feature of the NVR and should be included in offer.
 - c) Redundant recording capabilities shall be a basic feature of the NVR and should be provided if required.
- The NVR system shall be based on the latest in software programming technology Microsoft .NET frame work or better.
- The NVR approved IP cameras except PTZ shall provide the ability to be powered by power over Ethernet (PoE) 802.3af option. PTZs shall be powered by Redundant mode Solid State Power Supplies, which shall have inline filters and surge protection circuitry to enable safe operable power to the Cameras.
- The NVR shall be able to support all cameras at the up to 25 frames and full resolution as per camera specifications.
- The NVR should support any of the following Video Analytics Features for selected outdoor cameras.
 - a) Trip wire detection
 - b) Loitering detection
 - c) Stolen object detection
 - d) Object left detection
 - e) Synchronous PTZ tracking (Handshake between fixed and PTZ)
 - f) Operator selected object tracking
- The NVR video storage shall be capable of storing video for a period of 15 days at D1 resolution.
- The NVR Storage solution shall be as minimum set at RAID-5 configuration
 - a) Storage system shall be of Direct Attached Storage (DAS) systems Network Attached Storage (NAS) systems and / or Storage Area Network (SAN) Systems.
- The NVR shall be based on high quality Dual MPEG-4/H.264 IP cameras. JPEG, MJPEG, Wavelet, or any other image based video compression will not be considered as approved equal due to the high network bandwidth associated with these types of digital video compression.
- Each Camera shall provide dual video streaming technology providing independent settings per stream.
 - a) A viewing stream of up to 25 fps and 720p video resolution and a recording stream of up to 25fps and upto 720p video resolution as per clinet / consultants Briefing on the same.
 - b) The system shall be flexible and allow bandwidth selection between 64Kb to 4Mb per stream.
 - c) When both the viewing stream and the recording stream are set at the same



FPS and resolution the camera shall send on the network a single multicast stream this shall help reduce network bandwidth.

- The NVR shall have a capacity to switch and control all the current cameras. It should be expandable to unlimited cameras in future.
- The system shall allow the recording, live monitoring, playback of archived video audio, and data simultaneously.
- The NVR shall provide file export tool for export the native video format with all video protections (e.g. watermark, encryption) and the ability to play this video on a standard computer.
- The native file format video player shall show the status of the video authentication as available with the original file format.
- The IP Based NVR shall provide file export tool for export of single frames of video in J-PEG and BMP file formats and for export of motion video files in AVI file format for transport and playback on computers utilizing a Windows environment.
- The Client shall provide the required computers for the NVR client and servers, these computers shall be of the most current state of the art technology available at the time of installation and as minimum shall be better than the minimum requirements specified by NVR system manufacturer as well as tender specifications.

F) Network Video Recorder shall have below mentioned capabilities:

- a) **Video Streaming: NVR** shall relay the real-time streaming to the VMS CLIENT (IF REQUIRED)
- b) **Recording:** NVR shall store the real-time streaming for a certain period of time when it receives the storage command from Trigger Service.
 - a. Each individual camera can be set at different preset recording frame rate. Camera recording frame rate will be changed to full frame rate upon motion detection or other alarm information (according to configuration). Frame rate change interval (from alarm received to recording frame rate change) shall be less than 1second.
- c) **Video playback and download:** NVR shall allow the user to playback and download video records from NVR-Client. It shall also allow the user to configure the storage locations.
- d) **Pre-alarm Recording:** NVR shall be capable to cache the real-time streaming for a certain time (no longer than 10 minutes). When there is an event or alarm triggering recording, prerecording can help trace the situation before the event or alarm occurs.
- e) **Re-Linking:** NVR shall re-link to disconnected front-end devices. The following two conditions can result in re-linking:
 - a. If the NVR fails to link with the front-end device for the first time, it will try to re-link with the front-end devices repeatedly; the maximum interval is 30 seconds for each try.
 - b. When the NVR succeeds in linking with the front-end devices and is recording or relaying the streaming, if the bit rate from the device remains as "0", it will start the re- linking operation.



- f) **Overwriting:** NVR shall be capable to cycle overwrite video records. NVR supports the cycle overwrite in the following two situations:
- Delete the videos older than N days regularly. If the disk can store the videos for N days, at which point the NVR deletes video files older than N days according to the required video storage space after a certain capacity is filled.
 - Delete the oldest videos when the disk capacity is full.
- g) **Device Status Monitoring:** NVR allows the user to monitor the running status of NVR via GUI. The following health statuses need to be monitored: system overload (CPU, Network), storage getting full, hard disk error, data accumulation to an unstable level, temperature too high, power supply failure and fan failure.
- Health status abnormal shall be able to be reported out to VMS CLIENT (IF REQUIRED)-as alarm information.
 - User shall be able to configure which alarm to be received The following status shall be provided:
 - Total connected device number
 - Working device number
 - Receive BPS(KB/S)
 - Relay device number
 - Relay BPS(KB/S)
 - Storage device
 - Storage BPS(KB/S)
 - Historical Relay number
 - Historical Relay BPS(KB/S)
 - Storage locations
 - All space(MB)
 - Remain space(MB)
- h) **Remote Upgrade:** NVR shall be able to be upgraded without sending device back to factory. It shall be remotely upgraded from VMS CLIENT (IF REQUIRED).

J) HARDWARE COMPLIANCE

• FOR ALL TYPES OF CAMERAS

Certification	CE, FCC and UL
Compression	H.264 (Main/High) and MJPEG
Protocol	Open ended / ONVIF Profile S and G / PSIA and CGI / Third party management platform
Protocols Support	RTSP, HTTP, Multicast, Unicast, FTP, NTP, DHCP, TCP, SMTP, SNMP,
	IPV4/IPV6, SNTp, SNMP, Telnet
Scan	Progressive
Physical IR Filter	Should be available
Setup parameters	Web server based remote camera video and network setup
Minimum Illumination	.1 lux @ 30 IRE
Alarm Inputs/Outputs	2 in/1 out, 1 in/1 out for fixed and PTZ



Streaming	VBR mode / Live Stream at full frame rate at the chosen resolution independently configurable) / Recording Stream at full frame rate at the chosen resolution (independently configurable) / Ability to set the bit rate and fps independently
Alarm Trigger	Any software alarm and external input
Operating Temperature	(-)10°C ~ 50°C
Operating Humidity	20% ~ 80% (non-condensing)
Security	Security password protection, HTTPS (SSL, TLS), IP filtering, IEEE 802.1X

• **IP BASED INDOOR FIXED DOME CAMERAS**

IP Based Dome Cameras shall have following feature:

2MP, Full HD, 1/2.8 type CMOS image sensor, Fixed Lens: 2.8 mm / 3.6 mm, H.265 / H.264 & MJPEG triple-stream encoding, 25/30fps@1080P (1920 ×1080), Max IR LEDs length 30 m, IP66 rated.

Power	PoE / SMPS Power Supply
Video Format	PAL
Image Device	CCD/CMOS
Iris Control	DC Iris/IP Iris
Electric Shutter	Automatic with manual override
WDR	>90dB, Signal-to-noise ratio > 50 dB, White Balance
Edge Analytics	Details to be shared
Edge Storage	Details to be shared

• **IP BASED INDOOR VARI FOCAL DOME CAMERAS**

IP Based Dome Cameras shall have following feature:

2MP, Full HD, 1/2.8 type CMOS image sensor, Vari Focal: 2.8 mm - 12 mm, H.265 / H.264 & MJPEG triple-stream encoding, 25/30fps@1080P (1920 ×1080), Max IR LEDs length 30 m, IP66 rated, Optical Zoom- 4.4X Dome Camera.

Power	PoE / SMPS Power Supply
Video Format	PAL
Image Device	CCD/CMOS
Iris Control	DC Iris/IP Iris
Electric Shutter	Automatic with manual override
WDR	>90dB, Signal-to-noise ratio > 50 dB, White Balance
Edge Analytics	Details to be shared
Edge Storage	Details to be shared

• **IP BASED OUTDOOR BULLET CAMERAS**

IP Based Outdoor Bullet Cameras shall have following feature:

2MP, Full HD, 1/2.8 type CMOS image sensor, Vari Focal: 9 mm to 22 mm, H.265 / H.264 & MJPEG triple-stream encoding, Max. IR LEDs length 30 m, IP66 rated, 25/30fps@1080P (1920 ×1080), Support ICR for day time and night time operation, Zoom ratio :2.4x Optical (Motorized zoom/ Motorized focus)



Power	PoE / SMPS Power Supply
Video Format	PAL
Image Device	CCD/CMOS
Lens Mount (Box)	CS Mount
Iris Control	DC Iris/IP Iris
Electric Shutter	Automatic with manual override
WDR	>90dB, Signal-to-noise ratio > 50 dB, White Balance
Ingress and Impact Protection (Housing)	IP 66/NEMA 4

• **IP BASED OUTDOOR PTZ CAMERA**

IP Based Outdoor PTZ Cameras shall have following feature

2MP, Full HD, 1/2.8 type CMOS image sensor, H.265 / H.264 & MJPEG triple-stream encoding, 30x optical zoom, 50/60fps@1080P (1920 ×1080),IR distance up to 150 m ,IP66 rated.

Power	AC24V/DC12V
Video Format	PAL
Image Device	CCD/CMOS
Iris Control	DC Iris/IP Iris
Electric Shutter	Automatic with manual override
WDR	>90dB, Signal-to-noise ratio > 50 dB, White Balance
Housing	IP 66/NEMA 4
IR Cut Filter	Available
Individually Configurable	
Privacy Masks	At least 12
Presets	At least 100
Preset Speed	240°/sec Pan or better, 200°/sec Tilt or better
PAN Angle	Continuous 360 degree endless rotation
PAN Speed	0. 1°~160°/Sec
Tilt Angle	0° ~90°
Tilt Speed	0. 1°~120°/Sec
Preset Accuracy	(+/-)0.1°
Tour	At least 2 and also auto track

• **NETWORK VIDEO RECORDER (NVR)**

32 / 64 /128 CHANNEL, 1080p NVR with HDD for RECORDING; 32 / 64 / 128 CH@1080p MANUAL/ MOTION/ TIMER 10/100 BASE ETHERNET USB BACK UP IR REMOTE complete as required and mentioned in tender specifications.

- Dual-OS design to ensure high reliability of system running
- ANR technology to enhance the storage reliability when the network is disconnected
- HDD hot swap with RAID0, RAID1, RAID5 and RAID10 storage scheme configurable
- Minimum Up to 8 SATA interfaces and 1 eSATA interface connectable for recording and backup
- Instant playback for assigned channel during multi-channel display mode
- Smart search for the selected area in the video; and smart playback to improve the playback efficiency
- Storage space effectively saved by 50% to 70% with the use of H.264+ decoding format



- 2 self-adaptive 10M/100M/1000M network interfaces, and two working modes are configurable; multi-address and network fault tolerance
- HDMI1/VGA1 and HDMI2/VGA2 outputs provided
- Recording at up to 12 MP resolution

- **INDUSTRIAL GRADE LCD MONITOR**

32" LCD Monitor to view min 32 cameras.

Power	AC220 Volt
Video Format	NTCS / PAL
Resolution	Min 1920 X 1080
Audio	2 X 2 Watt Speaker System
Inputs	VGA / HDMI / USB etc.

- **NETWORK SWITCHES**

- All network equipment shall be HP, Nortel, Cisco as per approved make.
- All networking equipment shall be as minimum of Layer-2 and as a minimum shall support IGMP Snooping Version 2 or later. It should have minimum two 1000baseT copper ports and minimum two slots for 1000baseT fiber modules.
- The IP network shall support Multicasting between all ports and shall allow for Multicast streams to be routed between networks
- All the edge switches should be minimum Layer-2. All Layer-2 switches must finally be brought together using 1000baseT ports to central Layer-3 switch. Connection to the servers and clients must be 1000baseT from 10/100/1000baseT ports. Connection between Layer-2 and Layer-3 switch should use fiber backbone.
- Uplink port should have sufficient speed to avoid network congestion, preferably network should not be loaded more than 70% at any stage.

- **CORE NETWORK SWITCH:**

Power Specification	200-240V, 50-60 Hz
Operating temperature range	0 to 45 at sea level
# of ports with 1 Gbps	
SFP Interfaces	30
# of ports with 1 Gbps	
Copper UTP6 Interfaces	12 Minimum
Cabling	Sufficient cables for all SFP and copper ports
(5 m each)	
Chassis Based	Yes
Required Modules	Supervisor
Supervisor Units	2
Hot Swappable	Yes
Redundant Supervisor	Yes
Supervisor Load Distribution	Yes
Redundant Power Supply	2
Hot Swappable	Yes
L4 Support	Yes
L3 Support	Yes
L2 Support	Yes
IGMP Snooping and Filtering	Yes
SMLT, R-SMLT, MLT	Yes
OSPF, RIPv1, RIPv2, PIM Stub	Yes
Empty Slots After Pluggable Modules	5
Redundant Fan Modules	Yes



Hot Swappable I/O Fabric	2	Yes
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MODULE SUPPORT

40 Gb support		Yes
10 Gb support		Yes
1 Gb Support	Yes	
Min 10 G Port support		128
Min Backplane Throughput	4 Tbps	
Min Packet Throughput	2 Mbps	
Min MAC Support	128000	
IPv6 Support	Yes	
ACL Support L2/L3/L4	Yes	
IEEE 802.1D (STP) Support	Yes	
IEEE 802.1p (CoS)	Yes	
IEEE 802.1Q (VLANs)	Yes	
Min number of VLANs		4094
IEEE 802.1w (RSTP)	Yes	
IEEE 802.1x (Security)	Yes	
IEEE 802.3ad (Link Aggregation)	Yes	
IEEE 802.3x	Yes	
IEEE 802.3ab (1000BASE-T)	Yes	
IEEE 802.3ae (10G Ethernet)	Yes	
IEEE 802.3z (Gigabit Ethernet)		Yes
Layer-3 Redundant Connection	Yes	
VRRP or Equal for Redundancy		Yes
Stackable	Yes	
Single Virtual Chassis	Yes	
Stacking over 40 Gpbs		Yes
Port Aggregation on different chassis		Yes

REMOTE MANAGEMENT

Telnet	Yes
SSH	Yes
FTP	Yes
TFTP	Yes

• **CAT-6 24 PORT JACK PANEL**

Size	24 Port: 482.6mm X 44.3mm (1U)
Panel Material	Aluminum
Color markings	Black background with gray silk screened
Temperature	20 C to 60 C
Humidity	0-90% non-condensing

Key Features

Support 24 ports per 1U
Enhanced cable retention fixture.
Unique assembly fixture
Color coded wiring blocks, compatible with both T568A and T568B wiring options.
Backward compatible with Category 5e cabling standards
Supports solid 22-24 AWG wires and stranded 24-26 AWG



- **RACK MOUNT SLIDING LIU / SPLICE TRAY**

Dimensions	44 * 410 * 280 mm (H*W*D)
Material	Box - Powder Coated Aluminum alloy Spool - FR Grade ABS Cable grommets - FR Grade Nylon Splice Tray - Aluminum + ABS
Splice Tray Dimensions	140 x 125 x 10mm
Voltage rating	72 Vdc
Contact Resistance	15 ohm (max) per contact

- **SINGLE MODE DUPLEX ADAPTORS (COUPLERS)**

Insertion Loss	< 0.3 dB max
Durability (1000 Matings)	<0.2 dB max
Compatible Optical Fiber	9/125 µm, 50/ 125 µm, 62.5/125 µm
Material Ferrule	Phosphor Bronze (for MM), Zirconia
Operating Temperature	- 10°C to 60°C

- **SM FIBER PIGTAILS**

Outside Diameter (Simplex)	1.6mm x 3.0mm
Outside Diameter (Duplex)	1.6mm x 3.0mm
Minimum Cable Retention Strength 1.6mm:	11.24lbs (50 N)

- **6 CORE FIBER**

Type	6 Core 9/125 micron Fiber
Operating Temperature	10°C to 60°C
Storage Temperature	-40°C to 75°C
Crush Resistance	44 N/mm
Tensile Strength	2670N/mm
Nominal Diameter	15 mm
Cable Sheath Thickness	2 mm
Weight	250 Kg/km (approx.)

- **CAT-6 CABLE**

Outer Diameter	Nominal diameter 6.0 mm 4 twisted pair
Conductor diameter	0.573mm (AWG)
Conductor type	23 AWG bare annealed copper
Jacket material	PVC
Standard Color	Grey
Overall shield	Tined copper braiding
Characteristic Impedance	100±6 ohm@ 1-300 MHz
DC Resistance	72 ohm/km (max)
Voltage rating	72 Vdc max
Dielectric strength	1500 V/1 minute min MHz
Insulation Resistance	500 Mohm km(min) @500 Vdc
Velocity of Propagation (NVP)	69%

- **PVC Conduit**

Outer Diameter	Nominal diameter 20 mm
Thickness	2 mm
Conduit Type	Rigid
Material	PVC



Length
Approval

3 Meter
ISI Approved

Sr No	Description	Visual	Test Readings	Documentation
1	All cables are tested for continuity, insulation, resistance etc.		√	√
2	System installation proper as per drawing	√		
3	Carry out visual checks on all cameras, cables, camera housing etc., to ensure they are clean and free from any mechanical damage	√		
4	Check for proper termination & feruling	√		
5	Check input A/C supply voltage		√	
6	Check Input supply DC voltage at every camera		√	
7	Check all cameras' signal on monitor. Also check for clarity, sharpness of the picture.	√		
8	Check PTZ controls of PTZ camera	√		
9	Check recording / playback FRAME RATE	√	√	
10	Check server software & client software is installed without any bugs.	√		√
11	Set programming of all cameras through software.	√		√
12	Check remote viewing of cameras on internet/WAN	√		

K) DOCUMENTATION

The CCTV system contractor, upon completion of the commissioning activity, shall hand over the system to the customer.

At the time of hand over, the contractor shall provide the customer with the following documentation:

- 1 Copy of detailed report
- 2 Component and equipment list
- 3 Product description sheets
- 4 System design drawing(s)
- 5 System schematic diagram(s)
- 6 System operating manual

Signature of Bidder/JV Firm

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L) HANDOVER

Prior to final acceptance, the installing contractor shall provide complete operation and maintenance instruction manuals to the owner. All aspects of system operation and maintenance shall be detailed, including wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s), illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, maintenance operations and procedures shall be included in the manual.

M) TRAINING

General

The contractor shall provide the customer with details of the training required by personnel to operate and maintain the CCTV system.

The Contractor and the customer shall jointly agree the number of staff to attend the training courses.

N) MAINTENANCE

- Routine maintenance should be carried out in accordance with customer's requirements. All performance checks undertaken should be recorded in the system log book.
- As a minimum, the following performance checks must be undertaken on each maintenance visit.
- Remove dust and dirt from the camera enclosures (Inside & outside) exterior using a soft brush or a lint cloth. A solvent which is harmless to the finishes of metal and plastic may be applied to more stubborn stains.
- Examine the exterior of the enclosure for any signs of damage or loose cable glands and rectify any faults found.
- Remove any dust or dirt from the interior of the camera & DVR using a soft brush or a vacuum cleaner.
- Examine the printed circuit boards for signs of over heating, dry joints and/or damaged tracks



TECHNICAL SPECIFICATIONS FOR ADDRESSABLE AUTOMATIC FIRE ALARM SYSTEM –TROPICANA GARDEN

A .1 All areas will be covered by Fire Alarm System.

- B 1. The work shall be carried out as per tender specifications and in accordance with the followings:
- a) NFPA 72
 - b) BIS Code of practice (IS: 2189 – 1988) for Selection, Installation and Maintenance of Automatic Fire detection and Alarm system with amendments up to date.
 - c) NBC 2016
 - d) Local Fire Authority having Jurisdiction

- B 2. The contractor shall carry out the work as per requirements of the CFO and Local body regulations as applicable.

B 3. BUILDING CONSTRUCTION AND DRAWINGS

- B 3.1 The Contractor shall prepare detailed working drawings in coordination with other Architectural and Services drawing and get these working drawings approved by the Engineer-in-charge.

- B 3.2 The approval of such drawings by the Engineer-in-charge shall be from the point of view of assisting the Contractor in Coordination of Services with other agencies and shall not absolve the contractor from his absolute and indivisible responsibility on performance and operation of his installation.

B 4. INSPECTION AND TESTING

- B 4.1 The contractor shall provide all necessary facilities for inspection of his equipment. In case of imported equipment's, the contractor shall furnish the routine and type test certificates to the satisfaction of Engineer-in- charge.

- B 4.2 All information, documents and tests as required by CFO and other local bodies and their final approval for this installation shall have to be arranged by the contractor. All expenditure arising out of inspections of CFO or Local body shall have to be borne by the contractor and the same shall not be reimbursed by the department.

- B 4.3 **Completion Plan:** Completion plan indicating the wiring layout, location of detectors, inventories & manuals as per Technical specification shall be provided by the contractor after completion of work and before payment of Final Bill.

GENERAL CONDITIONS FOR E&M WORKS (FIRE ALARM)

B 5. SCHEDULE OF REQUIREMENTS

- B 5.1 It is the intent of this specification to define a state-of-art integrated addressable Fire Alarm System, which is user friendly, modular, flexible and expandable. The system is to be designed, installed, customized, tested, commissioned and supported by a local office or agent of the manufacturer by Engineers skilled in providing functional and efficient solutions to the needs of the Engineer in charge.



- B 5.2 The Vendor shall have an in-place support facility in Ahmedabad or nearby equipped with Competent Support Staff, Spare Parts Inventory and all the necessary Test and Diagnostic Equipment to provide support within 24 hours of any breakdowns.
- B 5.3 The entire installation shall be in accordance with the requirements and stipulations of the Chief Fire Officer/Local Fire Officer and his office. In addition, it shall also be in accordance with the national and local electrical codes and the Underwriters Laboratories standards.
- B 5.4 All electronic equipment shall conform to the pertinent regulations governing radio frequency electromagnetic interference and should be so labelled.
- B 5.5 All system components and sub-systems are to be fault tolerant and provide satisfactory operation without damage at + 10% of the rated voltage and at + 3 Hz variation in line frequency.

B 6. TECHNICAL DATA

- B 6.1 The Tenderer shall submit comprehensive technical information for all the equipment and material. This must include but not necessarily be restricted to, all data as required under **"SCHEDULE OF TECHNICAL DATA"**
- B 6.2 Technical catalogues and performance Tables/ Curves of all equipment and machines must be submitted with the offer.
- B 6.3 Information given by the tenderer under chapter "SCHEDULE OF TECHNICAL DATA" is meant for general information only. In case of discrepancies between tender specifications and details given by the tenderer under chapter "SCHEDULE OF TECHNICAL DATA", the decision of Engineer-in-charge will be final and binding on Contractor unless departures are indicated by the Tenderer under chapter "SCHEUDLE OF DEPARTURE FROM SPECIFICATION" as mentioned here in after.

B 7. PERFORMANCE GUARANTEE AND TESTING

- B 7.1 The Contractor shall execute the work on the basis of indicative designs hereby given and accepted by him with or without modifications or new designs submitted by him at the tender stage and accepted by Engineer in charge, as the case may be. All Variations, i.e. additions, omissions or substitutions necessitated at any time for any reason whatsoever, shall be deemed to have been accepted by the Contractor as not vitiating the performance based nature of this contract. If any such variations, irrespective of whether such variations are intended to be executed by other agencies employed by the Engineer-in-charge, have any bearing on the performance of this Contract, the same shall immediately be brought to the notice of Engineer-in-charge by the Contractor in writing. In any case the Contractor shall have to guarantee for due and proper performance of the works agreed to be so erected.
- B 7.2 The Fire Detection and alarm System installation shall be designed and guaranteed to perform as indicted in other parts of these specifications and drawings read in conjunction with statutory requirements.
- B 7.3 All equipment shall be tested at manufacturer's Works as per latest relevant BIS specifications or in the absence of IS specification approved testing methods shall be followed and Test Certificates/ Reports submitted to the Engineer-in-charge. The contractor shall intimate in advance the probable date of such tests to the Engineer-in-charge to enable their representatives to witness the tests if they so desire. But under no



circumstances shall this absolve the Contractor of his responsibility for Performance of the Equipment or System.

- B 7.4 In addition to the above, all equipment and systems shall be tested after installation as required by various statutory authorities, certifying agencies and as required by various sections of these specifications.
- B 7.5 The Contractor shall take full responsibility for proper operation of the entire system including debugging and proper calibration of each component and sub-system.
- B 7.6 The Contractor shall leave necessary provisions required for fixing instruments, gauges, meters, etc. for testing the installation even if these are not shown on the drawings. The Contractor at his own cost shall arrange all such instruments, services etc. needed for the tests.
- B 7.7 It is the sole responsibility of Contractor to obtain all the necessary approvals from the statutory authorities, either prior to, during or after installation as required. All tests specified herein-after and witnessed/ approved by Engineer-in-charge, may be deemed to be invalid at the option of Engineer-in-charge, if the requisite, final and unconditional approvals from the concerned statutory authorities are not obtained by the Contractor.
- B 7.8 The Contractor shall intimate in writing to Engineer-in-charge as and when individual components of the installation are ready for tests required for further progress of erection. All such tests shall be carried out as per these specifications and/ or as directed by Engineer-in-charge and recorded in the presence of Engineer-in-charge or his authorized representatives.
- B 7.9 On completion of erection, the contractor shall thoroughly clean all the equipment, inspect and check the entire installation for correctness and completeness and furnish a detailed report on all components of the installation to Engineer-in-charge. The contractor shall also inspect and check the services required by him and provided by other agencies employed by the Engineer-in-charge and confirm the completeness and correctness of such services to the extent necessary.
- B 7.10 The Contractor shall intimate in writing to Engineer-in-charge, the proposed date of initial startup.
- B 7.11 The Contractor shall, on approval of Engineer-in-charge, proceed with necessary pre-commissioning activities and tests and put the installation initial operation and start-up during which preliminary adjustments and addressing shall be carried out.
- B 7.12 Based on preliminary observations during the initial operation described above, necessary modifications/ repairs/ replacements/ etc. if any shall be carried out by the Contractor to the entire satisfaction of Engineer-in-charge. On successful completion of initial operation, the Contractor shall proceed with trial runs.
- B 7.13 Notwithstanding approval of tests or equipment or materials by Engineer-in-charge etc., up to the tests in static state as described here-in above, the Contractor shall be required to perform site tests to prove correctness of ratings and performance of equipment and materials supplied and installed by him, in normal operating condition.
- B 7.14 All equipment shall be capable of performing the duties specified in these specifications without damage, distortion or failure of any component.



- B 7.15 Individually, the performance of various equipment's shall not be less than quoted ratings and consumption of power shall not exceed the ratings quoted by the tenderer, when tested in normal operating conditions. Otherwise the equipment / material is liable for rejection.
- B 7.16 All test instruments shall be calibrated for accuracy prior to taking the performance tests.
- B 7.17 Failing satisfactory performance of equipment and/ or overall installation after rectification etc. as stated above, the Engineer- in-Charge, at his sole discretion, reserves the option of charging liquidated damages for such non-performance or demand supply and installation of new installation all at no extra cost to Engineer-in-Charge or demand for full refund of all "On Account" payments made to the Contractor for that part of the work which has failed to perform, and the Contractor shall be obliged to do so as directed by the Engineer-in-Charge.

B 8. INSTALLATION:

- B 8.1 Installation shall be in accordance with the local and state codes, as shown on the drawings, and as recommended by the equipment manufacturer.
- B 8.2 All conduits, 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.
- B 8.3 All wiring shall be properly supported and run in a neat and workmanship like manner. All wiring exposed and in equipment rooms shall be parallel to or at right angles to the building structure. All wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals.
- B 8.4 The Contractor shall be responsible for all electrical installation required for a fully functional control system and not shown on the electrical plans or required by the electrical specifications.
- B 8.5 All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted or surface mounted as per instructions of the Engineer-in-charge.
- B 8.6 Manual call boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed at a height of not less than 1,000 mm, and not more than 1200 mm above the finished floor level.
- B 8.7 The service of a competent, factory-trained engineer or technician authorised 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.
- B 8.8 At the final inspection, an authorized representative of the manufacturer of the major equipment's shall demonstrate that the system functions properly in every respect.

B. 9 DEMONSTRATION:

- B 9.1 The Contractor shall completely check out, calibrate and test all connected hardware and software to ensure that the system performs in accordance with the approved



specifications and sequences of operations submitted.

B 9.2 This demonstration shall consist of the following:

- a) Display and demonstrate each type of data entry to show site-specific customizing capability
- b) b) Demonstrate parameter changes.
- c) c) Demonstrate scan, update and alarm responsiveness.

B. 10 MANUALS

The following manuals will be provided at the time of Handing over:

B 10.1 An Operator's Manual shall contain graphic explanations of keyboard use for all operator functions specified under Operator Training.

B.10.2 Computerized printouts of all data file layouts including all point processing assignments, terminal relationships, scales and offsets, command alarm limits, program flowcharts, etc.

B 10.3 On completion of works "As Built drawings for completed installation" shall be prepared by the Contractor and five (5) copies of the same will be supplied to the Engineer-in-Charge. In addition, Five (5) sets of the followings shall be supplied to the Engineer-in-charge.

- 1) Operation Manuals,
- 2) Technical Literature for the various components of equipment,
- 3) Controls and Accessories installed,
- 4) Recommended Spares and Services Manuals

B. 11 TRAINING & HANDING -OVER

B 11.1 All training by the Contractor shall utilize manuals and as-built documentation and the on-line help utility.

B 11.2 Operator training shall include:

- a. Sequence of Operation review
- b. Sign ON - Sign OFF
- c. Selection of all displays and reports
- d. Commanding of points, keyboard
- e. System initialization
- f. Trouble shooting of sensors (determining bad sensors)
- g. Password modification

B 11.3 Supervisor training shall include:

- a. Password assignment / modification
- b. Operator assignment/modification
- c. Operator authority assignment/modification
- d. Point disable/enable
- e. Terminal and data segregation/modification

B. 12 GUARANTEE

B 12.1 The contractor shall guarantee the entire Intelligent Addressable Fire Alarm system installation as per specifications both for components and for system as a whole. All equipment shall be guaranteed for **One year from the date of completion** against unsatisfactory performance or breakdown due to defective design, manufacture and/or installation. The installation shall be covered by the conditions that the whole installation or any part thereof found defective within one year from the date of completion shall be replaced or repaired by the contractor free of charge as decided by the Engineer-in-Charge.

B 12.2 The warranty shall cover the following: -



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- a) Quality, strength and performance of materials used.
 - b) Safe mechanical and electrical stress on all parts under all specified conditions of operation.
 - c) Satisfactory operation during the guarantee period.
 - d) Performance figures and other particulars as specified by the tenderer under Chapter – F.

B 12.3 Labour to trouble shoot, repair, reprogram or replace system components shall be furnished by the contractor at no charge to the Engineer-in-charge during the guarantee period.

B 12.4 All corrective software modifications made during guarantee period shall be updated on all user documentation.

B. 13 MISCELLANEOUS:

B 13.1 The onus of incorporating the statutory requirements as per local rules and obtaining necessary approval for the fire alarm systems shall rest fully with the Contractor.

B 13.2 All the Equipment Supplied and Installed by the Contractor shall have compatibility to be connected to Standard Building Management System (BMS). Adequate Potential Free Contacts shall be provided for sending/ receiving digital signals. The Contractor is required to co-ordinate with the BMS Vendor to ensure that Fire alarm system effectively communicates with the BMS as per the strategy to be decided by the Engineer-in-Charge.

B 13.3 The installation shall be carried out using new Equipment/ Materials complying with applicable standards in a workmanship like manner. Engineer-in-charge reserves the right to reject any part of installation having poor workmanship.

B 13.4 All minor Masonry, Carpentry and Civil works such as cutting / opening in Masonry Walls/Internal Partitions, Chasing on Walls, etc. and making good the same to match existing surface shall be done by the Contractor. Nothing extra shall be paid on this account.

B. 14 REQUIRED TEST:

A. Required Functions

- i. **Operator Console/HMI:** The operator console/HMI shall offer the means to display, monitor and control all the ALARM, TROUBLE and SUPERVISORY signals from the initiating devices connected to the FACP. The operator console/HMI shall meet the specifications mentioned for it under "Product Specification" part of this document.
- ii. **Annunciation:** Operation of ALARM, TROUBLE and SUPERVISORY initiating devices shall be annunciated at the FACP and the Remote Annunciator indicating the type of device, the operational state of the device (Alarm, Trouble or Supervisory) and shall display the custom label associated with the device.
- iii. **Priority of Signals:** Fire Alarm events shall have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second, third, and fourth-level priority, respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. However, all the events shall be annunciated regardless of priority or order received.



- iv. **Non interfering signals:** An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.
- v. **Alarm:** A system alarm shall include:
- Indication of alarm condition at the FACP and at the annunciators.
 - Identification of the device / zone triggering alarm at the FACP and the annunciators.
 - Operation of audible and visible notification appliances until silenced at FACP.
 - Selectively closing doors normally held open by magnetic door holders on the fire floor, floor above and floor below.
 - Unlocking designated doors.
 - Shutting down supply and return fans serving zone where alarm is initiated.
 - Closing smoke dampers on system serving zone where alarm is initiated.
 - Initiation of smoke control sequence as defined.
 - Transmission of signal to the supervising station.
- vi. **Alarm Silencing:** If the "Alarm Silence" button is pressed, all audible signals shall cease operation. The visible signals shall be off at Panel Reset.
- vii. **System Reset:** System Reset shall do the following
The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-arming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
Should an alarm condition continue, the system will remain in an alarmed state.
- viii. **Supervisory Operations:** Upon activation of a supervisory device such as a fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows
- Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
 - Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
 - Record the event in the FACP historical log.
 - Transmission of supervisory signal to the supervising station.
 - Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.
- ix. **Walk Test:** The system shall have the capacity of 8 programmable pass-code protected one-person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one-person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:
- The city circuit connection and any suppression release circuits shall be bypassed for the testing group.
 - Control relay functions associated with one of the 8 testing groups shall be bypassed.
 - The control unit shall indicate a trouble condition.
 - The alarm activation of any initiating device in the testing group shall cause the audible notification appliances assigned only to that group to sound a code to identify the device or zone.
 - The unit shall automatically reset itself after signaling is complete.



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- **Any opening of an initiating device or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.**
- x. **Install Mode:** The system shall provide the capability to group all non-commissioned points and devices into a single "Install Mode" trouble condition allowing an operator to clearly identify event activations from commissioned points and devices in occupied areas.
- It shall be possible to individually remove points from Install Mode as required for phased system commissioning.
 - It shall be possible to retrieve an Install Mode report listing that includes a list of all points assigned to the Install Mode. Panels not having an install mode shall be reprogrammed to remove any non-commissioned points and devices.
 -
- xi. **Service Gateway:** The system shall be compatible to a service gateway as described. If asked for a Service Gateway software application shall be provided that allows an authorized service person to remotely query panel status during testing, commissioning, and service without the need to return to the panel using standard email / Instant Messaging Tools / Smart Phones / Tablets / I Pads etc.



TECHNICAL SPECIFICATION FOR ANALOGUE ADDRESSABLE FIRE DETECTION & ALARM SYSTEM

1. INTRODUCTION

This Section shall include furnishing of all labor, equipment, materials, and performance of all operations associated with the Supply, installation, testing and commissioning of the Networkable Analogue Addressable Fire Detection & Alarm System (FAS) as drawn in these specifications.

2. DESIGN DESCRIPTION

- a) Main Fire Control Room for the entire building to monitor the Analogue Addressable Fire Alarm System shall be provided preferably in Security Control Room.
- b) The Design of shall consist of one or one Main Fire Alarm Panel with Active Repeater panels, Multisensor detectors, Heat Detectors, , Control Module, Monitor Module, Relay Module, Fault Isolators, Response indicators, Manual Call points, Addressable and Power Supplies.
- c) Loop cabling shall be Armoured Fire Cable 2X1.5 Sq.mm. FRLS Copper conductor fixed/laid on surface of wall/existing cable tray/ or laid in existing conduit/PVC channel as reqd. Each floor shall have one or more loops depending upon No. of detectors and devices. Minimum of 20% spare capacity shall be kept in each loop.
- d) Monitor Modules shall be provided for sprinkler system where ever required. Control Module shall be provided to give Address to any Conventional device such as manual call point, Hooters, where ever required.
- e) Relay Module shall be provided to give signals to 3rd party devices such as Fans etc. to enable them to be given trip signal in case of Fire from the Main fire panel.
- g) Separate cabling shall be provided for speakers.

3. SCOPE OF WORK

- o The Contractor shall provide all devices and components required to accomplish this intent whether or not specifically shown or specified for proper functioning of the Fire Alarm system .
- o The complete installation shall conform to the applicable sections of NFPA-72, NFPA-71, and IS 2189:2008 with up to date amendments.
- o The work covered by this Section of the Specifications shall be coordinated with the related work as specified elsewhere under project specifications.
- o The contractor shall furnish, and install complete and ready for intended use and operation, a FAS including control panel, repeater panel, initiating devices (manual pull stations, intelligent Addressable detectors, etc.) indicating devices (hooters, strobes, etc.) and supervisory devices, annunciators, wiring apparatus and accessories.
- o The installation and locations of equipment and devices in the building shall be governed by the specifications and drawings with due regard to actual



site conditions, manufacturers' recommendations, ambient factors affecting the equipment and other operations in the vicinity.

- All materials and equipment shall be new, first grade, standard and current models of the manufacturer and shall be suitable for proper functioning of system. All materials, devices, and equipment shall be compatible with the circuits or systems in which they are utilized.

4. CODES & LISTING

All equipment and installation shall be installed in compliance with the following codes and listing:

A. LOCAL CODES

National Building Code- 2005 :	Fire and Life safety
IS : 2175 :	Heat Sensitive Detectors.
IS : 2189 :	Automatic Fire Detection and Alarm System.
IS : 11360 :	Smoke Detectors.

B. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) - USA:

NFPA 72	National Fire Alarm Code
NFPA 76	Telecommunication Facilities
NFPA 318	Clean Room Applications
NFPA 101	Life Safety Code

C. UNDERWRITERS LABORATORIES INC. (UL) - USA:

UL 268 Smoke Detectors for Fire Protective Signaling Systems
UL 864 Control Units for Fire Protective Signaling Systems 9th Edition Listed
UL 268 A Smoke Detectors for Duct Applications
UL 521 Heat Detectors for Fire Protective Signaling Systems
UL 464 Audible Signaling Appliances
UL 38 Manually Actuated Signaling Boxes
UL 346 Water flow Indicators for Fire Protective Signaling Systems
UL 1971 Visual Notification Appliances
UL 228 Door Holders

D Mandatory Approvals

- **UL LISTING**
- **ULC LISTING**
- **FM APPROVAL**

Note: The Entire System should be have all the above approvals. No Components having just one of the approvals will be accepted

5. SUBMITTALS

After award of work, the bidder shall submit following with in fifteen days: -



A. General:

- i. Three copies of all submittals shall be submitted to the Engineer in charge for review.
- ii. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality

B. Shop Drawings:

- i. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
- ii. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
- iii. Show annunciator layout, configurations, and terminations.

B. Manuals:

- i. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
- ii. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
- iii. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

C. Software Modifications

- i. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 24 hours.
- ii. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site.

D. Tests & Test Reports

- i. Tests certificates shall be furnished for approval of all Fire alarm devices and system devices.
- ii. All routine tests as per relevant codes for the Fire Alarm Panel, shall be conducted and results furnished to the Project Manager.

E. Warranty:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance by the end user. The full cost of maintenance, labor and



materials required to correct any defect during this one year period shall be a part of the bid.

H. Post Contract Maintenance:

- i. Complete maintenance and repair service for the fire alarm system, Voice evacuation and two way fire fighter communication system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of 4 years after expiration of the warrantee.
- ii. In the Sub Work II, the bidder shall quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Submittals that do not identify all post contract maintenance costs will not be accepted. **Rates and costs shall be valid for the period of Two (2) years after expiration of the warrantee of 12 months from date of handing over the system to client.**
- iii. Maintenance and testing shall be on a monthly basis or as and when required by the Project Manager. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:
 - a Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water & flow switches and all accessories of the fire alarm & DVC system.
 - b Each circuit in the fire alarm system shall be tested semi-annually.
 - c Smoke detector shall be tested randomly in accordance with the requirements of NFPA 72 Chapter 7.

6. SPECIFICATIONS

A. FIRE DETECTION & ALARM PANEL

General

1. The Panel shall be UL 864 – 10th Edition, ULC and FM Approved and shall comply to the latest amendments of NFPA 72.
2. The panel shall be a Microprocessor based, Analogue addressable networkable and Intelligent.
3. The panel shall have all necessary provisions for interfacing with BMS, smoke evacuation system, Air handling units, firefighting equipment, elevators, access control system, and other third-party systems.
4. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds

Main Fire Alarm Control Panel

- The control panel shall be microprocessor based networked system designed specifically for fire, smoke control, extinguishing agent releasing (if required), integration modules for BMS or any third party control/annunciation. The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system. Control Panel shall have a dedicated mass storage memory to store project related critical back-up like Auto-CAD as-built drawings, reports, logs, customer-text files etc in line with NFPA-72, 2013 requirements. The memory shall be fully monitored by the FACP



CPU and shall be password-protected. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified. The control panel operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

- Fire Alarm panel shall be a multi-loop (exact number of loops as per schedule of quantity) panel with minimum loop capacity of 125 detectors and 125 devices. The vendor shall consider number of loops, keeping min. 20% spare capacity per loop to accommodate detector and devices. All Panel shall have min. 80 ch. LCD display except the Main Panel which should have min 800 ch LCD display. The HMI shall have at least 5 or more customer programmable buttons with LED indication in order to freely configure its programmed response as per project requirement and the provision of internal/external printer.
- The panel shall maintain a history file of the last 2000 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 2000 event history file.
- The loop interface board shall be able to drive an NFPA Style 6 twisted shielded circuit up to minimum of 6,250 feet in length. The loop Interface shall also be capable of driving an NFPA Style 6, no twist, no shield circuit up to 3,000 feet in length. In addition, loop wiring shall meet the listing requirements for it to exit the building or structure. "T"-tapping shall be allowed in either case.
- The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit liquid crystal display
The FAS shall have pre-signal and Positive Alarm Sequence that is 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. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
- 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.
- 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.
- The system shall support two password levels, master and user.
- The system shall provide means to obtain a variety of reports listing all event, alarm, trouble, supervisory, or security history.
- There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result or product of all cooperating detectors chamber readings.
- The Addressable Main Power Supply shall operate on 240 VAC, 50 Hz, and shall provide all necessary power for the FACP



- The FAS shall be networkable in a peer to peer style and shall be able to communicate with other network nodes. It shall be able to build a network on fiber optics.
- **FACP shall have a dedicated mass storage memory** to store project related critical back-up like Auto-CAD as-built drawings, reports, logs, customer-text files etc in line with NFPA-72, 2019 requirements. The memory shall be fully monitored by the FACP CPU and shall be password-protected.
- The minimum distance between two FACP in wired network should not be less than 3 K.M @ 9600 Baud rate
- FACP shall be UL & ULC listed and FM approved.
- **FACP shall comply to UL-864 10th edition.**

B. FIRE ALARM SYSTEM DEVICES

General

1. **Each device shall be UL & ULC listed and FM Approved.**
2. Addressable devices shall be simple to install and maintain. They can be soft addressed / hard addressed. Devices shall be capable of being set to an address in a range of 001 to 125 (minimum). Detectors shall receive power and communication from the same pair of conductors of the SLC.
3. The contractors shall not install the detectors until after the construction clean up of all trades is complete and final.
4. Initiating devices shall be installed in all areas, compartments, or locations where required by other NFPA codes and standards or as required by the authority having jurisdiction.
5. In the event of duplicate addressing of a device, the fire panel shall indicate this as a fault condition. However, the SLC should continue to function normally with the trouble condition display at the Fire panel.
6. Each addressable detector & device shall respond to Fire Alarm Panel scan for information with an analog representation of measured fire related phenomena (smoke density, particles of combustion, temperature).
7. The standard base of the Detector shall be interchangeable with other Smoke/Heat/Multisensor Detectors.



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, Chapter 7.
9. Addressable devices shall use simple to install and maintain type address switches.

C. INITIATION DEVICES

1. Intelligent Multi sensor Detector

- The multi sensor detector shall be an intelligent digital photoelectric detector with a programmable heat detector
- Multi Sensor Detector shall offer multiple selectable sensitivity levels from 0.2% Obs/ft to 3.7% Obs/ft in order to customize the sensitivity settings.
- Heat Detection shall have two selectable rate of temperature rise thresholds of 8°C per minute & 11°C per minute (or close to this value not deviating by more than 1°C) selectable from the FACP.
- Heat Detection shall have two fixed temperature alarm thresholds of 57°C and 68°C (or close to this value not deviating by more than 1°C) configurable from the FACP.
- Multi Sensor Detector shall have automatic drift compensation or environmental compensation capability for different contamination level of different areas in order to counter nuisance alarm.
- Multi Sensor detector shall have selectable bases with Response Indicator, Isolator, Sounder, Relay and CO detection capability as an option so that the best fit solution is selected depending on the requirement.
- Multi Sensor detector shall have manual DIP switch addressing method that does not require any special tool from manufacturer and commissioning activity for replacing the detector in case the detector goes faulty.
- Multi Sensor should respond after the combined effect of smoke and heat while compared with time.
- Multi Sensor Detector shall have an operating temperature range of -9°C to 50°C and humidity range up to 95% RH non-condensing.
- Multi Sensor Detector shall be UL & ULC listed and FM approved.

2. Intelligent Heat Detectors (Rate of rise type)

- Heat Detector shall have both Rate of Rise Temperature operation and Fixed Temperature operation freely configurable as per requirement of site.
- Heat Detector shall have two selectable rate of temperature rise thresholds of 8°C per minute & 11°C per minute (or close to this value not deviating by more than 1°C) selectable from the FACP.
- Heat Detector shall have two fixed temperature alarm thresholds of 57°C and 68°C (or close to this value not deviating by more than 1°C) configurable from the FACP.
- Heat Detector shall have selectable bases with Response Indicator, Isolator, Sounder, Relay and CO detection capability as an option so that the best fit solution is selected depending on the requirement.
- Heat Detector shall have manual DIP switch addressing method that does not require any special tool from manufacturer and commissioning activity for replacing the detector in case the detector goes faulty.



- Heat Detector shall have an operating temperature range of 0°C to 50°C and humidity range up to 95% RH non-condensing.
- Heat Detector shall be UL & ULC listed and FM approved.

3. **LPG Gas Detectors**

- The LPG Detector shall be intelligent, addressable detectors for protecting the kitchen areas where the LPG line is travelling.
- Microprocessor based system with in-built self-test facility & RS 485 digital data communication link. These should be wall mount flush mounting type. The detector should have the capability of giving output to for automatic activation of exhaust fan, hooter, solenoid valve etc Expected working life of the sensor should be min 10 years. Alarm acknowledgement / reset and mute keys on both local and remote consoles.
- The detector shall be UL Listed.

4. **Addressable Duct Smoke Detector**

- The smoke detector housing shall accommodate an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel. The Duct Casting Units shall be directly installed in the air conditioning ducts (Return air) for detecting any hazardous quantity of products of combustion being carried through the ducts.
- The complete unit shall consist of a housing to accommodate Photo Electric Detector with plug - in facility and sampling tubes, one for air inlet and other as the air outlet. The Inlet tube shall extend into and across the duct width (from 0.5 meter to 3.0 meter), the outlet tube shall be of fixed length of 7.5 cm length.
- When the AHU blower fan operates, a continuous cross sectional sampling of air from the duct shall flow through the housing containing the Detector. The outlet tube shall return the sampled air into the duct.
- The housing shall be mounted outside the duct, the probe tubes shall be inserted through the duct by cutting precision sized holes into the duct and sealed with rubber gaskets. The Duct Casting Unit shall be FM and UL Approved.

5. **Addressable Manual Pull Stations**

- Stations shall be of the dual action design. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
- All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
- Manual fire alarm boxes shall be constructed of Poly carbonate / MS with clearly visible operating instructions provided on the cover.

D. **NOTIFICATION DEVICES**



1. Addressable Hooter

- Hooter/Horn should be true addressable system.
- The audible output shall be multi-tone selectable horn output from 85 DB up to 98DB.
- Hooter shall be connected to the NAC of FACP and it shall be fully monitored by FACP.
- Hooters shall be controlled independently on the same 2-Core NAC as per programmed activation and deactivation criteria or from the FACP.
- It shall be possible to poll each and every hooter from the HMI / Display / Operator Console at FACP, isolate and include in the circuit (NAC), activate and deactivate, view the voltage received by it from the HMI / Display / Operator Console at the FACP & Network Repeater.
- Hooter shall report its status with configured parameters to FACP.
- Hooter shall support individual field testing in "Silent Mode" and "Non-Silent Mode" (full operational mode).
- If asked for, it shall be possible for FDA system to generate, print and e-mail the diagnostic report of notification devices with tested and verified parameters.
- It shall be ensured that the last notification device at respective NAC receives at least 20Vdc (or 3 V above the min operating voltage) to ensure the desired performance. There shall be a provision to verify the same either from FACP or a hand-held testing device.
- Hooter shall have an operating temperature range of 0°C to 50°C.
- Hooter shall have humidity tolerance range up to 93% RH non-condensing.
- Hooter shall be UL and ULC listed and FM approved.
- The power supply should be monitored from the panel itself. **However if external power supply is used then the same should be UL listed and should be monitored from FAC .**All the notification devices should have a capability of scheduling and self - test without any human intervention and should send the report with exact dB levels

2. Strobe cum Alarm Hooters (Addressable)

- Hooter with strobe should be true addressable system.
- Hooter with Strobe unit shall have both audible and visual output units housed within the same device. The audible output shall be multi-tone horn output up to 98DB and strobe output shall have selectable intensity of 15, 30, 75 and 110 candela.
- Strobe unit shall have a flash rate of 1Hz synchronized throughout the Fire Alarm Network.
- Hooter with Strobe unit shall be connected to the NAC of FACP and it shall be fully monitored by FACP.
- Hooter with Strobe unit shall report its status with configured parameters of each unit (hooter and strobe) to FACP.
- Hooter with Strobe unit shall support individual field testing in "Silent Mode" and "Non-Silent Mode" (full operational mode).
- If asked for, it shall be possible for FDA system to generate, print and e-mail the diagnostic report of notification devices with tested and verified parameters.
- Hooter with Strobe unit shall be controlled independently on the same 2-Core NAC as per programmed activation and deactivation criteria or from the FACP. Audible (hooter) and Visible (strobe) outputs shall be independently configurable from FACP for its activation and deactivation criteria as required.
- In absence of any specific mention of activation and deactivation criteria, the hooter shall stop at "Alarm Acknowledge" or "Alarm Silence" and the strobe shall



stop at "System Reset" or "Panel Reset". This requirement shall not be deviated from unless otherwise stated cause-and-effect configuration or unless a formal written approval is taken from the design consultant.

- It shall be possible to poll each and every hooter with strobe unit from the HMI / Display / Operator Console at FACP, isolate and include in the circuit (NAC), activate and deactivate, view the voltage received by it from the HMI / Display / Operator Console at the FACP & Network Repeater.
- It shall be ensured that the last notification device at respective NAC receives at least 20Vdc (or 3 V above the min operating voltage) to ensure the desired performance. There shall be a provision to verify the same either from FACP or a hand-held testing device.
- Hooter with Strobe unit shall support individual performance check by a hand-held testing tool during in "Silent-Mode" or "Sound-Mode" to facilitate performance check during normal working hour.
- Hooter cum Strobe shall have an operating temperature range of 0°C to 50°C and humidity range up to 93% RH non-condensing.
- Hooter with Strobe unit shall be UL and ULC listed and FM approved.

• **E. MODULES**

1. **Monitor Module (For input to fire alarm panel)**

- The Input Device shall provide an addressable input for N.O. or N.C. contact devices such as manual water flow switches, sprinkler supervisory devices, etc. The input device shall provide a supervised initiating circuit.
- An open-circuit fault shall be annunciated at the Fire Alarm panel (Subsequent alarm shall be reported.) The device shall contain an LED which blinks upon being scanned by the Fire Alarm panel. Upon determination of an alarm condition the LED shall be latched on. The operating voltage shall be in the range of 15 to 32 VDC, Maximum current draw 5.0 mA (LED on).

2. **Control Module (for output from fire alarm panel)**

- The control module shall provide an addressable output for a separately powered alarm indicating circuit or for a control relay. The control module shall provide a supervised indicating circuit where indicated on the plans. An open circuit fault shall be annunciated at the Fire Alarm panel.
- The Output Device shall provide a control relay where indicated on the plans. The relay contacts shall be SPDT rated at two amps 24 V DC. The device module shall contain an LED which blinks upon being scanned by the Fire Alarm panel. Upon activation of the device, the LED shall be latched on.

3. **Fault Isolator Device**

- A wire-to-wire short circuit fault on any circuit, before or after the circuit has been activated, shall initiate a trouble signal and shall isolate that circuit from the rest of the system.



- The Fault Isolator Device shall detect and isolate a short-circuited segment of a fault-tolerant loop. The device shall automatically determine a return to normal condition of the loop and restore the isolated segment.
- The fault isolator device shall be placed every [20] devices to limit the number lost in the event of a short-circuit.

4 Relay Module

- Addressable Relay Module provides the system with a dry-contact output for activating a variety of auxiliary devices, such as fans, dampers, control equipment, etc. Addressability allows the dry contact to be activated, either manually or through panel programming

F. Active Repeater Panel (ARP)

The Repeater Panel shall be a Liquid Crystal Display (LCD) 80 character display annunciator which shall mimic the Main fire alarm panel. It shall be supervised, remotely located and shall have a back-lit LCD display. It shall have an on-board input, output, and status indicators to support diagnostics. It shall display all alarm and trouble conditions in the system. It shall have functional keys like Acknowledge, Signal Silence, System Reset, Lamp Test etc.

G. Fire Graphic Software

- The network shall 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.
- 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 an 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 pre-programmed 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.

1. **Fire Network**

- The network architecture shall be based on a peer-to-peer SM Fiber, inherently regenerative communication format and protocol.
- The network shall use a deterministic token-passing method. Collision detection and recovery type protocols are not acceptable substitutes due to life safety requirements. In addition, there shall be no master, polling computer, central file computer, display controller or other central element (weak link) in the network which, on failure, may cause complete loss of network communications or cause major degradation of network capability. There shall be no cascading of CPUs or master/slave relationships at the network level to facilitate network communications. Failure of any node shall not cause failure or communication degradation of any other node or change the network communication protocol among surviving nodes located within distance limitations.
- Each node/panel shall communicate on the network at a suitable baud rate. A node may be an intelligent Fire Alarm Control Panel (FAS), Active Repeater panel (ARP), Digital Voice Evacuation (DVC), Network Control Station (NCS) etc. The network shall be capable of expansion to at least 100 nodes.

2. **TESTING**

Random Sample Testing:

- About 5% of all fire alarm components shall be subjected to random testing by connecting to the panels.
- All smoke detectors shall be tested as given above and later cleaned with a vacuum cleaner.
- Hooters shall also be tested through direct 24V supply. It shall be tested for 10 minutes.

Testing of Earthing system:

- The earth continuity conductor including metallic parts of the equipment shall be tested for earth to electrical continuity. All tests shall be carried out as per IS 3043 and resistance of complete installation shall not be more than one ohm.

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Tests at site

Following test shall be conducted: -

- a. Loop Checking



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- b. Checking of smoke detectors, Heat detectors etc. by simulation.
 - c. Functional tests for fire alarm panel.
 - d. The Mock trial of the complete Fire Detection and Alarm system.

3. COMMISSIONING AND ACCEPTANCE TESTS

- The commissioning and acceptance tests shall be apart from the standard or routine tests prescribed and normally conducted by the manufacturer /Design-Build Contractor and will be irrespective of the fact whether the same are covered by such tests or not. All commissioning tests at site will be in line with NFPA 71 and 72.
- a. Each sounder circuit shall be energized separately and the sound level reading taken to check for conformity with the minimum standards.
 - b. Mains failure performance.
 - c. Battery disconnection test.
 - d. Open circuit of each sounder circuit to be tested.
 - e. Short circuit of each sounder circuit to be tested.



PUBLIC ADDRESS & BACKGROUND MUSIC SYSTEM –MALL & OFFICE AREA TROPICANA GARDEN Scope

The scope of work under this head shall include design, supply, and installation of Public Address & Back Ground Music System. In case of any fire/ Important announcements PA system will override BGM.

The work under this system shall consist of design, supply, installation, testing, training & handing over of all materials, equipment and appliances and labor necessary to commission the said system, complete with Speakers, Amplifiers, Call Stations relays etc. for interfacing with other systems. It shall also include laying of cabling necessary for installation of the system as indicated in the specification and Bill of Quantities. Any openings/chasing in the wall/ceiling required to be made for the installation shall be made good in appropriate manner.

The work under this system shall consist of design, supply, installation, testing, training & handing over of all materials, equipment, hardware, software appliances and necessary labor to commission the said system, complete with all the required components strictly as per the enclosed tender specifications, design details.

The scope also include the supply, installation & commissioning of any material or equipment including civil works that are not specifically mentioned in the specifications and design details but are required for successful commissioning of the project.

Ceiling Mounted Speakers

The speaker shall be flush mounted in the False Ceiling cavity and shall be suitable for a general purpose applications such as Public Address, Music Reproduction etc.,

The Speaker shall consists of a single piece 6 W dual cone loudspeaker, frame, a 100 V line matching transformer and a circular metal grille. The speaker shall come with a screw terminal block for line matching transformer connection. The speaker shall be screw mounted to the ceiling and it shall have a protective steel fire cover to prevent entry of fire into the false ceiling void area thro the speakers. The speakers shall also meet the following specifications

- Max. Power : 6 W
- Rated Power (PHC) : 6 W(6-3-1.5 W)
- Rated voltage : 100 V AC
- Rated impedance : 1667 Ohms
- Effective frequency range(-10 dB) : 80 to 18 kHz
- Opening angle(1 KHz/ 4 KHz, -6dB) : 175/55
- Power handling capacity : Min 6 watts with a tapping facility for 1.5,3,6 Watts
- Sound pressure level at 1 KHz, 6W, 1m : Min 92dB
- Sound pressure level at 1 KHz, 1W, 1m : Min 84dB
- Speaker diameter : Around 200 mm
- Connection : 4 - pole screw connector
- Operating Temperature : 0°C to +55°C

Wall Mounted Speakers

The speaker shall be wall mounted type and shall be suitable for a general-purpose applications such as Public Address, Music Reproduction etc.,

The Speaker shall consist of a wall mount enclosure, 6 W high quality speakers and a 100 V line matching transformer. The speaker shall come with a screw terminal block for line matching transformer connection for full load and shall also have a provision for secondary tappings. Connectors shall be provided on the rear of the speakers for cable connections.

There shall be a uniformity of sound both in loudness & quality. The speaker shall be designed to minimize reverberation effects, howling etc., caused due to reflection of sound from hard surfaces. The speakers shall also meet the following specifications



- Max. Power : 6W
- Rated input voltage : 100 V AC
- Rated impedance : 1667 Ohms
- Effective frequency range : 180 to 20 kHz
- Opening angle @ 4 KHz) : 70 Deg
- Power handling capacity : Min 6 watts Internal taps : 6W, 3W, 1W
- Sound pressure level at 1 KHz, 6W, 1m : Min 90dB
- Sound pressure level at 1 KHz, 1W, 1m : Min 85dB
- Connection : 3-way screw connector
- Operating Temperature : 0°C to +55°C

Power Amplifiers

The main function of the power amplifier shall be the amplification of audio signals for the speakers. It is possible to select output voltages of 100 V, 70 V or 50 V by changing jumpers. The power amplifiers shall receive input signals via the TCPIP network. The power amplifiers shall have LCD display or LED indicators for status display. The display shall indicate the VU meter reading when the audio monitoring mode is selected. There shall be a facility for automatic switching to the fail over amplifier when ever any of the amplifier in that node fails.

The power amplifiers shall also have at least 2 auxiliary audio inputs, freely programmable control inputs for system actions, and priorities can be assigned to these inputs. The control outputs shall also freely programmable for faults and calls. The control input shall be programmed for momentary or toggle or latching operation. Each control input shall have the ability to monitor the cable between the control input and the external trigger switch for open- circuits and short-circuits.

Speakers in medical area will be connected with paging station and FA system (for EVAC), whereas speakers in common area will be connected with Background Music system and FA system (for EVAC).

The power amplifiers shall be equipped with amplifier monitoring and change-over relays. The amplifier shall provide short-to-ground and short-circuit detection functions. End-of-line supervision card shall be provided to monitor the speaker lines for open circuits. A pilot tone for the monitoring shall be generated in the power amplifier itself when there is open or short circuit fault.

The power amplifiers shall be a single or multiple channel type that shall be equipped with audio processing facilities for each amplifier channel. They shall be designed for operation at voltage levels ranging from 25V To 110V.

The output stage of amplifier shall be powered by a low voltage supply, which supports not only 230 VAC AC mains voltage, but also 48VDC. Voltage switching shall be automatic and completely silent.

The amplifier shall have the minimum following characteristics:

- 120W, 240/250W, 360/ 480/500/1000W range of amplifiers.
- Single, dual or quad channel vendor proposing amplifier with multiple channels, shall en-sure that the amplifier chosen shall meet in full the amplifier wattage requirement for eachzone, in each of the amplifier channel
- Balanced 0dB input at 770mV
- 100V/110V and 70 V line output
- Thermostatic Ventilation
- Amplifier Status LED / contacts
- Frequency response Less Than -3dB (35Hz - 20KHz)
- Distortion at nominal power <0.5%(1KHz)
- Signal/noise ratio: >100dB

The amplifier shall communicate with the zone/ network controllers with TCPIP interfaces or vendor specific interface. All the required interface cards for this communication between



the amplifiers, network controller & the interface shall be considered in the cost of the amplifier.

The amplifier shall be rack mountable and shall power speakers up to its full rated load.

Zone Controllers

The zone controllers shall form the local control for each block/set of blocks as per the system design. These controller shall supports the connection & communication option. It shall employ DSP (Digital Signal Processing) technology for Voice Evacuation and shall have the capability to expand at least to 16 zones through cascading configuration. The zone controller shall encompasses the functions like the audio playing, zone control, fault monitoring, log recording, volume control and amplifier switchover.

The zone controllers shall be multi zone type and shall connect to the speakers either directly after taking amplifier inputs or thro amplifiers with amplifier control capability.

It shall be possible to control & configure individual digital control for each input and output level from the software. The controller shall monitor all the system components and reports any changes in status. All communication shall be digital between the entire system components, excepting for the output to the speaker circuit and the output of the amplifier units.

The Zone controller has come with 4 or 8 or as suggested by vendor loudspeaker out-put circuits to connect the loudspeaker in zones as per design requirement (Vendor offering zone controllers with 4 Zones shall consider 2x4 zones controllers for a 8 zone requirement)). Each zone controller shall connect to the required quantity & size of amplifiers to meet the zone requirements.

The controller shall have the capability to switch amplifiers to any required zone & the switching matrix shall also support the redundancy amplifier switching. When a main amplifier fails to function, the standby amplifier shall be replaced automatically. After the main amplifier recovers or rectified, the zone controller shall re instate the main amplifier and make standby amplifier as standby automatically.

The zone control shall have programmable control inputs to be used to trigger automatic messages actions in the system. It shall be possible to configure at site as momentary or toggle or latching operation and for specific preprogramed time schedules. Volt free dry contact input/output interface shall be provided to connect the external audio sources and also to interface with the fire alarm system. It shall have a built-in or attachable flash card memory of min 1 GB memory to store the audios such as digital voice messages and the alarm tone of the emergency broadcast. It shall be possible to broadcast messages at least in 4 different languages.

The zone controller shall also be capable of playing background Music for multiple music/audio channels simultaneously, with high quality music features, fully programmable route from any source to any zone. The zone controller shall be capable of connecting to external audio sources from devices such as the CD, DVD, Radio and MP3 player to provide the zones with different audio sources, which shall meet the various requirements for different zones. The audio source inputs methods shall be either from the network and from local zone controller.

The Zone Controller shall automatically switch to the emergency broadcast under any emergency (either through external input & also on manual override). Once the emergency broadcast is triggered by a remote control microphone or other external devices (fire alarm system), the other functions (like background music and general broadcast) shall be paused, & the zone controller shall play the recorded voice message (alarm and evacuation information) for fire emergency or the information from the emergency microphone until the all-clear. The zone controller shall switch to emergency broadcast in 3 seconds. The zone controller shall also have the facility to automatically record voice messages sent thro any IP call station microphone so that occupants can listen to and broadcast the voice message again & again, if required.

It shall have an internal real time clock and the clock shall be synchronized periodically with the PC programming software or any other external network source as defined by client. The



zone controller shall have timed broadcast function feature that shall allow client to set the periods for playing different music or service broadcasts in different zones. It shall be possible to transmit automatic playback of scheduled pre-programmed messages, music or automatic volume changes of announcements or background music, e.g. during pre-programmed hours and for pre-programmed zones. Messages shall be routed automatically to any zone at any specified time interval and at specific time of the day. It shall be possible to create a calendar for at least 1 year for automatic voice transmission of such pre-recorded messages. It shall be possible to change the volume of the speakers from the PC, any call station & from zone controller.

These units shall initiate the broadcast of live speech in the designated public areas using manual controls as well automatically according to the input from FACP. The use of the PA system shall be primarily for broadcast fire & emergency evacuation messages, as well live evacuation messages and instructions from the operator or the fire brigade to direct the people to the safety points of the building and also for other auxiliary messages as well the back ground music. It shall be possible to program multiple messages of at least 10 minutes length each.

There shall be multiple priority levels for message transmission & each of these messages shall be programmed to be transmitted with a delay from 0-300 secs from the message initiation time. All messages shall be of WAV files directly can be downloaded to the system through a PC and once down loaded, this device shall operate independently without the PC.

The zone controller shall store all control information. It shall also have an inbuilt interface or shall connect to an external or connect to the Ethernet interface for connection to the PC for enabling system configuration as well as diagnostic and logging functions. The zone controller shall store the digital audio messages for automatic announcements including automatic evacuation message from a fire trigger given by the fire alarm control panel.

The zone controller shall also have buffer memory to stores the configuration details and the last at least 100 fault messages & 100 other events. The zone controller shall continuously monitor the availability of the digital audio messages, the alarm tones and alarm tone generator and the status of the control

The Zone Controller shall have the capability to detect faults and continuously check the host system, main power amplifier circuit, standby amplifier circuit, power source, communication, and detect the open circuit, short circuit and grounding fault of speaker line and report faults in time. When a short-circuit error takes place, the device shall isolate the zone where error happens to protect the amplifiers and to cut off its impact on other zones. Like wise, 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.

The zone controller or power amplifier shall monitor the speaker circuit. When short-circuit or open-circuit faults are found, the device shall send a warning automatically.

The zone controller shall monitor the digital measurements of (levels and impedance) of amplifiers and the speaker circuit.

The zone controller shall come with a switch mode power supply.

The zone controller shall comply with EN54-16 Standard

Paging desk console microphone call station

The system shall comprise of desk Intercom/VOIP/ /Paging station panel buttons / multiple pages directory list. The call station shall come with digital signal processing feature for audio processing, including adjustment of sensitivity, limiter and parametric equalizer settings. It shall be possible for users to operate on the touch screen to configure multi-zones settings without the need to extend hardware key modules.

It shall have functions for operations, like zone selecting, calling, audio sourcing selecting, emergency broadcast, monitoring and internal communication. The functions of the programmable network paging console shall be configured using the configuration software.

The paging microphone shall allow users to make paging and broadcast search notices by



any zone, group of zones or all call. It shall be possible for users to configure the functions directly on the screen. It shall be possible for users to select the zone and audio source, adjust the volume, and enable the emergency broadcast by pressing the button on it.

Paging microphones shall have multiple broadcast priorities levels. It shall intercommunicate with other paging microphones on the network so that the announcements can be made by selected microphones on the basis of priority so that at no time two microphones shall address any one zone simultaneously. It shall be possible to set priority levels on the call stations so that the higher priority level call station shall take over automatically when the announcement is being made from a call station of lower priority. It shall call only authorized zones. The paging station shall also meet the following technical specifications.

Messaging to all zone and individual zones of the entire system shall be possible thro PA connectivity & also directly connecting to any of the zone controller. Microphone shall come with volume control & mute feature. Monitored high quality gooseneck microphone.

Automatic gain control on microphone input

Monitored built in loudspeaker

SPEEX/MP3 audio encoding/decoding

Memory space for pre-recorded messages

RJ9 plug for optional headset

LED for power status, fault status, message playing status etc.,

2 monitored input contacts

output contacts NO/NC

Built in speaker: Power 4 W RMS



S1.0 SCOPE OF WORK:

The scope of work includes complete Fit – up details, supporting details, Manufacture / Fabrication, supply, Storing, Installation / erection, testing, commissioning the fire hydrant system, Hose Reel system, first aid fire extinguishers, emergency exit Signage, civil works i.e., excavation, back filling for the buried pipes wherever applicable & with all necessary accessories as per Specifications. Further it is vendor's responsibility to take necessary approvals from local fire authority.

Fire Hydrant system is provided for the entire building. Hydrant system is designed as per regulation of NBC-2016 / Local CFO. Hydrant points are provided at the strategic location around the periphery of the building. These shall be accompanied with a hose box containing 2 Nos. 15 Meters hoses along with a short pattern branch pipe.

In addition to this we have considered Hydrant Point at every landing of the building. Wet riser is considered to the most effective coverage of the floor areas in case of any emergency. Each internal hydrant valve is provided with a hose of 15 M hosepipe and a short pattern branch pipe. In addition to this a 25 mm dia and 36.5 M long hose reel is also provided at each landing of the wet riser to tackle any fire at its incipient stage. Wet risers are connected to the overhead tank provided at the terrace of the building. The entire network of the hydrant system shall be kept pressurized.

Fire Brigade inlet connections are connected to the firewater tank and to hydrant riser through the ring main. In case of emergency if any additional water requirement is felt, fire brigade inlet connection to the firewater tank shall feed it. Due to any reason if the pumps do not operate and water is required at upper levels it shall be feed through fire brigade inlet connection connected to the riser by fire tenders.

The selection of pumps is based on the NBC – 2016 / Local CFO for building protection. 1 No. automatic electric motor driven pumping set of capacity 2280 LPM for Hydrant System and 1 no. Jockey pump of capacity 180 LPM are provided as base pump sets. 1 No. of Diesel Engine Driven Pump Set of 2280 LPM is provided as Standby for Hydrant System.

In case of any minor leakage in the hydrant system network resulting, a pressure drop. Jockey pump will automatically "cut in" at its set point and will re-compensate the pressure losses. However, in case of an actual fire when one or more hydrant valves / hose reel is opened and the jockey pump can't meet the water demand resulting a continuous pressure drop in the hydrant network, main hydrant pump will come into operation sequentially. Once the fire is extinguished the main hydrant pump shall be stopped manually.

Note –Main pump & Standby Pump shall be stopped manually only after ascertaining that the fire is completely extinguished.

Pressure switches are provided to activate a signal to start the pump etc.
All the pumps will come into operation sequentially.

A successful vendor as described in the Bill of Quantities will carry out the entire work. All hard wares like nuts, washers, bolts, packing material, gaskets, flanges, scaffolding etc. will be in contractor's scope. The contractor shall provide the material whatever required for the completion of job.

2.0 PROJECT EXECUTION

2.1 SUBMITTALS

A. DURING BIDDING

- a. Bidder's confirmation as per the tender format.



b. Technical Data sheet of all Equipments and material as asked in tender supported by OEM's product data to include Mechanical, Electrical, and hydraulic details.

B. POST AWARD

- Shop drawings in 1:100 scale for firefighting system to incorporate,
- General arrangement of systems, sub systems, equipments, components and assemblies.
- Supporting arrangements to include hangers, seismic isolations, and vibration isolators.
- Foundation details Sectional elevations.
- Levels, insert levels and gradient
- Typical details.
- Blown up details.
- Construction joints.
- Wall and slabs penetrations, levels, sleeves, sealing mechanism, fire separation, fire integrity, fire stoppers and fire sealants.
- Equipments details containing key engineering performance parameters and equipment tagging.
- System schematic drawings indicating riser arrangements, sizing on individual floors, tap-offs and system flow.
- Electrical single line diagram, control wiring, GA drawings and termination diagrams for all electrical systems and panels.
- Product data sheets incorporating the physical, mechanical, electrical, hydraulic, chemical properties substantiated by OEM's catalogue, equipment computerized selection, performance curves, characteristics curves and relevant standards.
- Prepare detailed design calculations & Drawings for approval from client as well as statutory agencies.
- Product /Material certifications from relevant authorities, manufacturers, testing labs etc as and where required as per the tender specifications at Free of Cost.
- Calculations to substantiate the design and engineering intent to meet the performance requirement for all mechanical, electrical, hydraulics, seismic, vibration, thermal, and structural considerations. Such Calculations, if required and insisted upon by client/Consultant, shall be carried out by independent experts to be hired by contractor without any extra cost to client.
- Revised Bill of Quantities based on the shop drawings and statement of variation to be pre-approved before execution or commencement of any work beyond the tender quantities and rates.



- OEM's QAP to indicate the quality check at manufacturer's works.
- Manufacturer's shop testing procedure as per the relevant standards for the equipments wherever required.
- Lifting, access and maintenance strategy for all equipments.
- Sample board at site to include all the materials for which data sheets can't be approved or can't be submitted. Physical sample of all materials required for aesthetic and visual approvals.
- Obtain necessary statutory approvals after installation.
- The Contractor shall submit detailed schedules showing the program and the sequence in which the Contractor proposes to carry out the work with dates and estimated completion times for various parts of the work. Such schedules shall be approved by the client before starting the work and shall be binding on the Contractor. If so required by the client, the Contractor shall furnish weekly progress reports.
- Installation procedures with site QAP indicating material handling, storage, installation methodology, inspection stages, pre commissioning checks, commissioning, testing and validation procedure for each system, subsystem and equipment.
- Routine, type and specific test reports for the equipments and materials wherever required.
- AS BUILT DRAWINGS in all the format of shop drawings including coordinated drawings.
- Internal Installation check and completion certificates.
- Pre commissioning procedures
- Pre Commissioning results.
- Certification of punch list attendance.
- Commissioning and testing Procedures
- Commissioning and testing results.
- System validation report.
- Warranty certificates from OEM.
- Operation and maintenance manuals.
- List of recommended & mandatory spares and consumables.

2.2 QUALITY ASSURANCE



INTENT OF DRAWINGS

- A. Provide complete and functional systems for the project. The systems shall confirm to the details stated in the specifications and shown on the drawings. Items or work not shown or specified, but required for complete systems, shall be provided and confirm to accepted trade practices. The drawings and specifications are presented to define specific system requirements and serve to expand on the primary contract requirements of providing complete systems. The drawings are diagrammatic and indicate the general arrangement and routing of the systems included in this contractors work.
- B. Do not scale the drawings. Because of the scale of the drawings, it is not possible to indicate offsets, fittings, valves, or similar items which may be required to provide complete operating systems. Carefully investigate conditions affecting the work associated with this project. Install systems in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features are avoided. Provide items required to meet the project conditions without additional cost to the owner.
- C. These documents may not explicitly disclose final details required for a complete systems installation; however, contractors shall possess the expertise to include the necessary appointments of complete operating systems.
- D. Contractors shall be "Experienced" in this type of construction and realize the extent of the work required.

2.3 PRE-BID SITE VISIT

Bidders shall visit the site and become completely familiar with existing conditions prior to submitting their bid. No extra charges shall be allowed as a result of existing conditions. To schedule a site visit, contact client's representative at least 48 hours in advance of desired time of visit.

2.4 GENERAL STANDARDS OF MATERIALS

Equipment and materials, unless otherwise noted, shall be new and of first quality, produced by manufacturers who have been regularly engaged in the manufacture of these products for a period of not less than five years.

Equipment of one type shall be the products of one manufacturer; similar items of the same classification shall be identical, including equipment, assemblies, parts and components.

Materials furnished shall be determined safe by a nationally recognized testing organization, Underwriters' Laboratories, Inc., or Factory Mutual Engineering Corporation, and materials shall be labeled, certified or listed by such organizations. Where third party certification is required for packaged equipment, the equipment shall bear the appropriate certification label.

With respect to custom made equipment or related installations which are constructed specially for this project, the manufacturer shall certify the safety of same on the basis of test data. The Owner shall be furnished copies of such certificates.

2.5 PRODUCTS AND SUBSTITUTIONS

Where a specific manufacturer's product is specified, the contract sum shall be based on that product only. Any substitutions from the specified product shall be offered as a Substitution Request. Substitutions shall not be permitted after the bidding phase without a



Substitution Request Form included with the bid.

Where several manufacturers' products are specified, the Contract Amount shall be based upon the specified products only. Any substitutions from the specified products shall be offered as a Substitution Request. Substitutions shall not be permitted after the bidding phase without a Substitution Request Form included with the bid.

Where only one manufacturer's product is specified, the associated systems have been designed on the basis of that product. Where several manufacturers' products are specified, the associated systems have been designed on the basis of the first named manufacturer's product. When products other than those used as the basis of design are submitted, the contractor shall agree to accept a unilateral change order that includes additional costs incurred by the Owner for the consultant's review of submissions, redesign, and system and/or structure modifications required by the use of that product.

2.6 APPLICABLE CODES

Materials furnished and work installed shall comply with applicable codes listed, with the requirements of the local utility companies, and with the requirements of governmental departments or authorities having jurisdiction.

The following codes and Indian Standard shall be applicable with amendments up to date-

CODE OF PRACTICE

Standards for life safety

NBC – 2016

Local CFO.

Pumps for FFTG

12469

IS-

Motors

12615

IS-

Type II A – Fabric reinforced rubber lined hose.

636

IS-

Sluice valves for water works purposes (50 mm to 300 mm).

780

IS-

Couplings double male and double female instantaneous pattern

For fire fighting.

901

IS-

Fire hose delivery couplings, branch pipe, nozzles and nozzle spanner.

903

IS-

Mild steel pipes for pipes from 200 mm dia to 300 mm dia.

3589

IS-

Mild steel pipes for pipes from 25 mm dia to 150 mm dia.

1239

IS-

Fixed type wall mounted hose reel with drum.

884

IS-

Signature of Bidder/JV Firm



Hose tubing. 388	IS-
Foot valves for water works purposes. 4038	IS-
Landing valves. 5290	IS-
Anti-corrosion treatment for underground pipes. 10221	IS-
Swing check type reflux (non- return) valves. 5312	IS-
Specifications for portable fire extinguisher. 15683	IS-

2.7 CUTTING AND PATCHING

Provide cutting and patching necessary to install the work specified herein. Patching shall match adjacent surfaces.

No structural members shall be cut without prior approval of the Architect.

Provide ceiling removal and replacement where work above ceilings is required. Replace ceiling components damaged in the process.

2.8 ELECTRICAL CONNECTIONS

Regardless of voltage, provide control wiring, interlock wiring, and equipment control wiring for the equipment provided under this division of the specifications.

Furnish electrical disconnect switches, starters and combination starter disconnects required for equipment provided under this division of the specifications.

Power wiring not used for control functions, complete from power source to motor or equipment junction box, including power wiring through starters, shall be provided as per electrical work specification of the tender.

Coordinate to ensure that electrical devices furnished or provided are compatible with the electrical systems used for main electrical system.

2.9 EQUIPMENT FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

Provide necessary foundations, auxiliary steel, supports, pads, bases and piers required for equipment specified in this division; submit drawings in accordance with Shop Drawing Submittal requirements prior to the purchase, fabrication or construction of same.

Provide adequately thick concrete pads for equipment as indicated on drawings. Pads shall be extended 6 inches beyond machine base in each direction with top edge chamfered. Anchor equipment pads to the floor in accordance with latest building codes seismic requirements.

Construction of foundations, supports, and pads where mounted on the floor, shall be of the same materials and same quality of finish as the adjacent and surrounding floor material.

Equipment shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Consultant, deemed insufficient shall be replaced as directed, with no additional cost to the Owner.



2.10 EQUIPMENT GUARDS

Guards shall consist of heavy angle iron frames, hinged and latched, with heavy galvanized iron crimped mesh wire securely fastened to frames.

2.11 CLEANING, PROTECTION AND ADJUSTMENT

Cleaning:

- Upon completion of the work, clean the exterior surface of equipment, accessories, and trim installed. Clean, polish, and leave equipment, accessories, and trim in first-class condition.

Protection of Surfaces:

- Protect new and existing surfaces from damage during the construction period.
- Provide plywood or similar material under equipment or materials stored on floors or roofs. Provide protection in areas where construction may damage surfaces.
- Surfaces damaged during the construction shall be repaired or replaced at the cost of the Contractor at fault. The method of repairing or replacing the surface shall be approved by the Owner and Consultant

Protection of Services:

- Protect new and existing services from damage during the construction period.
- Repair, replace and maintain in service any new or existing utilities, facilities or services (underground, over ground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction.
- Services damaged during the construction shall be replaced at the cost of the Contractor at fault. The method used in repairing, replacing or maintaining the services shall be approved by the Owner and Consultant.
- The Contractor shall make good all damages to the Purchaser's building, property, equipments and articles, how so ever arising from the erection of the equipment. The Contractor shall indemnify and hold harmless the employer against all claims in respect of injury to any person how so ever arising out of the erection of the equipment in the course of such installation.
- During erection the Contractor shall at all times keep the working and storage areas free from waste or rubbish. On time-to-time, as directed by Employer in charge, he shall remove all temporary structures, debris, insulation bitumen, EPS wastage and leave the premises neat and clean in a satisfactory condition.
- All equipment shall be complete with approved safety devices wherever a potential hazard to personnel exists and with provision for safe access of personnel to and around equipment for operational and maintenance functions.
- These items shall include not only those usually furnished with elements of machinery but also covers, guards, crossovers, stair ways, ladders, platforms, handrails etc. which are necessary for safe operation of the system. The contractor shall include for all safety devices including but not limited to the following items-
 - a. Belt Guards shall be designed with approved provision to facilitate belt inspection, adjustment, replacement and general servicing.
 - b. All couplings are to be covered with an approved guard, fabricated from welded plate and structural steel.
 - c. Access Ladders and Platforms

Protection of Equipment and Materials:

- Equipment and materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground and out of standing water by means of pallets or



racks, and covered with tarpaulins.

- Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Consultant or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed.
- The contractor shall make his own arrangements for the storage of materials & their safe custody at site.
- During the construction period, protect ductwork, piping and equipment from damage and dirt. Properly cap ductwork and piping. Each system of piping shall be flushed to remove grit, dirt, sand, and other foreign matter for as long a time as required to thoroughly clean the systems.

2.12 ACCESSIBILITY

- Coordinate to ensure the sufficiency of the size of shafts, and chases, and the adequacy of clearances in hung ceilings and other areas required for the proper installation of this work.
- Locate equipment which must be serviced, operated or maintained in fully accessible positions. Locations in ceilings requiring access shall be coordinated with, but not limited to lights, curtain tracks, speakers, etc. Equipment requiring access shall include, but is not necessarily limited to, valves, traps, clean-outs, motors, fire dampers, controllers, switchgear, drain points, etc.
- Furnish access doors under this division for installation by General Contractor. Coordinate during bidding phase with General Contractor.
- Indicate the locations of access doors for each concealed valve, control, damper, or other device concealed behind finished construction and requiring service on the coordination drawings. Equipment below floor slab or finished grade shall be also be indicated on the coordinating drawings.

2.13 PAINTING

Painting requirements of this section shall confirm to relevant standards. Refer guide specifications for painting provided in this tender.

All Hydrant exposed pipes shall be painted with 1 coat of 50-micron DFT of Zinc dichromate/Phosphate Epoxy Primer followed by two coats of 1 x 50-micron DFT Acrylic Polyurethane Finish paint of approved shade shall be applied (minimum total DFT of 150 micron). Paint used for this work shall be lead free quality. The cost of painting shall be inclusive in the respective items. All M.S. pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat, paint shall be applied. Each coat shall be given minimum 24 hours drying time. Wherever required, all pipe headers shall be worded indicating the direction of the pipe and its purpose etc. Wherever required, all pipe headers shall be worded indicating the direction of the pipe and its purpose etc.

Painting shall be expertly applied; the paint shall not over run on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.

Provide surface preparation, priming, and final coat application in strict accordance with manufacturer's recommendations.

Provide field painting of all piping, hangers, supports, equipment platforms, railings, and miscellaneous metals located outdoors (including galvanized piping). Application shall be in



strict accordance with manufacturer's recommendations.

Provide painting of mechanical items exposed in mechanical equipment room and in occupied spaces. All pipelines shall be identified with the description and direction of flow. The marking shall be done once every 30 m maximum and within 2 m of each tapping and as per client requirement

Paint color to be PO Red.

2.14 SITE ACCOMODATION

The Contractor shall make his own arrangements for providing accommodation for his workmen as accommodation at site is not possible.

2.15 WORKMEN PERMIT

The Contractor shall discharge all his obligations under the Indian Workman's Compensation Act & E.S.I. in so far as it affects workmen in his employment.

The Contractor shall make his own arrangements for procuring the necessary labor, skilled and unskilled. He should conform to all local government laws and regulations concerning labor and their employment.

The contractor and his employees will submit to the regulations in force for controlled entry into the premises where the air conditioning equipment is to be installed.

Provisions shall be made for access ladders and platforms with handrails as necessary to provide operator's safe access to inspection.

Access to the work shall be allowed only to the Contractor and his duly appointed representatives. The Contractor shall not object to the execution of work by other Contractors or tradesman and shall afford them every facility for execution of their works simultaneously with his own.

Work shall be carried out in conformation with the specifications, accompanying drawings and with the requirements of the general architectural and structural plans after approval by the Employer. The Contractor shall be responsible for taking actual measurements at site and effecting variations in the work in details, if required, to meet the site conditions. Such deviations shall however be subject to the approval of the Employer.

2.16 CO-OPERATION

The Contractor shall also co-operate with other Contractors employed by employer, compare plans, specification & time schedules & shall forward to the Employer copies of all correspondence & drawings so exchanged. Failure to check plans and conditions will render the Contractor responsible for bearing the cost of any subsequent change.

2.17 NEGLIGENCE

If the Contractor shall neglect to execute the work with the due diligence or shall contravene the provisions of the contract, the Employer may give notice in writing to the Contractor, calling upon him to make good the neglect or contravention complained of. If the Contractor fails to comply with such notice within a reasonable period, the Employer shall have the option and be at liberty to determine the contract and to take the work wholly or in part out of the Contractor's hands and complete it either by himself or his agents at a reasonable price. The Employer shall then be entitled to retain any balance payment which may otherwise be then due on the contract.

The cost of execution of such work as aforesaid will be adjusted against the payment due to the Contractor. If the cost of execution shall exceed the balance due to the Contractor, the Employer shall be at liberty to dispose off any of the Contractor's material or construction system that may be at site and apply the proceeds for payment of the difference of such cost and recover the balance by process of law, or from any moneys due to the Contractor.

2.18 INSPECTION

The Employer is at liberty to inspect the system during installation and the Contractor free of cost shall remedy defects found. The Contractor shall furnish all instruments and services



needed for the tests. Any defects and deficiencies that are noticed during these inspections will have to be attended by the Contractor from time to time.

Only after the entire installations are satisfactorily completed and the defects found during inspections rectified, the system will be ready for commissioning and then will be subjected to run at least 48 hours to demonstrate its satisfactory performance.

The contractor shall undertake to extend free training in operation and maintenance of Fire Fighting System offered by them to two technical persons of Client/ End users at site for a period of 15 days.

The choice of dates for training is to be decided in consultation with the Employer.

2.19 WARRANTY SERVICES

The Contractor shall guarantee that all material, machinery, Consumables and components, supplied, fabricated, designed and installed by him shall be free from defects due to faulty material and/or workmanship and that the system shall perform satisfactorily, and the efficiency of the system and all the components shall not be less than the values laid down in the specifications and the capacities shall be at least equal to those specified. The period of the guarantee shall be **Twelve (12) months** from the date of handing over of the System, during which period any or all components found to be defective shall be replaced or repaired free of charge and shortcoming found in the system as specified shall be removed at no extra cost. The Contractor shall provide the necessary personnel and tools for fulfilling the guarantee.

If the defects are not remedied within a reasonable time, the Client may proceed to get the defects remedied at the Contractor's risk & expenses without prejudices to his right.

The Contractor shall without any cost to the Employer carry out during the guarantee period all routine and special maintenance of the system and attend to any defects that may arise in the operation of the system.

2.20 BIDDER'S CONFIRMATION

The Bidder shall submit his confirmation with offer as under valid until end of the guarantee period.

- We confirm that tender package comprising of tender documents, drawings and relevant documents have been thoroughly studied and verified by us. We confirm that design of FFTG systems outlined by above documents and drawings meets the performance requirement of various sub systems, equipments and components as specified in the tender documents and drawings. In our opinion, the design outlined in the tender documents is the most economical and energy efficient to achieve the building services performance requirements which we are guaranteeing.
- We confirm that we have visited the site and are well aware of site conditions and status. We confirm that site location, layout and conditions are suitable for executing the MEP services work outlined in the tender and has no bearing on completion period specified in the tender.
- We confirm that the design on which this tender is prepared has been verified by us and that it meets with the requirements of all Government, Semi-Government, Municipal, local and other authorities, whose permission would become necessary for the completion of the project. We confirm that all such necessary approvals will be obtained by us without any extra cost to client.
- We confirm that the design outlined in the tender meets all safety standards and services built in eventually shall be suitable for public from all walks of life and will not create any hazard.



- We confirm that the design outlined in the tender meets all life safety requirements expected out of MEP and Life safety services in accordance with the latest global standards and practices. We also confirm that life safety systems specified in the tender supports the performance based fire engineering approach for the issues not explicitly specified in the standards.
- We confirm that we have studied the drawings furnished along with the tenders and all equipments layouts shown in the drawings are meeting the requirement of installation, access, removal and maintenance of all systems, sub systems, equipments and components. We confirm that proposed layouts indicated in the tender also suit the requirement of man power access to all equipments for necessary maintenance and handling.
- We confirm that we have understood the intent of project building services requirement and all necessary computerized simulation studies, analysis, software programming, graphic developments and hiring expert services to substantiate the design will be provided by us without any additional cost as required by client/ Consultants.
- We have reviewed the quantities specified against each item in BOQ with respect to project intent, drawings and performance requirement outlined in the tender. We confirm that quantities specified in the BOQ, is sufficient to achieve project requirement specified in several terms in the tender.
- We confirm that items specified in the BOQ are adequate to achieve the project requirements specified in several terms in the tender. We confirm that we shall be supplying and executing any such items missed out in the tender but required for completeness of contract and to meet the project requirement without any additional cost to client.
- We have reviewed the list of approved makes and confirm to adhere to it during entire contract period. We also confirm that makes specified in the tender has no bearing on completion period.
- We confirm that there shall not be any deviation to tender terms and conditions.

2.21 GENERAL REQUIREMENTS

Unless otherwise specified rate quoted under Fire protection works shall include the following:-

1. Cost of all materials, labor, equipment / tools required, conveyance, infrastructure facilities required etc. Providing scaffolding, working platforms, ladder, etc., as required and removal of the same after completion of the work.
2. Preparing the surface and treating the surfaces of Horizontal / Rising pipes, floor chipping or any other insertions etc., which may cause leakage.
3. Work shall be at all levels, heights & elevation and location. Setting out the work to profile and making the location of end fittings and pipes suitable for marking layout of piping work.
4. All works should confirm to the specification in addition to the bye laws / Local Authorities within whose jurisdiction the work is required to be done.



5. All items of work shall be carried out through experienced technicians and the standard of workmanship shall be of best obtainable. The work shall be done strictly in accordance with approved shop drawings, specifications, approved data sheets and Bill of Quantities.
6. All joints of pipes shall be made properly and secured by clamps so as to be mechanically sound and leak proof and shall satisfy hydro test for leaking and sweating joints shall be redone.
7. Work shall be executed and completed ahead of general building work and the contractor shall ensure that no damage or breakage is done. The system installation work shall be adjusted so that it does not hold up progress of general builder contractor's work.
8. Contractor's attention is specially drawn to the list of materials of approved brand/manufacture / datasheets for various items of the tender/ Bill of quantities.
9. Excavation in all kinds of soil including soft rock for concealing the pipe and chambers to required depth with all lead and lifts and in or under water including bailing out / pumping out water, shoring, strutting, refilling, ramming well, watering and consolidating and spreading the earth within the site and disposal of surplus earth carting away from the site.
10. All subsidiary fastenings, fittings and supports required for complete installation of the work.
11. Making chases or holes through concrete and/or masonry and reinstating the surface to its original condition or redoing the same to match the surroundings. While filling holes cut through concrete a suitable approved non-shrink free flow grout mix shall be added in concrete to avoid shrinkage.
12. Providing all fittings and specials for pipes such as couplings, bends, unions, tees, plugs, elbows, offsets, reducers, check nuts etc as required and wherever required. These specials, shall not be measured separately, but shall be measured in running lengths along with pipes under piping works specified elsewhere in the Bill of quantities.
13. Painting all exposed pipes, fittings, brackets, clamps, valve chamber covers/frames etc with 1 coat of 50-micron DFT of Zinc di-chromate/Phosphate Epoxy Primer followed by two coats of 1 x 50-micron DFT Acrylic Polyurethane Finish paint of approved shade shall be applied (minimum total DFT of 150 micron). All primer coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied.
14. Paint shall be ready mixed and of first quality of the approved brand and manufacturer. The paint shall generally conform to the chemical composition and other characteristics laid down in the relevant Indian standard specification.

3.0 TECHNICAL SPECIFICATIONS

3.1 PIPES AND FITTINGS

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required.



Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc.

Supports shall be with Rigid GI Channel/Angle with U Clamps for Main/Secondary distribution header, and G.I materials clamps & full thread GI stud rods threaded type anchor fasteners only shall be used of branches with purlin Support, Deck slab etc. of approved quality, as shown in the layout drawings. Data sheet for supports to be submitted for approval. Multiple Headers (2 or more) shall be supported with GI channel ISMC 150/100 with U clamps for 100mm dia pipe and above sizes. Necessary load calculation to be provided and to cross verified with collateral load.

Pipe hangers shall be provided at the following maximum spacing:

PIPE SIZE	TOTAL LOAD IN EACH SUPPORT IN KGS	SUPPORT THREADED ROD DIA, WIDTH OF CLAMP & THICKNESS OF CLAMP	MAX. SPACING IN MTRS
25 NB	5.25	8 mm, 25 mm & 1.5 mm	2
32 NB	7.05	10mm, 25 mm & 1.5 mm	2.7
40 NB	11.5	10mm, 25 mm & 1.5 mm	2.7
50 NB	16.5	10mm, 25 mm & 2.5 mm	2.7
65 NB	22.6	10 mm, 25 mm & 2.5 mm	3
80 NB	38.25	12 mm, 25 mm & 2.5 mm	3
100 NB	56.37	12mm, 25 mm & 2.5 mm	3.6
150 NB	65.50	16 mm, 30 mm & 3 mm	3.6

The cost of the fittings shall be included in the Piping costs. Costs towards fittings & supports shall not be considered separately.

- All pipes within the building in exposed locations and shafts including connections buried under floor shall be M.S. C Class ERW tubes conforming to IS-1239 up to 150 mm dia/IS-3589 for 200mm dia and above (Minimum 6 mm thick) with Butt welded joints for 65 mm dia and above and for 50 mm and below shall be socket welded. Factory Manufactured fittings shall be used for all sizes.
- Fittings shall be approved type Seamless fittings with tapered groove for welded joints for 50 mm and above. Fabricated fittings will not be accepted. For below 50 mm Forged socket welded Fittings shall be used.

JOINTING-

This covers the welding of systems. Deviations from applicable codes, approved procedures and approved shop drawings shall not be permitted. Materials or components with welds made off site shall not be accepted if the welding does not conform to the requirements of this specification. Develop and qualify procedures for welding metals included in the work. Certification testing shall be performed by an approved independent testing laboratory. Contractor shall bear cost of such testing.

Certified welders, for 6G position previously certified by test, may be accepted for the work without re-certification provided that all of the following conditions are fulfilled:

- Submit copies of welder certification test records.
- Testing was performed by an independent testing laboratory.



- The welding procedures and welders are certified and base materials, filler materials, electrodes, equipment, and processes conform to the applicable requirements of this specification.
- Certification has been within a one (1) year period from the start of the project.

Filler metals, electrodes, fluxes and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to assure safe handling.

Submit certificates of electrodes for review. Each welder assigned to work covered by this specification shall be certified by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires.

Before assigning welders to the work, provide the architect with their names, together with certification that each individual is certified as specified by engineering in-charge. No welding work shall start prior to submissions. The certification shall state the type of welding and positions for which each is certified, the code and procedure under which each is certified, date certified, and the firm and individual certifying the certified tests.

Each welder shall be assigned an identifying number, letter, or symbol that shall be used to identify his welds. A list of the welders' names and symbols for each shall be submitted. To identify welds, either written records indicating the location of welds made by each welder shall be submitted, or each welder shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved method that does not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3 foot intervals. Identification by die stamps or electric etchers shall be confined to the weld reinforcing crown, preferably in the finished crater.

Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a certified welder using qualified welding procedures.

EXECUTION

Perform welding in accordance with qualified procedures using certified welders. Weldings shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions.

Field bevels and shop bevels shall be by mechanical means, i.e. using grinders/cutting machines, not by flame cutting.

The following sizes of electrodes to be used for welding. Root – 2.5 mm dia.

Filler – 3.15 mm dia. Final – 3.15 mm / 4 mm.

Minimum 2.5 mm gap for Root should be maintained with 'V' groove for butt welded joints.

Replace and reinspect defective welds. Repairing defective welds by adding weld material over the defect or by peeling shall not be permitted. Welders responsible for defective welds must be recertified.

Store electrodes in a dry heated area; keep free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.

Joints between M.S.

pipes of 50 mm and below shall be made by providing socket welded/threaded fittings. Wherever flanges are welded to the pipe, the same shall be fastened with standard nut bolts and 3 mm thick neoprene gaskets. All the pipe joints after welding shall be applied with zinc spray to maintain the galvanizing of the pipes.



PIPEPROTECTION-

All Hydrant exposed pipes shall be painted with 1 coat of 50-micron DFT of Zinc dichromate/Phosphate Epoxy Primer followed by two coats of 1 x 50-micron DFT Acrylic Polyurethane Finish paint of approved shade shall be applied (minimum total DFT of 150 micron). Paint used for this work shall be lead free quality. The cost of painting shall be inclusive in the respective items. All M.S. pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat, paint shall be applied. Each coat shall be given minimum 24 hours drying time. Wherever required, all pipe headers shall be worded indicating the direction of the pipe and its purpose etc. Wherever required, all pipe headers shall be worded indicating the direction of the pipe and its purpose etc.

Painting shall be expertly applied; the paint shall not over run on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.

Provide surface preparation, priming, and final coat application in strict accordance with manufacturer's recommendations.

Provide field painting of all piping, hangers, supports, equipment platforms, railings, and miscellaneous metals located outdoors (including galvanized piping). Application shall be in strict accordance with manufacturer's recommendations.

Provide painting of mechanical items exposed in mechanical equipment room and in occupied spaces. All pipelines shall be identified with the description and direction of flow. The marking shall be done once every 30 m maximum and within 2 m of each tapping and as per client requirement

Paint color to be PO Red.

WRAPPING COATING OF UNDERGROUND PIPES

Pipes buried in soil shall be treated by applying one coat of primer and covered with 4 mm anticorrosive bituminous tape after successful completion of hydraulic testing of piping network. Tape should be with tough 45 GSM fiber glass and bottom core of 15 microns high Tensile strength HMHDPE.

Application of 4mm Tape Clean the surface of the pipe with a wire brush or an emery paper to remove all loose scales of Rust. Then clean the pipe with water and wipe it with a dry piece of cloth. After the primer is applied on the pipe, it is allowed to dry for about 30 min. till it becomes touch dry. Before adhering the tape to the pipe, gently heat the primer coated pipe by a run of LPG torch. Remove the bottom polyethylene from the tape & then heat bottom surface of the tape by LPG torch or any heat source & start wrapping the tape to the pipe by heating the primer coated pipe & by removing the bottom polyethylene from the tape before wrapping better adhesion between the tape & pipe is obtained. Overlaps are maintained with a minimum of 25 mm. Tape coating of weld joints - The tape is applied over the weld joints after the necessary welding & testing methods of the joints is completed. The procedure for application of tape shall be the same as bare pipe procedure. Overlaps on each side of the weld joints shall be 50 mm.

Holiday Test

For all the underground pipes, protected with wrapping and coating, holiday testing shall be conducted for proper workmanship i.e. Holiday detectors shall be used with high voltage between the pipes & spring coil electro designed to roll over the coated surface. At any point, where there is defect of 'holiday' in the continuity of the coating, a pronounced 'ARC' occurs which will be visible and also audible. These spots have to be subsequently repaired



with further coating. A minimum of 14,400 Volts shall be applied for the 4 mm thick wrapping & coating.

Wrapping & Coating to be done for Minimum 300 mm above the Finished Ground Level for the Pipes come out from Under Ground.

3.2 VALVES

BUTTERFLY VALVES OF PN 16

Butterfly valves of PN 16 rating shall be of SG iron conforming to IS 1865 Gr.450/10. Butterfly Valves shall be Lever operated for 50 / 80 / 100 / 150 and for 200 & above Gear operated.

Name	Butterfly Valve
Pressure Rating	PN 16
Design Standard	BS 5155
Body	SG iron conforming to IS 1865 Gr.450/10
Disc	SG iron conforming to IS 1865 Gr.450/10
Service	Water
Vacuum	Full
Disc Coating	Nylon Coated
Body Liner	EPDM Integrally Moulded
O Ring	EPDM
Vapor	N.A.
Op. Temperature – Min/Max (°C)	Ambient

CAST IRON NON – RETURN VALVES

Cast Iron double flanged swing type non-return valve of PN 16.

Name	Non-Return Valve
Type	Swing Type
Service	Water
Op. Temperature – Min/Max (°C)	Ambient
Op. Pressure – Min/Max (kg/cm ² (g))	7.0
Rated Pressure of Valve, minimum required – (kg/cm ² (g))	PN 16
Test Pressure	22
End	Flanged
Material of Construction	Cast Iron

CAST IRON GATE VALVES – PN 16

CI Gate Valves of PN 16, Valve shall be flanged end type. Gate Valves shall be of Rising Spindle. Tamper Switch shall be UL Listed / FM Approved.

Name	Gate Valve Flange End 150#
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Type	Rising Spindle Type
Design Standard	IS 780
Service	Water
Op. Temperature – Min/Max (°C)	Ambient
Op. Pressure – Min/Max (kg/cm ² (g))	7.0
Rated Pressure of Valve, minimum required	PN 16
Seat Hydrostatic Pressure(kg/cm ² (g))	21
End	Flanged RF
Material of Construction	
Body	Cast Iron
Stem	SS 316
Gasket	Neoprene
External Surfaces	Epoxy Painted
Body Test Pressure (kg/cm ² (g))	21

BALL VALVES

Ball valve of 15 / 25 / 32 / 40 / 50 dia as per IS; 778 with fittings as required for instruments / draining any water in the system / Risers in low points.

S.no.	Description	Material of Construction & Specifications
1	Name	Ball Valve (Screwed type)
2	Body	Forged Brass conforming to IS 6912 Gr. FLB
3	Bonnet	Forged Brass IS 6912 Gr. FLB
4	Ball	Forged Brass (Hard Chrome Plated) IS 6912 Gr. FLB
5	Body Seat Ring	PTFE conforming to BS EN 12086 – 1
6	Thrust Washer	PTFE conforming to BS EN 12086 – 1
7	Gland Packing	PTFE conforming to BS EN 12086 – 1
8	Stem	Forged Brass conforming to IS 6912 Gr. FLB
9	Gland	Forged Brass
10	Lever	Aluminium Alloy / Mild Steel
11	Nut	Brass (Chrome Plated)

AIR RELEASE VALVES

The contractor shall provide 25 mm dia. Screwed inlet G.M. single acting air valve shall be fixed on all high points in the system with ball valves or as shown on drawings.

Name	Stainless Steel, Air Release valve
Type	Single ball type
Model No.	As per product
Service	Water



Vacuum	Full
Vapor	N.A.
Op. Temperature – Min/Max (°C)	Ambient
Op. Pressure – Min/Max (kg/cm ² (g))	11 / 16
End	1" BSP (M) threaded
Material of Construction	
Body	Gun Metal

Pot type/ Y Type strainer:

Pot type / Y Type strainer shall consist of cast iron body and cover with a removable perforated SS strainer.

Working pressure: 10 kg/CM².

Test pressure: 15 kg/CM²

End connection: Flange type

3.3 Pressure Gauges with Syphon & Valve

General	
Type	Bourdon Sensing Pressure Gauge, Glycerin Filled
Dial Size	150 mm (6") / 100 mm (4") as per BOQ
Case	Weatherproof IP-65, Die cast Aluminum Material
Glass	Toughened, Shatterproof
Pointer	Micrometer type, Aluminum Black Colored
Zero Adjustment	Required externally
Accuracy	± 1% of FSD
Dial	Single Black marking on white background
Bezel Ring	Screwed type/Bayonet Type
Process Connections	1/ 2" BSPT (M)
Pressure Range	0 to 16 Kg/cm ² (g)
Over Range Protection	130 % Of Range span
Blow Out Disc	Required (Neoprene)
Material	
Bourdon	SS 316
Socket	SS 316
Movement	SS 304
Case	Die Cast Aluminum
Bezel Ring	Die Cast Aluminum
Accessories	For requirement refer attached annexure
Syphon	½" BSPT (F) x ½" BSPT (M), SS 304
Snubber	½" BSPT (M) x ½" BSPT (F), SS 304

3.4 PRESSURE SWITCH

The pressure switches shall be employed for starting and shutting down operation of



pumps automatically, dictated by line pressure. The Pressure Switch shall be diaphragm type. The housing shall be die cast aluminium, with SS 316 movement, pressure element and socket. The set pressure shall be adjustable.

The Switch shall be suitable for consistent and repeated operations without change in values. It shall be provided with IP: 55 water and environment protection.

3.5 ORIFICE PLATES-

The contractor shall provide orifice plates fabricated from 6 mm thick stainless steel plate to reduce pressure on individual hydrants to restrict the operating pressure to 5.5 Kg./Cm² and allow a discharge of 900 LPM. **The design of the orifice plates shall be given by the contractor as per the location and pressure conditions of each hydrant / hose reel for approval before installation.**

3.6 YARD HYDRANTS-

The hydrant system in the yard shall be furnished with external hydrants consisting of landing valve (positioned approx. one meter above ground level) fitted on M.S. standpipes installed on underground hydrant headers distributed 45 M apart approximately.

The approximate number of hydrants to be provided and installed is as given in the Bill of Quantities. The hydrant shall be conforming to IS: 5290.

By the side of each hydrant, there shall be a hose box of MS painted finish adequate size to house 2 Nos. 63 mm RRL hoses IS: 636 each 15 mtrs long, complete and bound with SS 304 instantaneous male and female couplings (IS: 903) each of 15 M length and a short SS 304 Branch pipe with Nozzles.

3.7 FLOOR FIRE HYDRANTS-

Hydrants inside the building shall be located on every landing of the floor furnished with required accessories such as hosepipes with instantaneous SS 304 couplings and short pattern branch pipes located in hose cabinets. The hose cabinets shall be of wall/column mounting type, constructed out of 16 gauge G.I. sheets. Contractors shall submit drawing & schedule of items and shall get it approved by EIC prior to delivery.

The internal hydrants (Landing Valves) shall be of Single headed type taken out from 150 / 100 mm dia riser through suitable tapping. The outlets shall be of SS 304 and confirm to IS-5290. The Hose reels shall be firmly held against the wall by suitable heavy brackets and supports. The hose reel shall be fixed type and the entire Drum reel etc. shall be as per IS: 3876. The hose tubing shall be of best quality (shut off) and the shut off nozzle shall be 6 mm dia. The equipment shall be out of one of the approved makes only.

3.8 HOSE REEL

Hose reel shall be circular made of Heavy Duty MS fixed type with mounting base plate confirming to IS 884. Hose reel shall consist with 25 mm dia high-pressure Nylon braided hose of 36.5 Mtrs length with SS nozzles. Hose reel water shall be tapped off from the wet riser with Ball valve. The hose reel shall be installed in fire hose duct inside the building.

3.9 LANDING HYDRANT VALVE

The landing valve (internal) shall be SS Single Headed type conforming to IS: 5290 complete with hand wheel, quick coupling, spring and blank cap. 2 Nos. of RRL type hose pipe of 63mm dia and 15 mts. length as per IS: 636 with 63mm dia instantaneous type SS heavy duty



couplings & SS Branch pipe and nozzle to be provided. Fire hoses and branch pipes shall be mounted inside the fire shaft with suitable supports.

3.10 FIRE HOSE

RRL (REINFORCED RUBBER LINED) TYPE A:

Fire hoses shall be Reinforced Rubber Lined (RRL) type A as per IS: 636 & 63 mm dia and 15 mts long. Hoses shall be bounded by Copper wire to heavy-duty instantaneous SS couplings as per IS 903. Working Pressure shall be 14 Kg/ Sq.cm, Test pressure shall be 21 Kg/ Sq.cm and Burst pressure shall be 35 Kg/ Sq.cm.

3.11 BRANCH PIPE WITH NOZZLE

Branch pipe shall be SS, 63 mm dia with Nozzle of 19 mm dia made as per IS: 903 and suitable fitted with hoses.

3.12 HOSE CABINET

Hose cabinet shall be fabricated by M.S. sheet of 16 swg and size shall be 750mm x 600mm x 250mm. Hose cabinet shall have glass fronted double door fitted with 4mm thick clear glass & powder coated finish of red outside & white inside. Cabinet shall be suitable for stand mounting and shall have built in breakable glass type feature to keep key with locking arrangement and bear the words "Fire Hose Cabinet" in prominent position.

3.13 FIRE BRIGADE INLET CONNECTION (FBIC)

FBIC shall be confirming to IS 5131. External Hydrant shall be equipped with SS four way connecting head with 4 Nos. 63 mm dia instantaneous type inlets with built in check valve and One 150mm dia Flanged outlet connection to the fire main grid with 150mm dia Butterfly valve and non – return valve. The fire brigade inlet shall be connected to Under Ground Fire Water Tanks and Fire Water Main headers for use by Local Fire Brigade.

2 Way Fire Brigade Inlets shall be provided with built in check valve and one 100mm dia Butterfly valve and non – return valve to connect the Risers of Hydrant.

3.14 AIR VESSEL

The air vessel shall be provided to compensate slight loss of pressure in the system and to provide an air cushion for counter acting pressure, surges, whenever the pumping sets come into operation. Air vessel shall be fabricated with minimum of 10 mm thick M.S. plate with dished ends having minimum 12 mm Thk. and suitable supporting legs. It shall be provided with one 25 mm dia connection from pump delivery, one 25 mm drain with valve, one water level gauge and 25 mm sockets for pressure switches. The air vessel shall be tested to 1.5 times of working pressure for duration of 2 Hours. The size of the Air Vessel shall be 450 mm dia x 2000 mm height. Air Vessel shall be painted with 1 coat of 50-micron DFT of Zinc dichromate/Phosphate Epoxy Primer followed by two coats of 1 x 50-micron DFT Acrylic Polyurethane Finish paint of approved shade shall be applied (minimum total DFT of 150 micron). Paint used for this work shall be lead free quality.

3.15 EXPANSION BELLOWS:

Expansion Bellows:



a.	General	
	Design Standards	ASTM F1120 , EJMA 10
	Type	SS 304 EXPANSION JOINTS WITH FLOATING FLANGES ON BOTH SIDES.
	Working Pressure	7.0 Kg / Sq.cm
	Test Pressure	16 Kg / Sq.cm
	Lateral Movement	2 mm.
	Axial Movement	+/- 10 mm.
	Size	80 mm and above
b.	MATERIAL	Stainless Steel Bellow with Carbon Steel Flanges and Tie Rods

3.16 HAND APPLIANCES

Codes and Standards

The following shall be followed

- Tariff Advisory Committee Rules
- Bureau of Indian Standards

(A). ABC Type Dry Powder Extinguisher (Minimum Fire Rating 3A:21B)

- The Extinguisher shall be filled with ABC Grade 40, Mono Ammonium Phosphate 90% from any approved manufacturer.
- When filled with Dry Chemical Powder (First filling) as per IS 14609. Part II, it shall be 6 Kg. $\pm$ 2% or 9 Kg. $\pm$ 3%.
- Shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shall have a safety pin tied with soft rubber material and provided with tamper indicator, to prevent accidental discharge. It shall be pressurized with Dry Nitrogen, as expellant. The Nitrogen shall be charged at a pressure of 15 Kg /Square cm.
- The Body shall be of mild steel, conforming to relevant IS standards. The neck ring shall also be of mild steel and welded to the body. The discharge valve body, shall be forged brass or leaded bronze, while the spindle, spring and siphon tube shall be brass. The nozzle shall be of brass, while the hose shall be of braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.
- The Neck Ring shall be externally threaded, the threading portion being 1.6 cm. The filler opening in the neck ring shall not be less than 25 mm. (actual 28.5mm). The discharge nozzle shall be cramped to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85% of contents up to a throw of 4 mtrs, continuously, at least for 15 seconds. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia internally for 6 Kg. capacity, and 12 mm dia for 9 Kg. capacity. It shall have a pressure gauge fitted to the valve assembly or the cylinder to indicate pressure available inside. The extinguisher shall be treated with anti-corrosive paint, and shall be labelled with words ABC, 2.5 mm high, within a triangle of 5 cm. on each face. The extinguisher body and have assembly shall withstand an internal pressure of 30 Kg./Square cm. for a minimum period of 2 minutes. The pressure gauge shall be imported and suited for the purpose.



(B). CARBON DIOXIDE EXTINGUISHER (Minimum Fire Rating 21B)

The Carbon Dioxide Extinguisher shall be as per IS 15683-2006.

The body shall be constructed of seamless manganese steel conform to IS 7285, and have a convex dome and flat base. Its dia shall be maximum 140 mm. and the overall height shall not exceed 720 mm.

The discharge mechanism shall be through a control valve, conforming to IS-3224. The internal siphon tube shall be of copper or aluminium, conforming to relevant Specifications.

The Hose pipe shall be high pressure braided Rubber hose with a minimum burst pressure of 140 Kg /Cm², and shall be approximately 1.0 meter in length, having an internal dia of 10 mm. The discharge horn shall be of high quality unbreakable plastic, with gradually expanding shape, to convert liquid carbon dioxide into gas form. The handgrip of the Discharge horn shall be insulated with Rubber of appropriate thickness.

The gas shall conform to IS-15222 and shall be stored at about 85 Kg /cm². The expansion ratio between stored liquid carbon dioxide to expanded gas shall be 1:9, and the total discharge time (effective) shall be minimum 8 secs. As per IS 15683 requirements.

The extinguisher shall fulfill the following test pressures:

1.	Cylinder	:	236 Kg/Cm ²
2.	Control Valve	:	125 Kg/Cm ²
3.	Burst Pressure of Hose	:	140Kg/Cm ² minimum

It shall be an Upright type. The cylinder, including the control valve and high pressure discharge hose shall comply with relevant statutory regulations, and be approved by chief controller of Explosives, Nagpur and also bear IS marking.

The Extinguisher, including components, shall be IS marked.

(C). MECHANICAL FOAM TYPE FIRE EXTINGUISHERS

The foam extinguishers shall be as per IS: 15683 (50 Ltrs. Capacity) Filled with AR-AFFF foam

The extinguisher shall be treated for anti-corrosion internally and externally powder coated with Pure Polyester Fire Red/PO red Shade confirms to IS 5.

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The body of the extinguishers shall be steel welded. The neck ring shall be of seam less pipe with external thread. The locking ring & cap shall be brass stamping nickel plated.

The CO₂ Gas Cartridge shall be of 60 gms Capacity. The overall height & width of the extinguishers shall be 595 mm & 210mm respectively. The extinguisher, body and Squeeze grip Valve shall be treated to an internal hydraulic pressure of 35 Kg/cm². The extinguisher shall be upright in operation, with the body placed on ground and discharge tube with nozzle held in one hand to give a throw of not less than 6 Mtrs, and duration 25 to 35 seconds (as per IS min. 8 seconds)

3.17 PASSIVE FIRE PROTECTION SYSTEM



(A). Intumescent coating Fire stopping System:

This system is to be used for the sealing of service shaft like plumbing, firefighting and electrical shafts openings in the Wall penetration.

Technical Specification of Composite Board

Fire barrier for sealing of wall openings application with a Intumescent coating Fire stopping System used in combination with Mineral Wool Board tested in accordance to EN 1366-3, ETA-16/0523 standards and capable of providing a fire resistance up to 2 hrs. The product along with the system should be designed for use with single cables, cable bundles, cable trays, combustible and non-combustible pipes, fire dampers and also insulated ventilation systems to prevent the spread of smoke, fire and heat.

Application Details in accordance EN 13501 for water based hybrid firestop coating on mineral wool board of minimum density 140 Kg/M3, melting point > 1000 Deg C.

The system is tested for a maximum opening size of 1000 mm width and 3000 mm height and openings larger than this shall be done with the help of separation elements.

All the services penetrating through the opening mineral wool board 2 x 50 mm thickness to be coated with Intumescent coating fire stopping system. A coating of minimum 0.7mm dry film thickness (DFT) including 50mm on the perimeter of the mineral wool board, sealed thoroughly on both the sides. Identical services (cables) to be bunched together for proper sealing. On the cable trays, cable ladders (plates & flanges), metal pipes to be back coated along their length till 100 mm minimum with a dry film thickness of 1mm (DFT) for a rating of EI 120min.

The system shall be tested with the through penetrants and shall have a valid report or a Engineering Judgement supporting the same.

(B) MORTAR SYSTEM:

This system is to be used for the sealing of Service Shafts like, Fire Fighting Shaft, Chilled Water, Electrical and Plumbing Shaft etc. and openings in the Floor penetration.

Technical Specification of Mortar system

Fire barrier for sealing of floor openings applying gypsum based Mortar System tested in accordance with to UL 1479, BS 476 (Part 20) and IS 12458: 2019 standards and capable of providing a fire and smoke resistance for 120 minutes for both E (Insulation) & I (Integrity) followed by hose-stream test. For floor penetrations, install 8mm dia. rebar with no less than 200mm C/C spacing in both directions and secure the same with 25mm x 25mm x 1.5mm thickness square mesh. Provide/install 2 no's (layers) of 50mm thick rock wool insulation having 140 Kg/M3 density over wire-mesh. Once the rock wool is secured in place, install / pour gypsum based Mortar system to a depth of 40mm adhering to manufacturer's installation guidelines (total depth of the system is minimum 140mm). Chalk the perimeters joints between Rockwool and floor-slab with an acrylic based sealant, and all the combustible and non-combustible penetrant to be chalked with sealant or wrap having intumescent property to maintain the over-all integrity of the system. The system shall be tested with the through penetrants and shall have a valid report or EJ in case of deviation supporting the same. Mortar shall carry Test certificate in accordance with IEC 60068-2-57-11 (Environmental Testing) as per part 2-57: Test for vibration-Time- History method & VERTEQII for seismic Zone 4. Product shall be UL Listed.

(C). High Density Structural Calcium Silicate Board

High Density Structural Calcium Silicate Board & Intumescent coating Fire stopping System for Hybrid Fire stopping System - to Achieve EI120 for Rigid or Flexible Wall penetration and EI90



for Rigid Floor penetration (Tested System) for Wall Opening and Floor Opening for the Bus Bar.

Application of System.

Firestop Application for the Busbar penetration with High Density Structural Calcium Silicate Board & Intumescent coating Fire stopping System for Hybrid Fire stopping System - to Achieve EI120 for Rigid or Flexible Wall penetration and EI90 for Rigid Floor penetration (Tested System)

The construction product High Density Structural Calcium Silicate Board & Intumescent coating Fire stopping System Hybrid Fire stopping System penetration seal for Bus bars are defined as penetration seals in horizontal and vertical orientation in flexible and rigid constructions.

The function of the product is to resist fire in accordance with typical product reactions as described in clause 5 of EN 13501:2016.

The construction product High Density Structural Calcium Silicate Board which is a non-combustible material along with Intumescent coating for Hybrid Fire stopping System penetration seal for Bus bars is water based fire stop coatings in combination with non-combustible mineral wool boards. Due to its intumescent action in case of fire, the construction product Intumescent coating penetration seal for Bus bars ensures safe protection against flue gas, heat transfer and fire spread along building component connections and installations.

(D). Fire Sealant: Acrylic Fire Stop Sealant with minimum 2 Hours Fire Rating when tested in accordance with UL 1479 standards, shall be used along periphery of services like Ducts, Pipes, Cable Trays etc without insulation passing through Fire Rated walls & Floors made of concrete, masonry, Metal, Gypsum construction to provide up to 2 Hours insulation & Integrity when subject to the test conditions of UL 1479 standards. Product should be tested for mold resistance as determined by ASTM G-21-96 & shall have a VOC content of approx. 75g/Ltr as per LEED 2009. The sealant to be tested in accordance with IEC 60068-2-57:1999-11 (Environmental Testing) as per part 2-57: Test for vibration-Time- History method & VERTEQII for seismic Zone 4. Product shall be UL Listed.

3.18. AUTO GLOW SIGNAGES

Auto Glow Signages should be a non-toxic and non-radioactive pigment made up of rare earth aluminate file coated over Aluminium, Acrylic and rigid PVC Sheet that the Glow in Dark Signage absorbs and stores energy from any ambient or UV light source, then it releases this energy in event of Darkness. This process should work in two phases. The first phase consist of strong immediate glow, followed by a decrease in brilliance within first 90 minutes. This should glow for 10 to 12 Hours. The glow should be complied with DIN 67510 Part – I.

4.0 CIVIL WORK

4.1. EXCAVATION

Excavations for pipelines shall be to levels and grades shown on the drawings or as required at site. Pipelines shall be buried to a minimum depth of 1 to 1.5 meter or as shown on the drawings.

Wherever required contractor shall support all trenches or adjoining structures with adequate timber supports.

On completion of testing trenches shall be refilled with excavated earth in 15cm layers and consolidated.



Contractor shall dispose of all surplus earth within a lead of 200 meters or as directed by the Engineer-in-Charge.

4.2. SLUICE / BUTTERFLY VALVE CHAMBERS-

A masonry pit of internal dimension of 1.2m x 1.2m x 1.5m depth or more as per site conditions shall be built to accommodate each of the valves placed externally. The walls shall be of 230mm thick brickwork with a base of 100mm thick PCC (1-cement: 3-sand: 6-coarse aggregate). The walls shall be plastered from both sides with a coat of cement mortar and finished with a coating of cement slurry. Valve chambers shall be provided with heavy duty G.I. Plate covers and frames with angle. Valve chambers shall also have RCC top slabs with reinforcement as required. The structure shall be cured for 7 days. One of the walls shall be provided with MS iron rungs of 20mm dia, painted with one coat of primer and two coats of paint. The rungs shall be spaced at 300 mm intervals.

The gap between the finished bottom of valve chamber and bottom of the flanges of butterfly valve should be minimum 150 mm.

5.0. FIRE PUMPS AND ANCILLIARY EQUIPMENTS

SCOPE OF WORK-

Work under this section shall consist of furnishing all labor, materials, equipment and appliances necessary and required to completely install electrically operated pumps and as required by drawings and specified hereinafter or given in the schedule of rates.

- a. Electrically operated pumps with motors common base plates, coupling, coupling guard and accessories.
- b. Vibration eliminator pads and foundation bolts.
- c. Leak-off drain shall be led to the nearest floor drain.

GENERAL REQUIREMENTS

Pumps shall be installed true to levels on suitable concrete foundations. Base plate shall be firmly fixed by properly grouted foundation bolts.

Pumps and motors shall be truly aligned by suitable instruments. Record of such alignment shall be furnished to the Project Manager.

All pump connections shall be standard flanged type with number of bolts as per relevant standard requirement for the working pressure. Companion flanges shall be provided with the pumps.

Manufacturer's instructions regarding installation, connections and commissioning shall be strictly followed.

Contractor shall provide necessary test certificates, type test certificates, performance curves and NPSH curves of the pumps from the manufacturer when called for. The contractor shall provide facilities to the Project Manager & Consultant for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the Project Manager or Consultant.

Seismic isolation and clamping for each pump and flexible connection on the suction as well



as the discharge side shall be provided.

The contractor shall submit with this tender a list of recommended spare parts for three years of normal operation and quote the prices for the same as a separate submittal / annexure.

ELECTRIC FIRE PUMP

The electric fire pump shall be suitable for automatic operation complete with necessary electric motor and automatic starting gear, suitable for operation on 415 volts, 3 phase, 50 Hz. A.C. system. Both the motor and the pump shall be assembled on a common base plate, fabricated M.S. channel.

Drive

The pump shall be direct driven by means of a flexible coupling. Coupling guard shall also be provided.

FIRE PUMP

The fire pump shall be horizontally mounted centrifugal type. It shall have a capacity to deliver 2280 LPM as specified, and developing adequate head so as to ensure a minimum pressure of 3.5 Kg/Sq.cm at the farthest outlet.

The pump shall be capable of giving a discharge of not less than 150 per cent of the rated discharge, at a head of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

Provision of Jockey Pump shall be made. The pump shall be vertical type and of detail as in schedule of quantity. The Jockey pump shall be of 180 LPM.

Motor

The motor shall be squirrel cage A.C. induction type suitable for operation on 415 volts 3 phase 50 Hz. system. The motor shall be totally enclosed fan cooled type conforming to protection clause IP 55. The class of insulation shall be F. The synchronous speed shall be 2900 RPM as specified. The motor shall be rated for continuous duty and shall have a horse power rating necessary to drive the pump at 150 per cent of its rated discharge with at least 65 per cent rated head. The motor shall conform to I.S.325-1978.

Technical Parameters and MOC for the Pump Sets are:

5.1. ELECTRICAL DRIVEN PUMP SET: (FOR HYDRANT SYSTEM)

Type of Pump: Horizontal Centrifugal.

Flow Rate: 2280 LPM

Head: 70 M.

Efficiency: Minimum 70%

Motor Rating: 75 HP.

Speed of Motor: 2900 RPM

Motor Type: AC 3 Phase Induction.

Enclosure: TEFC IP 55.



Insulation: Class 'F'

MOC OF PUMP:

Casing: C.I.

Impeller: Bronze.

Wear Ring: Bronze.

St. Box Sealing: Gland Packing.

Shaft: SS-410.

Shaft Sleeve: SS-410.

5.2. JOCKEY PUMP SET:

Type of Pump: Vertical.

Flow Rate: 180 LPM

Head: 70 Mtrs

Efficiency: Minimum 48%

Motor Rating: 7.5 HP.

Speed of Motor: 2900 RPM

Motor Type: AC 3 Phase Induction.

Enclosure: TEFC IP 55.

MOC OF PUMP:

Casing: C.I.

Impeller: Bronze.

Wear Ring: Bronze.

St. Box Sealing: Mechanical Seal.

Shaft: SS-410.

Shaft Sleeve: SS-410.

5.3. DIESEL ENGINE DRIVEN PUMP SET:

Type of Pump: Horizontal Centrifugal.

Flow Rate: 2280 LPM



Head: 70 M.

Efficiency: Minimum 75%

Engine Rating: 75 HP.

Speed of Engine: 2300 RPM

MOC OF PUMP:

Casing: C.I.

Impeller: Bronze.

Wear Ring: Bronze.

St. Box Sealing: Gland Packing.

Shaft: SS-410.

Shaft Sleeve: SS-410.

GENERAL REQUIREMENTS-

Pumps shall be installed true to level on suitable concrete foundations; Base plate shall be firmly fixed by foundation bolts grouted in the concrete foundations. Foundations shall be casted on the reinforcement steel of the floor.

Pumps and motors shall be truly aligned by suitable instruments.

All pump connections shall be standard installation; connections and commissioning shall be followed with respect to all pumps and accessories.

Manufacturer's instructions regarding installation, connections and commissioning shall be followed with respect to all pumps and accessories.

6.0. FIRE PUMP CONTROL PANEL:

TYPE OF PANEL:

All the PCC's / PDB's / MCC's shall be metal clad, totally enclosed, rigid, floor mounted, air - insulated, cubical type suitable for operation on three phase / single phase, 415 / 230 volts, 50 Hz.

The PCC's / MCC's shall be designed to withstand the heaviest conditions at site, with minimum expected ambient temperature of 45 degree Celsius, 80 percent humidity and dusty weather.

Panel shall conform to Indian Electricity Act and rules (till last amendment) & approved as per FIA norms.



VARIOUS CODES FOR ELECTRICAL PANELS

A. APPLICABLE IS STANDARDS

1. METERS (MEASURING) FOR ANALOG METERS 1958	IS: 1248-
2. INSTALLATION AND MAINTENANCE OF SWITCH GEARS 1975	IS: 3072-
3. AIR BREAKER, SWITCH GEARS FOR VOLTAGE NOT EXCEEDING 1000 VOLTS 1977	IS: 4047-
4. GENERAL REQUIREMENTS FOR SWITCH GEAR AND GEAR FOR VOLTAGE NOT EXCEEDING 1000 VOLTS	IS:4237-1967
5. DEGREE OF PROTECTION PROVIDED BY ENCLOSURES FOR LV S/GEARS	IS: 2147-1962
6. INSULATED CONDUCTOR RATING 1972	IS: 8084-
ENCLOSED DISTRIBUTION FUSE BOARDS AND CUT-OUTS	
7. FOR VOLTAGE NOT EXCEEDING 1000 VOLTS 1983	IS: 2675-
8. CONDUCTOR FOR INSULATED ELECTRIC CABLES AND FLEXIBLE CORDS	IS: 8130
9. SHUNT CAPACITORS FOR POWER SYSTEMS	IS: 2834-1954
10. AC ELECTRICITY METERS: PART – 1 GENERAL REQUIREMENT AND TESTS PART1	IS:772
11. DIRECT ACTING ELECTRICAL INDICATING INSTRUMENTS	IS: 1248
12. CURRENT TRANSFORMERS	IS: 2705
13. ELECTRICAL RELAYS FOR POWER SYSTEMS PROTECTION	IS: 3231
14. PHOSPHATE TREATMENT OF IRON AND STEEL FOR PROTECTION AGAINST CORROSION	IS: 3618
15. GUIDE FOR MARKING OF INSULATED CONDUCTOR	IS: 5578
16. CODE OF PRACTICE OF PHOSPHATING OF IRON AND STEEL	IS: 6005
17. FACTORY BUILT ASSEMBLIES OF SWITCHGEAR AND CONTROL- GEAR FOR VOLTAGES UPTO AND INCLUDING 1000V AC AND 1200V DC.	IS: 8623
18. GUIDE FOR UNIFORM SYSTEM MARKING AND IDENTIFICATION OF CONDUCTORS AND APPARATUS TERMINALS	IS: 11353
19. LV SWITCHGEAR AND CONTROL GEAR (PART 1 TO PART 5)	IS: 13947
20. STRUCTURE CONSTRUCTION (IP-54)	IS: 2147
21. MINIATURE CIRCUIT BREAKER (MCB)	BS: 3871 (PART-1) 1965 IS: 8825 (1996)
22. AIR CIRCUIT BREAKER	IS: 2516 PART 1,
23. CONTACTORS	IS: 2959 & BS: 775
24. DIGITAL METER	IS: 13779
25. ELECTRICAL POWER & CONTROL WIRING CONNECTION WIRING INSIDE THE MODULE FOR POWER, CONTROL PROTECTION	IS: 694 & IS: 8130
26. DANGER NOTICE PLATE	IS: 2551-1982 & IS: 5-1978
27. MCCB	IEC 60439-2 / IS: 8623-2
28. ELCB	BS 3871 & 4293, IS., CEE 27

Tube Based Fire Suppression System:

Fire sense Automatic Fire detection and firefighting system consisting of cylinder filled with HFC227 Clean Agent gas (UL Approved) with all necessary DLP valve, pressure gauge suitable to work automatically when fitted with sensitive Polymer Base tube.



Cylinder: - Cylinder should be made from mild steel. Cylinders to be hydro tested to 30 kg/cm² for leakage and 110 kg/cm² at burst pressure. Cylinder to be duly hot phosphate & epoxy powder coated internally & externally with not less than 65 microns.

Valve: - Valve should be of SS304.

Clean Agent: - Clean agent should be UL Listed.

Sensor tube: - Sensor tube should be UL Listed and actuate between 90°C to 110°C. Working pressure should be 20 bar. ID of tube should be 4 mm inner dia & dia of 6 mm with tolerance of ± 0.13 mm for inner dia & ± 0.08 mm for outer dia.

The Panel Structure shall be:-for TTA PANEL (Panel Design shall confirm to IEC 61439, Type tested design) – For All 3B & 4B panels shall be IEC 61439 type tested panels by OEM's. Only 2B panels shall be system integrated panels approved as per the approved makes list.

The Panel shall be totally metal enclosed, Symmetrical, stable profile frame construction, consisting of rolled hollow section with punching in the DIN measure raster of 25mm. All profile edges rounded. Vertical profiles with two assembly levels for space-saving interior fittings. Floor mounted, free standing cubicle type with MCCB and ACB with compartmentalized design of form 4b as per IEC 61439 -1&2 with dedicated terminal boxes (rear side of feeder/dedicated common VCA) as per current ratings of feeders and having knockout facility for easy cable routing during commissioning and also Panel shall be flush fronted and arranged to form a single structure with a common Bus bar assembly.

The Switchgear panel shall be provided with integral base frame for each vertical panel which shall be suitable for directly bolting or tack welding to the Client's base frame. The frame of individual vertical panels shall be fabricated using suitable mild steel structural section single sheet 2mm. wherever required, stiffeners and ride up rollers shall be provided to increase stiffness of large size doors and covers.

Switchgear and Bus bars shall be arranged to permit future extension at both ends. End of bus bar shall be suitably positioned for this purpose. Panels at extreme ends shall have opening which shall be covered by using screwed plates. Details of extended bus-bar and opening shall be clearly indicated in the suppliers drawing.

Provided with access to the feeders, bus bars, cable termination, cable alley etc. from front for single front panel. Incomer cable termination shall be considered at the back side of the incomer. Main bus bar and all cable entries shall be top entry.

Max height of the main panel shall be 2275 MM / 1875 MM for Distribution panels / 1200-1500 MM for floor panels Operating height needs to be limited to 1800mm including base frame.

Minimum feeder section width shall be 400 mm and minimum height of the feeder shall be 250 mm.

Structures, including doors and panels, shall be capable of withstanding the internal pressure created by faults within the structure (equal to the maximum fault-current rating for a specified duration) without danger to the operating personnel. The minimum standard required is detailed in IS 3427. Type test certificate(s) shall be provided with the OFEER

Structures shall be capable of bearing static load of Max 1.4 tons viz., cubicle module rack in, rack out and in no case the frame/base plate shall deform during the normal specified operation.

Structures shall be provided with barriers to prevent the transfer of ionized gasses between adjacent compartments except bus bar chambers.



Switchgear panel shall generally be self-ventilating with louvers. Soft Starter feeder, VFD PANEL capacitor bank & required cooling fan for each feeder bucket and is further interlinked to respective breaker.

Interlocks shall be provided to prevent opening of the front doors of cubicles whilst the circuit breaker / switch is in the closed position.

Key interlocking shall be provided on door of incoming, outgoing and sensationalized Units.

All circuit breaker / MCCB shall have provision for padlocking. Padlocking facility for multiple locks shall be provided in the off / Test / Isolated position in compartment type of panels.

Switchgear shall be designed and constructed to facilitate inspection, cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance. It shall be possible to work safely within individual compartments whilst the other switchgears are energized.

Similar parts and components shall be interchangeable.

All indoor panels shall be min IP42 & Outdoor shall be min IP55.

Finger touch protection shall be provided for all live parts / terminals / cable terminations chambers. Bus bar end terminals shall be suitable to cable sizes provided in the SLD.

All hardware shall be corrosion resistant. All joints and connections of the panel members shall be Zinc passivated, high quality plated steel bolts (self-tapping), and secured against loosening. High tensile bolts and spring washers shall be provided at all bus bar joints.

Outgoing feeder units shall be arranged in tier formation with a single front for main LT Panel. Incomer and Bus coupler shall be located in non-tiered separate cubicle.

Each vertical section shall comprise: -

All Cubicles / panels shall be comprised of rigid welded structural frames made pressed and roll formed CRCA sheet of thickness 2 mm. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker, main horizontal bus bars, vertical risers and other front mounted accessories, etc.

The cladding of the frames (Covers) and partitions shall be of minimum 2mm CRCA sheet, whereas doors shall be of min. 14 SWG (2 mm) sheet. All cable gland cover plates shall be made of 10SWG (3.0mm) thick sheets of steel and should be of 01 parts.

The structure shall be mounted on a rigid channel base frame of minimum standard plinth 75mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation (Transport plinth).

Each compartment shall be provided with a hinged door interlocked with MCCB / breaker housed inside the compartment so that door cannot be opened unless the MCCB / breaker is in 'OFF' position. Hinged shall be Concealed and bolted type. Doors shall be provided with right angle turn type door lock.

Panel shall be single/double front type as mentioned in the SLD; single front type panel shall not have access from rear side for operation and for maintenance purpose unless specified



and approved by consultant. Each switchgear shall also be fitted with a label indicating the switchgear rating and duty. Each relay, instrument switch, breaker and contactor shall be provided with a separate label.

A cover plate at the top of the vertical section, provided with a ventilation hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

The front and rear doors shall be fitted with dust tight anti-fungal form gaskets which can withstand a maximum temperature of 65Deg C continuous with easy operating type fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust. The doors shall have concealed hinges. Removable covers shall be provided on the front/rear side of vertical/horizontal Bus bar chamber of the cubicles with torx screw.

A set of horizontal main bus bars shall be provided at the top and bus bar rating shall be of uniform cross section throughout the length and made of high Purity electrolyte copper F20 with 99.9% Oxy free Or Aluminum E91 Up to 4000A. The vertical bus bars shall be housed in separate fully enclosed chambers of minimum width 300 mm and accessible from front and rear shall be tapped off from main horizontal bus bars. A separate horizontal enclosure for all auxiliary power and control buses if required. Bus bars shall be provided with the minimum clearance in air as specified and horizontal bus bar chamber should be minimum of 300mm height.

All bus bar taps shall be insulated with close fitting non-hygroscopic, thermally modified hard PVC of high dielectric strength to provide a permanent high dielectric non-aging and non-tracking protection impervious to water, tropical condition and fungi. The insulation shall be non-inflammable and self-extinguishing and in fast colors to indicate phases. The continuous operating temperature max 91Deg C and fire protection corresponding to UL 94-V0

The joint shall be insulated in such a way as to provide accessibility of contact bolts for maintenance. The dielectric strength and properties shall hold good for the temperature range of 0°C to 90°C.

Bus bar joints shall be bolted & projections shall be insulated. Spring washers shall be provided to ensure good contact at the joints. Bus bars shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied just before making a joint.

The bus bars shall be located in air insulated enclosures. Direct access or accidental contact with the bus bars and primary connections shall not be possible. All apertures and slots shall be protected by baffles to prevent accident shorting of bus bars by the entry of maintenance tools. To provide a tight seal between cubicles, bushing or insulating panels shall be provided for bus bars crossing from one cubicle to another.

Incoming/ Outgoing terminals of the individual feeders shall be provided with insulated shrouds to avoid accidental contact with live parts.

Apparatus forming part of the panel shall have the minimum clearances as per relevant IS. Clearances shall be maintained during normal service conditions. Creep age distances shall comply with those specified in relevant standards.

All insulating material shall be of DMC/SMC to withstand the effects of high humidity, high temperature, tropical ambient service conditions etc.



The lifting eyes bolts (combination angle at bayed conditions) for each shipping section.

Functional units such as circuit breakers and fuse switches vertical section shall be provided with space heater controlled by thermostat.

Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact.

Extra protection covers (See through' acrylic cover) over removable cover providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorized access. Provision shall be made for permanently earthing the frames and other metal parts of the panel by the independent connections (unique feature of TS8 automatic polarization)

All identical equipment and corresponding parts be fully interchangeable without any modification (LH to RH assembly).

The panel shall be complete with inter-panel wiring.

All instrument transformers shall be cast resin type. Min insulation shall be class F.

One metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchgear except for the horizontal bus bar compartment. However, each shipping sections shall have metal sheets at both ends (Divider sheet is optional used as removable part at site).

After isolation of the power and control connections of a circuit, it shall be possible to safely carry out maintenance with the bus bars and adjacent circuits alive.

All incomers shall be provided with MFMs. TCP/IP RS 485 compatibility. RTU communication. All the meters shall be connected to an Ethernet switch for further communication to EMS.

ON, OFF, Auto Trip, trip current healthy, RYB indications and Key lockable type Emergency push buttons shall be provided on the incoming feeders.

Each panel's control power requirement shall be provided (two 100% capacity where indicated) with control transformer of 415V/ 55-0-55V, center tap earthed complete with primary and secondary protections suitably sized. Primary shall be protected with MPCB and secondary shall be protected with RCBO (30mA) of suitable rating.

Each panel's auxiliary power supply requirement shall be provided with Aux. control transformer 415V/120V-0-120V, complete with primary and secondary protections. Primary shall be protected with MPCB and secondary shall be protected with RCBO (30mA) of suitable rating.

All ACB/MCCB/MPCB's operating handles shall be pad lockable in OFF position and in addition to this door shall be interlocked with switch handle.

All panel doors shall have padlocking facility.

Each panel shall be provided with a danger sign symbol as per relevant IS and complete with warning and voltage level in 3 languages. Mimic diagram shall be provided in the panel front.



The panel shall be provided with a PE bar of suitable size (sized as per panel fault level) throughout the length of the switchboard. The same to be extended at both ends of the panel for connections to plant main earth grid. Each end of the the PE bar shall be provided with double holes for rigid connection for extension to plant earth grid.

The entire control & power network must be designed as fuse less system. Hence, no control fuses shall be used in control circuits of equipments. MPCBs/ MCBs of suitable rating are to be used for control circuits and PT secondary circuits.

All panel mounted indicating lamps shall be of cluster LED type.

No instrument / switches shall be mounted on ACB compartment door.

All terminal blocks shall be of push on wago/equivalent make cage type with a minimum size of 6 sq.mm. A minimum of 10% of terminal blocks shall be provided as spare. CT terminal blocks shall be of shorting link type.

All control wiring for CT and other circuits shall be of FRLS & minimum of size 2.5 Sq. mm stranded copper wire.

Terminal rubber boots of suitable size shall be provided for power cable terminations.

Suitable colored sleeving (RYBN) of bus bars shall be done with phase identification marking.

Trip-Neutral-Close switches shall be of heavy duty 25A rated.

All bus bar tapping to control transformer (for incoming supply) shall be with Lapp thermal (225 Deg C) cable minimum of 6 sqmm with suitable rated MPCB of 65 KA.

20% Spare feeders need to be considered comprising all feeder ranges of the respective panel/DB

3.4 Metal treatment & finish: -

All steel work used in the construction of the panel should have undergone rigorous metal treatment process.

Oil, Grease, Dirt and Swarf shall be thoroughly removed by High pressure warm multidirectional jets using Alkali Chemicals & DM water free from hazardous chemicals.

After pressurized conveyor system cleaning, finishing shall be carried out with DM Water, followed by final Uniform coating with special nano ceramic coating - applied by high pressure jets and the coating should be environment friendly and free from phosphating and COD/BOD and deprive of toxic heavy metals like Fe & Zn (Improve the adhesion property of powder).

First primer should be EC dip coat (RAL 7035) Like in automobile industry, which is free from any heavy metals, chromates and silicon thereby ensuring the RoHS compliance and Over the Primer, the final powder coating of RAL 7035 paint shall be applied and the overall paint thickness should not be above 80-130 microns. The sample sheet for the finishing paint shall be approved by Client/Consultant.

The final finished thickness of paint film on steel shall not be less than 80 microns.

The finished painted appearance of equipment shall present aesthetically pleasing appearance, free from dents and uneven surface.



Metal parts of the Panels should have convincing corrosion protection by undergoing 168 hours of salt spray testing to DIN ISO 7253.

The Panels should have compliance certificate for RoHS and WEEE standards.

BUSBARS :

The busbar shall be air insulated and made of high quality, high conductivity, high strength Al. and as per relevant IS code. The busbar shall be for 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 Al. 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. The bus bar shall have uniform cross sections throughout the length. Ratio of 1 sqmm = 0.64 A shall be adopted for Aluminum. Busbar. / As per TTA Panel manufacturer.

The busbar and interconnection shall be insulated with heat shrinkable PVC sleeves and be color 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 sufficiently 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.

The busbar shall be housed in a separate compartment. The busbar shall be isolated with 3 mm thick sheet (as per type tested design) to avoid any accidental contact. The bus bar shall be arranged such that minimum clearances between the busbar are maintained as per below.

Between phases	:	60 mm min.
Between phases and neutral	:	60 mm min.
Between phases and earth	:	60 mm min.
Between neutral and earth	:	60 mm min.

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

All connection between bus bar 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.

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

Black without coating High tensile bolts and spring washers shall be provided at all bus bar joints. Also, all bus bar joints shall be protected by using hylum/plastic shrouds

The main horizontal bus bars shall run throughout the entire length of the panel and shall be accessible for maintenance from the front as well as rear. Busbar chamber shall have separately screwed covers. All bus bars, links etc. shall be provided with 3 mm thick FRP sheet/Hylam sheet to prevent accidental contact.

Busbar and interconnection shall be insulated with heat-shrink sleeves of applicable grade and marked to indicate the phase coloring, which shall be red, yellow, blue and black unless specified otherwise. Necessary de-rating due to insulation shall be considered for sizing the busbars.



Busbar and connections shall be adequately sized, braced and supported to withstand the mechanical forces and thermal effects resulting from the switchgear rated short circuit current and carry certification from a recognized testing authority.

ELECTRICAL POWER & CONTROL WIRING CONNECTION:

Terminal for both incoming and outgoing cable shall be suitable for 1100 volts grade, aluminum/copper conductor FRLS insulated and sheathed, armored 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.

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

On / Off / trip status of all breakers and Meters shall be wired up to the terminal block. All contacts and signals specified for integration with client's BMS system shall also be wired up to the terminal block.

Both control and power terminals shall be properly shrouded.

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.

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

Wiring inside the module for power, control protection and instrument etc. shall be done with use of 1100 V FRLS conforming 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 wires shall be used. Other control wiring shall be done with 1.5 sq mm copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solderless sockets at the ends before connections are made to the terminals.

Control power for the motor starter module shall be taken from the control transformer.

Particular care shall be taken to ensure neat and orderly laying of the wiring. Identification ferrules shall be tagged to all the wire termination for ease of identification and to facilitate and testing.

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

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 be mounted on the disconnecting type of terminal blocks. No direct connection of incoming and outgoing cables to the internal components connection of the distribution board is permitted. Only one conductor may be connected in one terminal. ONE HIGHER SIZE CONNECTOR TO BE USE. Push in type "Merkel" connectors need to be used.

WIRE WAYS:

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



CABLE COMPARTMENT:

Cable compartments of adequate size shall be provided in the PCCs, MCCs, and PDBs for easy termination of all incoming and outgoing cables entering from top. Adequate support shall be provided in the cable compartment. All terminal sizes shall be suitable to no. of runs cable size mentioned in SLD / Cable schedule.

EARTHING:

Tinned Copper earth busbar shall be provided in the PCCs, MCCs, PDBs for the entire length. Size of earth bus bar shall be as per fault level of panels. The framework of the PCCs, MCCs, PDBs shall be connected to this earth busbar. Two diagonal holes at each corner of the earth bus shall be made available for the main earthing grid inter connection. Minimum 75mm earth bus projection needed on both sides from the panel

The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with the earthing clamp and the clamp shall be ultimately bonded with the earth bar. All cable gland earthing terminals shall be separately interconnected nearest earthing strip. No daisy earthing allowed.

No looping of grounding terminals accepted. Independent earthing continuity conductor from control transformer / starters / relays / any components etc. shall integrate to the panel main earth bus bar.

LABELS:

Engraved Aluminum sheet 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.

Drawing pocket / holder need to be provided for each panel incomer door.

Reflective sticker type Mimic shall be provided for all PDBs/MCCs/PCCs.

NAME PLATE:

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

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

CT ratio, control transformer detail should be visible on name plate on compartment door

Engraved nameplates shall be of Aluminum strip of black colour and silver letters format. Nameplate shall be fastened by counter sunk screws / riveted and not by adhesives.

DANGER NOTICE PLATE:

The danger plate shall be affixed in a permanent manner on the operating side of the panel. The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.

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



The overall dimension of the danger notice plate shall be 200 mm wide and 150 mm high. The danger notice plate shall be made from a 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.

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

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

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

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

INTERNAL COMPONENTS:

The PCC / MCC / PDB shall be equipped complete with all type of required number of air circuit breakers, contactor, relays, meters, instruments, indicating lamps, push buttons, equipment, fittings, bus bar, 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.

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.

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

INSPECTIONS / TESTING:

Each equipment should inspect and witness by client & consultant.

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

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

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

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

Prior to dispatch of the PCC / MCC / PDB all routine tests with respective to relevant IS /IEC code shall be carried out at Factory

Mechanical endurance test shall be carried out by closing and opening of all the ACB's, MCB's switches etc.



Over voltage and Insulation resistance test shall be carried out between phases and between phases to earth bus, keeping the isolating switch in ON position. A similar test shall be carried out keeping the isolating switch in closed position.

All the interlocks, controls and tripping mechanism of the switchgears shall be tested for their proper functioning.

High voltage test, Continuity test, Control circuit test shall be carried out.

Type test:

Type test certificates for all bought out items/switchgears shall be provided.

L. T. SWITCHGEARS:

GENERAL:

The type, size, and rating of the components shall be as indicated on the relevant single line diagrams.

MINIATURE CIRCUIT BREAKER (MCB):

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 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 faulty 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 for overcurrent and short circuit protection. The overload 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.

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 only on those used as main incomer of all sources, bus coupler and inter connector. The trip devices shall be direct acting.

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

The ACB's shall have an arc-quenching device on each pole. The ACB's shall have 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 purposes.

Interlocks shall be provided to:

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



Prevent the breaker from being racked into 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 insulating 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.

The air circuit breaker shall be capable of clearing the maximum fault current, which can occur.

The breaker plates shall have ON-OFF indicators, spring charge indicators, provision to padlock manual handle and provision to lock draw-out mechanism. Electrically operated breakers 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 isolate the supply to the charging motor.

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.

The 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 microprocessor-based trip units. All the releases shall operate on common trip bus bar 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 TMD MCCB'S whenever called for in the drawings shall provide an earth fault relay. All microprocessor based MCCB shall have LSIG protection.

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

CONTACTORS:

Need to follow as per 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.

Meters

LOAD MANGER /MFM / KWH METER (All Meters with RS 485 PORT)

Flush mount 96 x 96 x 80 mm load manager type Conzerv EM 6400 or equivalent meter of accuracy class 0.5 as per IS 13779 shall be provided. The meter shall be accurate on distorted wave forms; simultaneous sampling of voltage and amperes shall be done. It shall have low burden on PT and CT shall have bright display, shall view 3 parameters together shall have auto scaling from kilo to mega to giga units, shall have programmable CT, PT ratios with built in phase analyser. Auto scrolling shall be programmable as per user choice and communication with PC; PLC DCS shall be possible through RS 485 serial port. It shall be dust



proof, tamper proof with data import export option and 10 years back up of integrated data.

Parameters to be monitored shall be Frequency, Line to line and average and line to neutral and average voltage, phase wise and average current, phase wise and total KVA, KW and P.F. reading and KWH monitoring.

User programmable facility for delta 2e and star 3e measurement, C.T. and P.T. ratios, sliding window auto sync. And auto scrolling of parameters will be available.

Sensing shall be 3 phases, 4 wire measuring True RMS with voltage input range of 110 to 415 V nominal and current input of 5 amps or 1 amp as per field configuration. The current range shall be from 50 mA to 7.5 A and burden on PT or CT shall be app 0.2 VA.

Accuracy for kW / kWh shall be as per IS 1377 / CBIP88 and for all other parameters shall be +/- 0.5% of full scale + 0.5% of reading + 1 digit. Digital readout shall be of 3 rows of 4 digits each (12.5 mm size) with 7 segments bright red LED. Input frequency shall be 50Hz / 60Hz +/- 5%. The power factor range shall be 0.5 lag – unit – 0.8 lead.

Resolution for power parameters shall be for 4 digits and energy parameters shall be 8 digits. Display update shall be at every 15 seconds for demand parameters and 1 sec for other parameters. Display sequence shall be parameter followed by value. Temperature range shall be 0-50oC and humidity <95% non-condensing.

Display pages shall be as follows:

Instantaneous –	VLL, A avg., F VLn, A avg., F KVA, kW, PF Individual pages of above parameters.
Integrated -	kVAh KWh Run hours On hours Interruption

CURRENT TRANSFORMER:

Where called for, CT's shall be provided for current measuring. Each phase shall be provided with separate CT of class 0.5 accuracy and * VA burden as shown in SLD for operation of associated metering and controls. Current transformer shall be in accordance with IS: 2705 - 1964 as amended up to date.

Burden calculations shall be shared for consultant /client review and validation.

CT's shall be cast resin type and the class of insulation shall be min Class F.

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.

INDICATING LAMP:



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. Push button shall be of self-glowing type with LED lamp.

The Indicating Lamp shall be LED type and shall supplied complete with translucent covers to diffuse the lamp light. Indicating lamps shall be part of push buttons.

Colour shade for the indicating lamps shall be as below:

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

TECHNICAL SPECIFICATIONS FOR REAL TIME POWER FACTOR CORRECTION (RTPFC) SYSTEM

Scope:

This specification covers design, manufacture, supply, testing, commissioning of thyristorised zero crossing – Real Time Power Factor Correction (RTPFC) system with capacitor banks suitable for continuous duty.

Standards:

The design, manufacture and performance of the power factor correction panel with capacitor banks shall comply with all currently applicable statutes, regulations and safety codes in the locations of installations. The capacitors used will also conform to the latest applicable Indian / British / IEC standards. In particular, the equipment shall conform to the latest revisions of the following.

IS : 13340 , 13341 & 12672	Capacitors for power system.
IS : 8828	MCB
IS : 13947	MCCBs

When the above standards are in conflict with these specifications, this specification shall prevail.

Capacitor Bank:

A capacitor bank shall comprise of identical three phase capacitors in case of RTPFC. The individual capacitor unit shall be manufactured out of MPP design, comprising of bi-axially oriented metalized polypropylene film. Capacitor shall be tubular (Cylindrical) MPP self-filling type (525 VOLT). The capacitor shall consist of many such elements in series / parallel combinations for getting desired kVAR output. The dielectric losses of capacitor shall be restricted to 0.5 watts per kVAR. The phase terminal connections of the capacitor unit shall be brought out at the top, for suitable connections. The capacitor shall be provided with suitably rated discharge resistor. The capacitor shall be provided with over pressure interrupter mechanism, which will automatically disconnect faulty capacitor unit from the network without bursting, bulging or exploding the capacitor.



Each bank shall have enough cooling fans. Same need to be integrated with respective incomer. If any fault in fan, incomer of the respective breaker needs to be tripped. Auto / Manual switches shall be provided for each bank.

Capacitor Panel

The capacitor control panel shall operate in Automatic mode as specified in the data sheet. The panel for capacitor shall be fabricated from 2 mm thick sheet steel and shall be finished with 7 tank process followed by powder coating.

Earthing terminals shall be provided as per clause No 4.0 of this specification. The panel shall be provided with suitably rated TP AL bus bar supported on epoxy insulator. Each capacitor unit shall be connected to the main bus bar through thyristor of suitable rating with safety margin. Protective MCBs /MCCBs of suitable rating shall be provided with base / holder as mentioned in the drawing. Connection shall be made with FRLS flexible copper cables having crimped copper lugs. All capacitor units shall be earthed; sufficient ventilation shall be provided to limit the temperature rise to maximum 95oC. Cooling fans shall be provided to each heat sink as per requirement. Drawing pocket shall be provided at the door of each panel. A 15-amp switch & socket and the lamp holder shall also be provided for panel illumination at the suitable location.

The main Bus bar shall be terminated on suitably rated MCCB / ACB. Detachable gland plates shall be provided with suitable knockout for incoming cable connection from bottom/top as specified. Capacitor unit shall be mounted to a frame of adequate strength construction.

The panel shall be mounted in the MS channel section at the bottom for easy installation. The panel shall be provided with lifting hooks /eye bolts for handling. Automatic Power Factor Correction Relay shall be provided with all related circuits and three load CT's for each phase in order to control/ achieve target Power Factor OR unity as per setting.

The controller shall be capable of correcting Power Factor within 2 to 120 sec in case of RTPFC. The capacitor shall be switched ON and OFF using thyristors from APFC controller.

Average compensation required and compensation supplied shall be continuously monitored for all the three phases simultaneously and total low kVAR requirement shall be calculated accordingly. It would automatically switch ON and OFF the capacitor bank so as to attain the set target power factor. The panel shall be provided as per respective drawing.

If the capacitor panel is integrated with any other PCC/MCC panel, same need to install in separate vertical chamber.

Enough louvers need to be considered for air exchanges.

Finger touch protection / guards need to be provided for all cooling fans.

The thyristorised switching system shall inclusive of following facilities.

Over voltage protection.

Under voltage protection.

Over temperature protection.

Voltage imbalance protection in each phase.

Facility of manually operating capacitor bank on First-in-First out basis

VARIABLE FREQUENCY DRIVE:



Variable speed AC drives shall be sensor-less vector control type, based on IGBT / PWM technology.

Variable speed AC drives shall be suitable for a speed variation from 40% to 100% of rated speed at full load.

The speed accuracy shall be $\pm 0.5\%$ for the load change of 100% and network voltage oscillations $\pm 10\%$ of rated voltage.

Variable speed AC drives shall be provided with MODBUS / PROFIBUS and compatible with owner's PLC/DCS for data exchange in future.

Variable speed AC drives should be capable to accept/provide 4-20 mA/0-10V DC for speed increase/decrease and speed indication.

Variable speed AC drives for Agitators / pumps shall be supplied along with resistance and chopper as a part of system.

Variable speed AC drive unit shall be IP-42 degree of protection. However, the same shall be installed in MCCs, and shall have additional cooling fan.

Total harmonics distortion based on IEEE 519 shall be as per below: -

-Total voltage distortion shall be less than 3%

-Total THD shall be less than 5%.

Input & Output chokes /Filters need to be considered for VFD/ soft starter feeders.

SOFT STARTERS

The soft starter shall be constructed and tested in accordance with the international IEC standards EN 60947-1 and EN 60947-4-2 and respect the following EC directives:

"Low voltage Equipment" No. 2006/95/EC

"Electromagnetic compatibility Directive" (EMC) No.2004/108/EC

The soft starter shall have documented coordination with circuit breakers for short-circuit protection. Suppliers need to submit a type-2 coordination chart.

The soft starter shall comply with the following technical requirements:

General specification

Soft starter shall be thyristor based three phase control with operation voltage: 208 - 600VAC, 50/60 Hz.

Wide rated control supply voltage: 100 - 250VAC 50/60 Hz.

Built-in bypass to reduce energy consumption at full speed and increase the lifetime of soft starter.

The soft starter shall have built-in Modbus RTU for communication. Support for other protocols shall be an option.

The soft starter shall be equipped with one analog output

Soft starter shall have Current transformer in all the three phases for current monitoring.

Soft starter shall have features which allows the soft starter to operate with only 2 controlled phases in case of short circuit of 1 set of thyristor avoiding unplanned stop and possibility to keep running motor until the soft starter is repaired

The soft starter shall have a minimum of 3 signal Relays Output for Run, Bypass (Top of Ramp) and Event signal.

User interface

The soft starter shall support English languages in both the manual and HMI, Fault and Data presented shall be possible to interpret without the use of index tables and manuals.

The soft starter shall have a detachable keypad with graphical LCD display. The keypad shall have start and stop buttons, an information button for access to a built-in manual, an USB-port for connection to a PC.

Environmental conditions

The soft starter shall have coated PCBAs to withstand harsh environments.



The Soft starter shall deliver its rated current in ambient temperature and should be able to operate up to 50 °C. If soft starter is rated for lower temperature the ampere rating must be selected to higher range so as to temperature de-rating suits the required ampere rating as asked.

The Soft starter shall be suitable for operation up to altitudes of 1000 meters without derating and shall be operable in relative humidity of 5 to 95 %, non- condensing.

Please note that the designed de rating conditions must be mentioned clearly during the drawing approval stage and if derating found to be insufficient to meet the requirement of motor, it reserves right to switch over to next higher rating soft starter

Motor starting, stopping and operation:

The soft starter shall have the following start ramps available:

Voltage start ramp

Torque start ramp

Full voltage start

The soft starter shall have the following stop ramps available:

Voltage start ramp

Torque start ramp

Dynamic brake

The soft starter shall have pre-start functions:

Stand still brake, to keep the load still before start

The soft starter shall have the possibility for slow speed forward and backward operation for positioning of a motor load.

The soft starter shall have Torque Control and pump cleaning feature, to eliminate water hammering and prolong lifetime of the pump system.

The soft starter shall include a kick start feature with selectable level & time.

The soft starter shall have the following types of current Limit, making it possible to run the motor in a weaker network and hence improving the availability of the system/equipment

Current Limit

Dual Current Limit

Current Ramp

The soft starter shall have a feature, which would allow the soft starter to operate with two controlled phases even with shorted thyristor in one phase.

The soft starter shall have the possibility for automatic restart.

Built-in motor protections and warnings

The soft starter shall integrate motor and load protections, which shall under no circumstances be disabled when the integrated bypass is used.

The soft starter shall also be able to present a warning before tripping for each protection.

The soft starter shall have the following motor protections available along with the warning function.

Electronic Overload Protection, class 10A, 10, 20, 30

Locked Rotor Protection

Motor Underload Protection, both current and power factor.

Current Imbalance Protection

Voltage Imbalance Protection

Overvoltage and Under Voltage Protection

Phase Reversal Protection

Total Harmonic Distortion (THD)

Fans fault

Thyristor overload

Number of starts

Motor runtime limit

In addition, soft starter shall also have Earth-fault Protection and input for PTC and PT100.

Built-in diagnostics



The soft starter shall have the following diagnostics features:

- THD(U)-Total Harmonic Distortion
- Counted number of start sequences
- Motor runtime measurement
- Thyristor runtime measurement
- Auto phase sequence detection
- Electricity metering
- Voltage sags detection
- Time to trip estimation
- Time to cool estimation
- Fault detection

The soft starter shall provide the following fault detection, to protect both the starting equipment, the load and the soft starter itself.

- Phase loss
- High current
- Low control supply voltage
- Fault connection
- Bad network quality
- Short circuit fault
- Heatsink over temperature fault

Fault History

The Soft starter shall show the event log of 100 latest events in chronological order, with "type of event such as Faults, Protections, Warnings, Parameter changed, Run" along with data

PUSHBUTTON STATION

- As per approved make start & stop pushbutton to be selected
- On pushbutton with red colour
- Off push button with green colour
- Thermo Plastic /Metal CRCA IP 42 / IP 55 / IP 65 enclosure to be as per mention in BOQ
- Terminal to be provided for connection of cable in enclosure
- Double compression type cable gland to be use for metal enclosure

SPECIFICATION FOR DG FIRE PUMP BATTERY CHARGER AND ENGINE DRIVEN PUMP FEEDER

The controllers are supplied with two fully automatic, 200AH, and 4 step battery chargers. The charger features switching technology and 10Adc pulse with modulation output current. (Data to be validated with DG pump OEM)

The battery charger also features the following

- Selectable AC Power voltage
- Selectable battery voltage
- Selectable battery type
- AC power fuse
- DC power fuse
- Charge cycle reset push-button.
- Metering

The controller provides a display of incoming AC power line voltages.

Total engine run time may be displayed.

Pressure displayed in PSI or bars in 1psiincrements (0.1bar).

Battery voltages and charging current are displayed on the main screen.

ENGINE CONTROL

The controller provides the following program mobile engine control functions:



Sequential start time (on delay)-0-60 sec.

Minimum run time -0-60 min.

Off delay time 0-60 min.

Weekly test Time/Duration/frequency

AC Power loss starts delay time-2-300 Sec.

Manual stop only-Yes/no

Pressure recording.

The system pressure may be recorded in three ways:

User programmable pressure differential between 5 & 50 Psi (0.3-3.4 bars. Every time the system pressure exceeds the differential. The pressure is recorded.

Hourly pressure is recorded on the hour.

If the engine is running, the system pressure is automatically recorded every 15 seconds.

HISTORICAL DATA

The controller stores historical data in a separate area of the n=memory from that of the data/event recording. The historical data may be viewed on the display and or served to a USB flash drive.

SERIAL COMMUNICATIONS

The mark is equipped with a RS485serial communication port. This port can be used with 2 wires or 4 wires Modbus RTU communications or with Modbus/TCP Ethernet LAN (using our optional 5150 module).

Battery charger ON/OFF status and engine driven pump ON/OFF status need to be integrated to FAPA. Necessary hard wiring and control provisions need to be considered by panel builder.

DRAWINGS/DOCUMENTS

The following drawings will be submitted along with the bid.

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

Type tested report

Vendor Data sheet

Vendor shall provide information on the offered make and Cat nos. of items offered for respective Panels

Catalogues for all the switchgears and other accessories to be used by them for the above panels.

LT CABLE SPECIFICATIONS

SPECIFICATION FOR L.V HR PVC CABLE:

This specification along with data sheets covers requirements for design, manufacture and supply of HRPVC (power, control, uninyvin, earthing) cables.

STANDARDS

This cable shall be complied with latest edition of the following standards as applicable:

IS: 1554 PVC insulated (heavy duty) electric cables.

IS: 7098 Cross-linked polyethylene insulated PVC sheathed cables.

IS: 8130 Conductors for insulated electric cables and flexible cords.

IS: 5831 PVC insulation and sheath of electric cables

IS: 3975 Mild steel wires, strips and tapes for armoring of cables



IS: 10810(Part 41) Methods of test for cables: Mass of zinc coating on steel armor.

IS: 209 Specification for zinc

IS: 3961(PT-2) Recommended current ratings for cables: Part-2 PVC

Insulated and PVC sheathed heavy duty cables.

IS: 10418 Drums for electric cables.

IS: 10462(Pt-1) Fictitious calculation method for determination of dimensions of protective coverings of cables: part-I electrometric and thermoplastic insulated cables.

IS: 10810(Pt-58) Method of test for cables: part 58 Oxygen Index test.

IS: 10810(Pt-61) Method of test for cables: Part 61 flame retardant test.

IS: 10910(Pt-62) Method of test for cables: part 62 fire retardant test for bunched B cables.

IS: 13573 Joints and terminations for polymeric cables for working voltage from 6.6kv up to and including 33 kV, performance requirements and type tests.

IEC: 332-3 Test on electric cables for rated voltage from 1 kV up to 30kv.

IEC: 502 Extruded solid dielectric insulated power cables for rated voltage from kV up to 30kv.

IEC: 540&540A Test methods for insulation and sheaths of electric cables and cords.

ASTM: D2863 Standard methods of test for flammability of plastic using oxygen index method.

Note: -

L.T. power cables should be XLPE ARMoured/UNARMoured CABLE CU / AL. CONDUCTOR.

Selection of the cable shall be

Indoor applications - Unarmoured cables to be used

Outdoor application - Armoured cables to be used

Indoor& Outdoor combination - Armoured cable to be used.

GENERAL CONSTRUCTIONS

LV power cables shall be of 1100V grade, XLPE insulated wire / flat armored, extruded PVC inner sheathed, aluminum / copper conductor, FRLS outer sheathed cables conforming to IS 7098 Part I, IS 1554 and IS - 694 required

Power cables of 1100V grade shall be Aluminum/copper conductor, XLPE insulated, sheathed & overall FRLS sheathed.

LV control cables shall be of 1100V grade, XLPE insulated, round wire armoured, extruded PVC inner sheathed, copper conductor, FRLS outer sheathed cables conforming to IS: 1554 Part1 / IS: 7098 Part1.

The conductors shall be stranded and compacted circular for all cables.

The core insulation shall be cross linked polyethylene insulating compound dry cured, applied by extrusion. It shall be free from voids & withstand all mechanical & thermal stresses under steady state & transient operating conditions. It shall conform to the properties given Table-1 of IS: 7098(Part-2).

The insulation screen shall consist of non-metallic extruded semi-conducting compound in combination with a non-magnetic metallic copper screen. Unless specified otherwise, the copper screen for all the three cores together shall be capable of carrying the single line to ground fault current value and the duration specified in the data sheet. Vendor shall furnish calculation in support of selection of the size of copper screen along with bids.

The inner sheath shall be applied over the laid-up cores by extrusion and shall conform to the requirements of suitable compound of IS:5831. The extruded inner sheath shall be of uniform thickness. In case of single core cables, there shall be extruded inner sheath between insulation metallic screen & armouring.

The outer sheath of the cables shall be applied by extrusion over the armouring and shall be of FRLS compound conforming to the requirements of suitable type compound of IS:5831. The thickness of outer sheath shall be as per IS:7098-part-2 for both unarmoured & armoured cables.



The dimensions of the insulation, inner sheath shall be governed by values given in IS:7098 Part-2

Where specified 1100V grade power cables may also be XLPE insulated & shall meet the requirement specified in IS:7098(Part-1). The overall diameter of the cable shall be strictly as per the values declared in the technical information furnished along with bids subject to a maximum tolerance of $\pm 2\text{mm}$ up to overall diameter of 60mm and $\pm 3\text{mm}$ for beyond 60mm. PVC/Rubber and caps shall be provided free of cost for each drum/coil out in addition ends of the cables shall be properly seated with cap to avoid ingress of water during transportation and storage.

The cable shall be tested for all routine tests.

TESTING AND INSPECTION

The cables shall be tested & inspected at the manufacturer's works. All the materials employed in the manufacture of the cable shall be subjected, both before & after manufacture, to examination, testing & approval by consultants/owner. The manufacturer shall furnish all necessary information concerning the supply to Consultants/Owner's inspectors. The inspector shall have free access to the manufacturer's works for the purpose of inspecting the process of manufacture in all its stage & he will have the power to reject any material which appears to him to be of unsuitable description or of unsatisfactory quality. The vendor shall give at least 4 weeks advance notice to the purchaser, regarding the data testing to enable him or his representative to witness the tests. After completion of manufacture of cables & prior to dispatch, the cables shall be subjected to type, routine, acceptance & special tests as detailed below Consultants/Owner reserves the right to witness all tests with sufficient advance notice from vendor. The test reports for all cables shall be approved from the Engineer before dispatch of the cables. All routine tests, acceptance tests, type tests & additional type tests for improved fire performance shall be carried out on cables as listed in IS:1554 (Part-1), and IS: 7098 (Part-2). The inner and outer sheath of XLPE cables shall be subjected to all the tests applicable for FRLS cables. The test requirements for insulation & sheath of FRLS cables shall be as per latest revision of IS:5831.

PACKING AND MARKING

Cable shall be dispatched in non-returnable wooden or returnable steel drums of suitable barrel diameter, securely battened with the take-off end fully protected against mechanical damage. The wood used for construction of the drum shall be properly seasoned, sound and free from defects. Wood preservatives shall be applied to the entire drum. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.

On the flange of the drum, necessary information such as project title, manufacturer's name, type size, voltage grade of cable, length of cable in meters, drum no., cable code, BIS certification mark, gross weight etc. shall be printed. An arrow shall be the drum with suitable instruction to show the direction of rotation of the drum.

Cable end caps need to be provided for each drum.

SPECIFICATION FOR INSTALLATION WORK

All equipments shall be installed conforming to good engineering practice in general and particularly conforming to Indian Electricity Rules, Indian Standard Codes of Practices and Statutory rules applicable in the area. Adequate clean & clear space shall be provided around all electrical equipments for easy operation and maintenance. Generally, all electrical equipment to be installed above flood level of the site.

The scope shall include

Supply, Installation, testing & commissioning of L.T. Panel / cables / cable trays / Earthing etc., as per the bill of quantities and as per details given in Single Line Diagrams & Layout.



Tendered shall include in their scope of supply, Installation, testing and commissioning of the following:

Complete electrical equipment and its installation as specified.
Laying and termination of power and control cables.
Cable supporting structures in the Plant room/Panel rooms and cable Trenches.
Earthing of all power distribution equipments
Erection accessories and consumables
Safety items like hand gloves, shock treatment charts, rubber mats, danger/caution boards, fire extinguisher, fire bucket etc.
Rubber mats – is 15652 -2006 polymer silicon base 3.3 kv – 2mm/0.415kv-1.6 mm
Supply of commissioning spares required during erection.
Bidder to provide necessary documentation required for CEIG approvals which is needed for Electrical Inspector & government approvals related to supply & installation work. Supply & installation of the equipment shall comply with all CEIG & government norms. Any deviations / observations by CEIG/Government authority, bidder must address the issues.
A single point of power supply (incomer supply) will be provided by the Main Electrical contractor at the main panel incomer. Further distribution is in vendor scope.
A single point earthing strip will be provided by the Main Electrical contractor near to the panel. Further distribution is in vendor scope.

INSTRUCTION TO THE TENDERER CODES, STANDARDS & REGULATIONS

The design, manufacture, erection, and testing of the equipments and material to be supplied shall comply with latest revisions of relevant Indian Standards.
In addition, the Indian electricity Rules, Statutory requirements of Central govt. and state Government of Gujarat, shall also be complied with.

The tenderer shall furnish the following documents / information along with the offer.
General description of equipment offered specifying the important features, make, technical parameters, materials of construction etc. to enable the owner to have proper understanding of the equipment offered and its operation.

Technical literature, catalogue & A drawing etc.
Single line diagram deviation if any
Typical general arrangement and foundation details specification.
Heat losses of various equipment offered.
The contractor shall submit a list of all drawings and documents he proposes to submit. The list will be approved by purchaser / consultant and may be modified if necessary. Each drawing / document in the list shall be identified with a serial number, description and scheduled date of submission.

FOR APPROVAL

Equipment layout plan with section detail with dimension.
Single line diagram with rating of all equipment, cable sizes and details of protection and metering.
Civil Foundation Detail with calculations for yard equipment foundation
Front view, general arrangement of equipment with plan and sectional views.
Control, alarm, indications, interlocking and other schematics.
Wiring terminal plan drawing with cable connection and cable schedule.
Cable layout drawing along with cable trenches.
Earthing scheme and layout of earthing network with calculations for yard and other areas / premises
Relay setting with calculations for total network, to ensure proper coordination.
Calculation for temperature rise of busbars.



VA sizing for CT'S, control transformers, Knee point voltage calculations need to be furnished for review.

Interlock scheme and circuit layout to be submitted for review & approval.

List of annunciation / alarm points place wise. Make and type terminal blocks.

Calculations for design of supporting structures for outdoor switch yard regarding wind pressure, short circuit forces etc.

Calculation for design of sizing of busbars, busbar supports considering the temperature rise and fault current.

Equipment Approval require from Gujarat State Fire and Emergency Service or Documentation support for approvals. Approvals are in Contractor scope.

Installation drawings of all equipment with

Layout of equipment

Layout of cabling

Earthing layout

FOR REFERENCE

Static and dynamic loading of all major equipment

Heat losses of all equipment

Inter panel wiring and terminal block arrangement

External connection diagram, panel wise and scheme wise

Composite drawings showing circuit of switchgear remote panels, and other items to complete circuit for its proper functioning.

Complete and comprehensive instruction manuals for operation and maintenance of the equipment with drawings, this shall include the following:

Log sheets indicating daily/hourly recording of power system parameters to be noted down by customers operating person. The parameters shall indicate loading of various electrical equipment quality of power supply, energy consumption and maximum demand of the plant.

Preventive maintenance schedule for each equipment.

Safety procedures for safe operation of equipment and complete system.

Test procedure for site tests.

Spares list for each equipment for 2 years operation and maintenance.

INSPECTION AND TESTING

GENERAL

Manufacturing progress review, inspection & testing of equipment covered under the technical specification shall be carried out by the Purchaser at the manufacturers' works/premises prior to dispatch, to ensure that their quality & workmanship are in conformity with the contract specifications and approved drawings.

Routine tests shall be carried out on all equipment at manufacturer's works as per appropriate IS regulations. No equipment shall be dispatched to site without a provisional certificate of acceptance issued by the Purchasers / consultant. Inspection and test shall be carried out at the place of manufacture as well as on receipt of the equipment at site. Inspection and tests do not relieve the contractor of his contractual obligations regarding performance of the equipment at site / in actual use.

Identification labels shall be provided on all equipments. All labels shall be engraved on Aluminium (white letters with black background) and all text shall be in English language after taking approval.

The installation rates for the equipment shall be inclusive of minor civil works such as cutouts etc, and necessary material required to complete the Installation.

Before dispatch to the site, but before energization, all equipments / components / accessories which are intended to be painted shall be thoroughly cleaned of rust, scales, grease, etc. and painted with two coats of proper primer. Two coats of finishing paint of the colour specified/approved shall follow this by the purchaser. The contractor free of cost shall make damage to the painting suffered during transit / erection good before the equipment is finally accepted by the purchaser.



For installation work at site, the contractor shall be fully responsible for arranging the supply of required tools and tackles, welding sets, pipe bending machine, cable crimping tools, labours, scaffoldings, ladders, water, watch and ward and power is in contractor scope etc. On completion of the installation but before energisation of the system, all installation shall be physically checked and properly tested. The contractor under the supervision of purchaser / consultant shall conduct these checks and tests, and contractor shall furnish the final status and the contractor free of cost shall make test result good within contractor completion period.

The rate towards installation shall include supervision from OEM for installation, testing & commissioning as per relevant product standard / OEM recommendation including certification LT Panels etc.

All clamps brackets, bolts, nuts, screws, markers, ferrules, lugs and glands and other hardware necessary for erection work, shall be included in the scope of work and shall be arranged by the contractor.

Following tests shall be conducted on equipment after erection from point of view of completeness in the presence of purchaser:

Visual inspection of total system.

Equipment shall be painted to withstand the heavily polluted atmospheric conditions.

Checking of continuity of power and control cables.

Checking of insulation by secondary injection or by primary injection.

Calibration of meters by secondary injections or by primary injection.

Checking of protective schemes.

Setting of relays, and the checking of their operation with one tower and one higher setting.

Checking of control scheme of breakers, etc. as per approved drawing and as per actual requirement.

Checking of alarm scheme by simulation of faults.

Checking of name plate data of complete system.

Verification of earthing resistance.

Checking of cable terminations and laying, dressing etc.

Checking of safe accessibility of components.

RESPONSIBILITY FOR INSPECTION

Any inspection by the Purchaser does not relieve the responsibility of quality assurance and quality control functions.

As such, any approval which the Inspecting Engineer of the Purchaser/ Consultant may have given in respect of equipment and other particulars and the work or workmanship involved in the contract (whether with or without test carried out) shall not bind the Purchaser to accept the plant and equipment, should it on further test at site be found not to comply with the requirements of the contract.

The Contractor is to meet the inspection & testing requirements for the equipment coming under statutory regulations e.g. weights & measures, safety, IE rules, etc. and submit certificates and documents from appropriate authority to the Inspecting Engineer for the same.

EXTENT OF INSPECTION

The extent of inspection & testing by the Purchaser shall vary from equipment to equipment as per design requirements if necessary.

Extent of inspection to be carried out shall be finalized with the Contractor after award of the contract on the basis of scope of supply, technical specification and approved GA drawings.

Following standard bought-out Items shall be accepted on the basis of manufacturers' test certificates :

LV current transformers

Standard AC motors upto 10kW rating and smaller kW rating.

Push button station in manufacturers' standard enclosure.

LT power and control cables.



Starters in manufacturer's standard enclosure

Thermocouples.

Level switches.

Pressure switches

Pressure gauges

LV panels

Refer annexure for check list formats with respective to each equipment.

METHOD OF GIVING INSPECTION CALLS

Inspection calls shall be given by the Contractor to the Purchaser / Consultant accordance with mutually agreed program within 15 days clear time for all equipments. All calls shall accompany four sets of relevant test certificates and inspection report of the Contractor/sub-contractor after satisfactory completion of internal inspection and tests.

The Purchaser reserves the right to visit at any stage of manufacture plant and ask for additional inspection & tests if it is found necessary after completion of detailed design & engineering and approval of drawings.

The Purchaser or his duly dispatched representative shall on giving written instructions to the Contractor, setting out any grounds of objection which he may have in respect of the work, be at liberty to reject all or any part of plant/dispatch or workmanship which are not in conformity with the contract provisions.

CONTRACTOR RESPONSIBILITY

The Contractor shall delegate a representative/coordinator to deal with Purchaser on all inspection matters. Also Contractor's representative shall be present during all inspections at sub-contractor's works.

The Contractor shall comply with instructions of the Inspecting Engineer fully.

The Contractor shall ensure that the equipment / assemblies/ components of the plant and equipment required to be inspected are not dismantled or dispatched before inspection.

The Contractor shall ensure that the equipment and materials once rejected by the Inspecting Engineer, are not-reused in the manufacturing of the plant and equipment. Where parts rejected by the Inspecting Engineer have been rectified as per agreed procedures laid down in advance, such parts shall be segregated for separate inspection and approval, before being used in the work.

INSPECTION WAIVER

For certain standard bought-out items and the products of reputed firms where the Purchaser has earlier experience on the quality of their products, the Purchaser may consider allowing of inspection water for such items. The respective Inspecting offices shall issue inspection waiver certificate after scrutiny of contractor's internal inspection report, test certificates and other documents.

TESTS

Test of all equipment shall be conducted as per latest IS Code.

All routine tests shall be carried out at manufacturer's works in the presence of purchaser or his representative.

The tenderer shall submit type test certificates for similar equipment supplied by him elsewhere. In case type test certificates for similar equipment is not available, the same shall be conducted in the presence of Purchaser or his representative if purchaser so desires, without any financial implications to the purchaser.

SITE TESTS AND CHECKS

General: All the equipments shall be tested at site to know their condition and to prove suitability for required performance.

All equipment's (protective relays and instruments) shall be tested as per standard check list formats of client / consultant) relevant to IEC/IS codes at site.

SPECIFICATION FOR EQUIPMENTS INSTALLATION

Installation of Equipments



All the electrical installation shall conform to the Indian Electricity Act, Indian Electricity Rules, and regulations in force in the state by Electrical Inspector. All the items required as per electrical inspector shall be included in the scope of work. These shall be installed by duly licensed and authorized person only.

The mechanical and other installation shall conform to the applicable acts and rules of corresponding inspector and other relevant authorities, if any.

All the works under this contract, including the installation of the equipment, shall be got inspected and approved by the relevant authorities like electrical inspector etc.

Erection and Commissioning Tools & Tackles

The tenderer shall provide all tools / tackles jigs and fixtures, winches, alignment tools, welding sets, testing kits, testing meters / instruments, breaker handling devices, all consumable items and construction equipments as required to install all the equipment and to complete the work in all respects, and shall necessarily include (but not be limited to) bolts, nuts, rivets, welding rods, shims, wedges, packing sheets, packing compounds, oil, flushing oil, protective greases and oils, all materials required for proper installation and protection of individual equipment in storage and during erection, testing and commissioning

This shall also cover proper alignment, tac welding, tagging, laying, marking of, and connection of cables, fabrication supply and installation of all support structures for installation of various electrical equipments and cables.

Provision of cable glands, ferrules, cable lugs, tags shall be arranged.

Supply and installation of first air boxes, shock treatment charts, rubber mats, etc.

Erection, testing and commissioning of various equipments shall be done strictly as per manufacturer's instructions.

Successful tenderer shall submit proposed test procedure to the purchaser for approval well in advance and shall not commence testing until approval is conveyed.

All plant equipment's painting of which has been damaged during transportation / erection or by corrosion shall be given two coats of paint after removal of scales rust oil, etc.

All iron framework erected shall be provided with two coat of primer and two top coat of finish paint.

Cables shall be laid in GI class A pipe of suitable dia pipe upto 2 meters height above the floor in case of vertical run to avoid mechanical damage.

Cables shall be laid in separate racks according to voltage levels. Sufficient Horizontal clearance to be provided.

Maximum cross section areas of cables passing through conduit shall not exceed 60% of cross section of conduit.

Approved type of danger boards, boards inscribing ISOLATED' 'DO NOT CLOSE. MEN AT WORK' shall be provided in sufficient numbers.

All ventilation and forced draft openings shall have suitable screen protection.

Special care shall be taken to make the enclosed equipment protected against entry of rats, lizard, and creeping reptiles which may create electrical short circuits.

Cables supports shall be provided at every 1000 mm along horizontal run and perforated trays shall be provided for control cables.

Stages of completion of works

The stages of completion of various works shall be as follows:

Completion of erection

Equipment shall be complete erected when the following activities have been completed.

Moving of all equipments to the respective foundations.

Fixing of anchor bolts or tack welding as required.

Levelling and alignment of equipment.

Assembling of all accessories such as relays, CTs, PTs, meters, instruments etc. as described in the job specification.

Drying of equipment as required and testing of oil for di-electric strength

Filtration and filling of oil as required



Cable laying, termination with continuity check.
Applying of finishing coat of paint. Mounting of lighting fixtures and connections.
Testing of all system with operation of all protection system.

INSTALLATION OF L.T. Panels

INSPECTION

The switchboard shall be checked for any damage.
Meters, relays etc. shall be checked and tightened before stilton.
All mechanical fasteners shall be checked and tightened before installation.

INSTALLATION

The distribution switchboard shall be assembled and aligned together and installed on the M.S. frame properly.
The switchboard shall be erected and levelled on the foundation as per the suppliers drawing.
Bus bar connections between the L.V. side of the transformer and incoming feeder shall be checked after installation.
Bus bar connections between the panels shall be checked and tightened as per the supplier's drawings.
Meters & 'relays shall be fixed in positions and connected as per the suppliers' drawings.
All earthing connections of earthing system shall be visible for periodical checking.
The entire equipment earthing shall be done as per drawing and shall confirm to Indian Standard 18:3043- 1987 and detailed specification given under separate heading of "EARTHING" of these specification.

TESTING & COMMISSIONING

Prior to commissioning the L.T. Panels / Switch board following tests shall be carried out by the Contractor.
Insulation resistance test.
High voltage tests - 1000 /2500 volts.
Tripping of breaker by applying secondary source and setting of relay and as per instruction of consulting engineer/site engineer.
Testing meters and calibration of all meters.

CABLING

LAYING OF CABLES

CABLE INSIDE BUILDINGS

Cables inside buildings shall be laid either in masonry trenches or carried on cable trays, racks or brackets. Where cables run in ducts inside the building the cables shall be adequately clamped to angle approved by the consultants. Where cables are suspended from ceilings they shall be carried over cable trays or racks as directed and approved by the consultant. The supports shall be placed not more than 600 mm apart. All cables passing through waits shall run through stone ware pipes or Hume pipes of adequate diameter. Cables running along walls shall be supported and clamped to saddles, or hanger rigidly anchored at close intervals. The contractor shall ensure that hangers, brackets and other supporting arrangements for cables are placed in proper position at the time of building the walls, concrete may be carried out only with prior permission of the consultants.

EXCAVATION AND BACK FILLING

Trenches shall be dug true to line and grades. The back fill for trenches shall be filled in layers not exceeding 250 mm. Each layer shall be properly rammed and consolidated before laying the next layer. The contractor shall restore all surfaces, roadways, sidewalks, curbs, walls or other works cut by excavation to their original condition satisfactory to the consultant.

Underground cable laying



Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks. The drums shall be unrolled and cables run over wooden rollers in trenches at intervals not exceeding 2 meters. Cables shall be laid at depth of 1000 mm depth below ground level in the case of 415V cables. A cushion of sand not less than 100 mm shall be provided both above and below the cable, joint boxes and other accessories. HV and MV. Cables shall not be laid in the same trench and/or alongside of water main. The cable shall be laid in excavated trench. 100 mm layer of sand shall be spread over the cable. The cable then shall be lifted and placed over the sand bed. The second layer of 100 mm sand then be spread over the cable laying RCC U / half round trough of suitable sizes over cables, warning tape. The relative position of the cables laid in the same trench shall be preserved and the cables shall not cross each other as far as possible. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius of bend not less than 12 times the diameter of cable. Minimum 3 meter long loop shall be provided at both sides of every straight joint and 5 meters at each end of the cable. Distinguishing marks shall be made on the cable ends for identification. Insulation tapes of appropriate voltage and in red, yellow and blue colors shall be wrapped just below the sockets for phase identifications.

MARKERS AND WARNING PLATES

Approved CI cables markers shall be provided along the route of the cables at every 25 meter distance and at both ends of road crossing, indicating LV cables as applicable. Special CI markers shall be provided at all buried cable joints indicating "Electrical Cable Joints".

TESTING OF CABLE

Prior to burying cable following tests shall be carried out:

Insulation test between phase to phase and phase to earth for each length of cable before and after jointing. On completion of cable laying work and jointing the following tests shall be conducted in the presence of the architects/consulting engineers.

Insulation resistance test.

Continuity resistance test.

Earth test.

High voltage test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The contractor shall provide necessary instruments, equipment engineers and labor for the above test and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the consulting engineers.

CABLES TERMINATION

Cable termination shall be done with DC cable glands, Lugs, Heat shrinkable color coding strips over lugs and Gland earthing tags. No additional Gland openings shall be permitted. All additional cutouts/holes shall be closed with Metal grommets and sealed properly.

Motor terminal box shall be suitable to cable sizes. The contractor has to ensure terminal box size shall be suitable to cable sizes.

If the motor terminal box size not suitable to cable contractor size, vendor has to provide suitable add on box without altering IP class. No extra charge shall be paid for that.

Necessary gland reducers to be provided if required. All extra holes shall be sealed properly with metal grommets.

BONDING OF CABLES

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



GI slotted / reinforced FRLS cable binders to be considered for cable.

EARTHING

GENERAL

All the non-current metal parts of electrical installation shall be earthed properly. All metal conduits, trunking, cable sheaths, switchgear, distribution fuse boards, lighting fittings & fixtures and all other parts made of metal shall be bonded together and connected by means of specified earthing system. All earthing will be in conformed to Indian Standard Specifications IS: 3043-1987.

EARTHING CONDUCTORS

All earthing conductors shall be of high conductivity G.I. /copper and shall be protected against mechanical injury or corrosion.

CONNECTION OF EARTHING CONDUCTORS

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

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor or its distribution boards or to an earth leakage circuit breaker. Metal conduits, cable sheathing and armoring shall be earthed at the ends adjacent to switchboards at which they originate or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc. which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of earthing conductor for earthing purposes, even though the run of metallic conduit is earthed.

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

Earthing conductors outside the building shall be laid 600 mm below the finished ground level.

In case of copper earthing strips, the cover lapping at joints where required shall be of minimum 75 mm. Sweated lugs of adequate capacity and size shall be used for all termination of wires above 6 sq.mm. size and bare copper wire above 2.5 mm dia. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned.

In case of G.I. earthing strips, only welded joints shall be provided at the joint of the earthing strips and at the joints, corrosion resistant bituminous & Zinc chromate spray paint shall be applied.

Check for earthing of all metallic equipments, cable trays, bus bar supporting structures, yard fencing steel structures of yard, rails, gates, building columns (if steel) all elect. Equipments, gas/oil/water pipelines etc. as per the drawing / specification.

G.I. earth strip welded jointing with 100 mm overlapping zinc paint on joint.

Copper earth strip brazing with 100 mm overlapping.

2 nos of 8 mm hole in strip at every 30 mtrs. / bend in cable tray.



Each panel room & entry in room earth bus to be mount for take multi pal earth strip
100 dia sleeve/pipe to be provided in beam / waqll for wall crossing of strip
Measurement of earth resistance for each electrode.
Measurement of total earth resistance.
Measurement of earth loop resistance for E/F path of biggest LT drive.
Making of earth pits – ER value, Pit details, Test date, due date etc.

PROHIBITED CONNECTIONS

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

PROTECTION FROM CORROSION

Connections between copper and galvanized equipment shall be made on vertical face and protected with paint and grease. Galvanized fixing clamps shall be used for fixing earth conductors. When there is evidence that the soil is aggressive to copper, buried earthing conductors shall be protected by suitable serving and sheathing.

PLATE ELECTRODE EARTHING

Earthing electrode shall consist of a tinned copper plate (not less than 600 mm x 600 mm x 3 mm thicker). The plate electrode shall be buried as far as practicable below permanent moisture level but, in any case, not less than 3 meters below ground level. Wherever possible earth electrodes shall be located near the water tap, water drain or near down take pipe. Earth electrodes shall not be installed in proximity to a metal fence. It shall be kept clear of the buildings foundations and in no case shall it be nearer than 2 meters from the outer face of the wall. The earth plate shall be set vertically and surrounded with 150mm thick layer of charcoal dust and salt mixture. 50 mm GI pipe shall run from the top edge of the plate to the ground level. The top of the pipe shall be provided with a G.I. threaded cap with funnel and mesh for watering the earth through a pipe. The G.I. cap over the GI pipe shall be housed in a masonry chamber or FRP chambers, approximately 300 mm x 300 mm x 300 mm deep. The masonry chamber shall be provided with a cast iron inspection cover resting over a Gt frame embedded in masonry.

PIPE ELECTRODE EARTHING

Earthing electrode shall consist of a CI (100 mm dia.) and 3 meters long, pipe electrode shall be cut tapered at the bottom and provided with holes of 12 mm dia drilled at 75 mm interval up to 2.5 meters length from bottom, the electrode shall be buried vertically in the ground as far as practicable below permanent moisture level but in any case, not less than 3 mtr below ground level. The electrode shall be in one piece and no joints shall be allowed in the electrode. Wherever possible earth electrodes shall be located close to water tap, water drain or a down take pipe. Earth electrode shall not be located in proximity to a metal fence. It shall be kept clear of the building foundations and in no case shall be nearer than 2 meters from the outer face of the wall.

The pipe earth electrode shall be kept vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture up to a height of 2.5 meters from the bottom. At the top of the electrode a G.I. with funnel cap shall be provided for watering the earth. The main earth conductors shall be connected to the electrode just below the G.I. cap, with proper terminal lugs and check nuts. The G.I. cap over the pipe and earth connection shall be housed in a



masonry chamber or FRP chambers, approximately 300 mm length x 300 mm wide and 300 mm deep. The masonry chamber shall be provided with a cast iron inspection cover resting over a C.I. frame embedded in masonry.

EARTH RESISTANCE

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

RESISTANCE TO EARTH

The resistance of each earth system shall not exceed 1 ohm in the case of M.V. system and 0.5 ohm in the case of H.V. system.

EARTHING

Check for tightness of all earth connections.

All the non-current carrying metal parts, which forms the package unit, shall be bonded for earth continuity to the main skid base as per IS:3043. All equipment, metal conduits, rising main cable armor, switch gear, distribution boards, meters, all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes. Earthing shall be in conformity with the provisions of Rules 32, 61, 62, 67 and 68 of IER 1956.

Gland earthing needs to be considered for all cable glands.

The minimum of two earth studs (M10) must be provided on the skid base, diagonally opposite to each other, for connection to the main plant earth system.

Earthing and bonding shall generally be in accordance with standard practice and as per IS 3043. Un-armored, single core copper conductor cable is to be used for earthing purposes.

Vendor shall bring his earthing system up to test link to be provided at the ground level from where Purchaser will take over and connect it to the Plant earthing system. All earth conductors shall be above grade or in-built-up trenches

Earthing Conductors:

All earthing conductors shall be of high conductivity copper/or GI as specified and shall be protected against mechanical damage and corrosion. The connection of earth electrodes shall be strong secure and sound and shall be easily accessible. The earth conductors shall be rigidly fixed to the walls, cable trenches, cable tunnel, conduits and cables by using suitable clamps.

Main earth bus shall be taken from the main medium voltage panel to the earth electrodes. The number of electrodes required shall be arrived at taking into consideration the anticipated fault on the medium voltage network.

Earthing conductors for equipment shall be run from the exposed metal surface of the equipment & connected to a suitable point on the sub main or main earthing bus. All switch boards, distribution boards and isolators disconnect switches shall be connected to the earth bus. Earthing conductors shall be terminated at the equipment using suitable lugs, bolts, washers and nuts.

All conduits cable armoring etc., shall be connected to the earth all along their run by earthing conductors of suitable cross-sectional area. The electrical resistance of earthing conductors shall be low enough to permit the passage of fault current necessary to operate a fuse/ protective device or a circuit breaker and shall not exceed 2 Ohms.

Location for Earth Electrode:

Normally an earth electrode shall not be situated less than 2 M from any building. Care shall be taken that excavation for earth electrode may not affect the column footings or



foundation of the building. Further the location shall be such where the soil has reasonable chance of retaining moisture as far as possible. Entrances, pavements and roadways are definitely to be avoided for locating the earth electrode.

Earthing System:

Main earthing grid shall be of 50 x10 or 50 x 6 (as per schematic/power and earthing layout). All other equipment shall be connected to this main grid. All panels, equipment and non-current carrying conductor shall be earthed through the strip/wire of suitable size as per the layouts..

Main panels	- 50 x 6 mm GI
Main panels to sub panels	- 50 x 6 mm GI /40 x 6mm/25 x 6mm GI
Sub panel to DB	- 19 x 3 / 25 x 6 mm GI
DBs to sub DBs	- 8 SWG G.I wire. / 4 sqmm / 6 sqmm copper flexible wire
Motors up to and including Upto 10 hp	-2 Nos. 6 sqmm copper wires/8 swg GI wire
12.5 HP to 30 HP capacity	-2 Nos. 10 sqmm copper wires / 2 Nos. 25x 6 mm G.I.STRIP
30 HP to 75 HP capacity	-2 Nos. 35 sqmm copper wires/ 2 Nos. 40 x 6 mm G.I.STRIP
75 HP & above.	-2 Nos. 50 x6 mm G.I.STRIP/ min 70 sqmm copper cable

The earthing connections shall be tapped off from the main earthing of electrical installation. The overlapping in earthing strips at joints where required shall be minimum double the width of the conductor/flat. These straight joints shall be welding for GI & brazed FOR COPPER in approved manner. Sweated lugs of adequate capacity and size shall be used for all termination of wires. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substance, and properly tinned.

All GI welded joints shall be properly painted with Zinc chromate or equivalent rust free zinc spray.

Earthing system shall be mechanically robust, and the joints shall be capable of retaining low resistance even after subjection to fault currents.

Joints shall be tinned, soldered and/or double rivetted. All the joints shall be mechanically and electrically continuous and effective. Joints shall be protected against corrosion.

Testing:

On the completion of the entire installation, the following tests shall be conducted:

- Earth resistance of electrodes.
- Impedance of earth continuity conductors.
- Effectiveness of earthing.

All meters, instruments and labour required for the tests shall be provided by the Contractor. The test results shall.

LT SWITCHGEAR /ACDB

IR test

HV test with 2.5 kV megger

Functional test for all feeders

Testing and calibration of all meters & relays.

Checking and calibration of overload relays.

Checking the local and remote operation of the contractor.

Checking of interlocking between incomers and other feeders. Wherever required.

Test to prove interchangeability of similar parts.



Tests to prove correct operation of breakers at minimum and maximum specified control voltages.

Checking of earthing connection for neutral-earth bus, cable armour, location of E/F CT etc. as per the scheme.

CABLES & CABLE SUPPORTING STRUCTURES

Checking of continuity and IR values for all the cables beforehand after HV test.

HV test and measurement of leakage current after termination of cable kits (for HT cables.)

Checking of earth continuity for armour and fourth core (If applicable).

Check for mechanical protection of cables.

Check for identification (tag number system) placement of cable marker, cable joint etc. as per the cable layout drawing.

Check for earthing of cable structures.

Check for proper fixing of cable structures.

Check for proper drainage and removal of water (if any).

CABLE TRAY – SS 304

Cable trays shall be fabricated from Stainless Steel. The design shall be wire mesh type. Shall be fixed or suspended from the ceiling with the help of suspenders which shall have adequate diameter to sustain the weight of the cables and channels. Also if necessary anchor fasteners shall be used for grouting purpose.

Cable tray support should as per capacity to take load of cable

Cable tray shall be supported at every 1.5 mtrs. (Max.) With maximum loading of 50 kg/mtrs for upto 300 mm wide, 75 kg/mtrs above 300 mm and upto 450 mm and 100 kg /mtrs above 450 mm wide cable trays.

All prefabricated accessories like coupling plates, nut bolts, bends and reducer etc. to be considered along with cable trays.

Cable tray support every 1500 mm / also near bend

The deflection of the wire cable tray must be no more than 1/200th of the distance between two supports 1500 mm and tested in accordance with the standard IEC 61537

All trays shall be arranged and positioned on the site itself in accordance with the manufacturer's instructions.

Taking into account the maximum carrying capacity authorized by the manufacturer.

For the purpose of assembling the various wire cable tray, only fast coupling systems or screw-based systems must be used. These must be designed, mechanically tested and supplied by the cable tray manufacturer

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

Maximum rung spacing in the ladder shall be 300mm. The rungs should be made of C profiles suitable to fix cables.

MOTORS

All motors shall comply with the purchase data sheet and/or Standard Specifications and shall be suitably rated for all duty conditions. The selected enclosure type and materials shall be suitable for the environmental conditions.

Motors (fractional kW/hp motor expected) installed in hazardous areas shall be fitted with thermistors with appropriate terminal and glanding arrangements.



Motor used in variable speed applications, where low speed can reduce the cooling ability of the motors fan, shall be appropriately and incorporate thermistors.

Motors below 0.18 KW may be single phase, all others shall be 3-phase. Make of motors shall be that of other motors of the plant as per owner's choice.

Motors upto 7.5 kW rating shall be 'direct on line' started and above 15 kW rating motors shall be started thru' star-delta starter, unless motor duty conditions impose alternative starting.

Service factor for motors shall be 1.

Energy Efficient motors IE2 category shall be considered except Motors are used for following application which shall be IE 3 category:

COMMISSIONING OF MOTORS

The Contractor shall however, check all the motors installed, carry out the tests required and commission the motors. The work will include the following:

- a) Check rotor for free movement.
 - b) Check end play in bearings.
 - c) Check for mechanical defects, if any, by visual inspection.
 - d) Inspect bearings to ensure they are greased.
 - e) For D.C. or slip ring induction motors, check commutators, slip rings, brushes, brush holders and springs, brush lifting gear, etc. for satisfactory condition.
 - f) Check direction of rotation for correctness and reconnect the leads, if necessary.
 - g) Check conduit entries on terminal boxes, block unused entries.
 - h) Carry out insulation test with an appropriate megger.
 - i) Ensure earthing connection to motor.
 - j) Setting of over load relay / MPCB as per motor rating.
- Measuring and recording of no load & full load current.

AS BUILT DRAWINGS

On completion of installation Testing and commissioning. The tenderer shall incorporate revisions/modification if any in the reproducible and submit 'as built' drawing for purchaser's record as per general condition of contract.

Protective Guard:-

All guards necessary to afford protection to personnel from electrical apparatus and moving parts shall be to the appropriate standard (or other recognized national or international standards) and meet the requirements of the factories acts or other relevant regulations and requirements of the locality in which the equipment is installed. The guards shall be capable of being removed without disturbing adjacent equipment.

RESPONSIBILITIES

The responsibility for design, supply of material and documentation within the packaged unit shall be as marked in the appropriate box following:

	Vendor	Purchaser / PDA	Remarks
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	Vendor	Purchaser / PDA	Remarks
A) Design / Engineering Rating of all materials & equipments Single line diagram Control & Schematic wiring diagram Power layout with GA Earthing layout with GA Cable Schedule Interconnection diagram /schedule Motor list Schedule	√		Complete design & engineering by vendor. (Main incoming power supply at one point shall be provided by Purchaser for each dedicated panel and further shall be considered by each vendor)
B) Supply of Materials ** Motors Control panel, if any Motor Control Centre Local push button stations Cables From Panel to Motors From Control Panel (if any) to field devices Earthing material Cable trays/cable rack & accessories	√		Complete supply of materials by vendor.
Junction boxes (if any) Installation materials Commissioning spares & maintenance spares for two years.			
C) Documentation as per Vendor Document Requirements 1) Maintenance Instructions 2) Operation Instructions 3) Test certificates 4) Installation drawings 5) As built drawings	√		
D) Installation of complete electrical system under the scope	√		Complete system, installation, testing & commissioning.
E) Onsite Testing, Pre-commissioning, Commissioning and Handover	√		

** This is a generic list for all packages. Vendor to refer to the BOQ & SLD for the supply of relevant materials

All testing equipment shall be arranged by the Vendor wherever commissioning is included in Vendor's scope. Vendor shall furnish the test result so obtained in the form of test certificate.

Whenever electrical installation is in Vendor's scope, Vendor shall assist owner to get the electrical installation approved by Electrical Inspector.

All design / engineering documents produced by the Vendor shall be submitted to PDA / Owner for their comments & approval.

GENERAL REQUIREMENTS

Signature of Bidder/JV Firm



Service Conditions

The materials and equipment shall be suitable for the service conditions, ambient temperatures, humidity, altitude, environment, etc. specified in cl. 2.0

System

The electrical system voltage, frequency and tolerance shall be as stated in clause 2.0.

All materials and equipment shall be capable of operation continuously and without adverse effect or injurious overheating, under all specified conditions of operation, including variations in the system voltage, frequency or combined voltage and frequency of the nominal rating as stated in clause 2.0.

The vendor shall provide estimated electrical power consumption when idle and under maximum load.

APPROVED MAKES

SR.NO	DESCRIPTION	MAKES
1	POWER & CONTROL -XLPE INSULATED ALUMINUM / COPPER ARMoured / UNARMORED CABLE 1100 VOLT GRADE	FINOLEX/POLYCAB /RR KABEL/ KEI
2	CABLE GLANDS (TO BE PROCURED WITH EARTHING TAGS)	COMMET / HMI / DOWELLS
3	CABLE TRAY	LABH/ELECTECH
4	PANEL COOLING FAN	RITTAL / REXONARD
5	SPACE HEATER & HUMIDISTAT	RITTAL / HONEYWELL
6	LIGHTING-LED	PHILIPS/WIPRO/PANASONIC
7	MCB/RCCB/RCBO	SIEMENS / SCHNEIDER / ABB /L & T AU SERIES
8	INSTRUMENT & CONTROL TRANSFORMERS <1.1 KV -CAST RESIN	KAPPA / AE / PRAGATI
9	INSTRUMENT & CONTROL TRANSFORMERS >1.1 KV-CAST RESIN	KAPPA / AE / PRAGATI
10	LV PANELS (3B& 4B)	SCHNEIDER / SIEMENS / ABB/ L&T – TYPE TESTED PANELS BY OEM
11	LV PANELS (FORM 2B)	SCHNEIDER / SIEMENS / ABB/ L&T – TYPE TESTED PANELS BY OEM



12	STEEL	TATA/ JINDAL/ SAIL
13	CAPACITOR / REACTOR	EPCOS / ABB / SCHNEIDER / UNIVERSAL/NEPTUNE DUCATI /
14	SELECTOR SWITCH / INDICATION LAMP / PUSH BUTTON	KEYCEE / SCHNEIDER ELECTRIC / SIEMENS
15	WELDING ROD	ADVANI / ESAB
16	PAINT	BURGER / ASIAN PAINT / NAROLAC
17	AIR CIRCUIT BREAKERS	SCHNEIDER NW/ SIEMENS 3WL/ ABB / SCHNEIDER
18	MCCB	SCHNEIDER NVX / SIEMENS 3VL /Equivalent in ABB
19	MCB/RCCB/RCBO	SCHNEIDER / SIEMENS /ABB/ L & T /HAGER
20	PLC	AB/SEIMENS/HONEYWELL/SCHNEIDER ELCTRIC/ABB
21	MOTORS	ABB /SEIMENS/CGL/KIRLOSKAR ELECTRIC/BBL
22	APFC RELAY WITH RS 485 PORT	EPCOS / BELUK/ SCHNEIDER / NEPTUNE DUCATI
23	METERS	SCHNEIDER / L&T / SECURE /ABB/SEIMENS
24	CONTACTORS	SCHNEIDER / ABB / SIEMENS
25	CRCA SHEET	TATA / SAIL / ESSAR
26	GASKETS	NEOPRENE
27	INDICATING LAMPS - LED	SCHNEIDER / SIEMENS / L & T - ESBE
28	PUSH BUTTONS	SCHNEIDER / SIEMENS / L & T - ESBE
29	CHANGE OVER SWITCH	C & S / HAVELL'S / L & T/ SOCOMEC
30	ATS(AUTO TRANSFER SWITCH)	ASCO 7000 SERIES/ LEGRAND /SCHNEIDER SOCOMEC
31	WALL MOUNTING PANEL / NON-COMPARTMENTALIZE PANEL ENCLOSURES/CONTROL PANELS/JB/DB	RITTAL /EN STEEL /SCHNEIDER /HENSEL(FOR POLYCARBONATE)/MDS LEGRAND/SITEX/SEIMENS/SPELSBERG
32	VFD	SCHNEIDER / DANFOSS/ SIEMENS/ ABB/AB
33	SOFT STARTER	SCHNEIDER / DANFOSS/ SIEMENS/ ABB/AB
34	SURGE ARRESTORS	FURSE/OBO BETTERMAN/PHOENIX/SCHNEIDER ELECTRIC
35	CONDUITS AND ACCESSORIES	AKG/BEC/LAPP KABEL/STEELCRAFT
36	CABLE JOINTING KITS & TERMINATION KITS	3M/RAYCHEM
37	ANALOG METERS	AE/ENERCON/MECO/RISHAB
38	POWER SOCEKTS(INDUSTRIAL/DOMESTIC)	SEHNEIDER/ABB/LEGRAND/

Notes:



The Consultants reserves the right to select the manufacturers or approved make from the above list & also to make changes (add or delete names of other makes) in this list during the execution of the contract.

DOCUMENTATION REQUIREMENTS:

Following Drawings and documents shall be required for the System in both HARD and SOFT COPIES during handover

Technical Specifications	:	4 sets
G.A / Foundation Drawing	:	4 sets
Tests Certificates	:	4 sets
O & M Manual	:	4 sets
List of Spare Parts	:	4 sets
Design Qualification Report	:	4 sets
Preventive maintenance schedule	:	4 sets
Any Other documents as per requirements	:	4 sets
As built drawings	:	4 sets
Catalogues	:	4 sets
Escalation matrix	:	4 sets
Calibration certificates	:	4 sets
Warranty/Guarantee certificates	:	4 sets

OPERATING SEQUENCE FOR FIRE PUMPS

PUMPS		START	STOP	REMARKS
Operating Pressure of system – 7.0 Kg/CM ²				
PS – 1	Jockey pump	6.0 Kg/CM ²	7.0 Kg/CM ²	
PS – 2	Main pump	5.0 Kg/CM ²	Manual	
PS – 3	Standby pump	4.0Kg/CM ²	Manual	

NOTES-

- Jockey pump shall start and stop through pressure switch automatically.
- Jockey pump shall stop when main starts.
- Main pump and stand by pump shall start automatically on fail of pressure but stopping shall be manual.

WORKING PHILOSOPHY OF AIR VESSEL

An air vessel shall be fitted by taking tapping from the discharge header to dampen out the pressure variations during discharge. As the discharge pressure rises the air is compressed in the vessel, and as the pressure falls the air expands. The peak pressure energy is thus stored in the air and returned to the system when pressure falls.



10.0. Mode of measurements shall be as given below:

Pipes shall be measured per linear meter of the finished length and shall include all fittings, clamps for fixing to walls or hangers.

- No additional payment shall be admissible for cutting holes or chases in the wall or floors.
- Making connections to pumps, equipment and appliances.
- Painting of pipes shall be included in the rates for pipes and no extra payment shall be made.
- Pump sets shall be measured as sets.
- Hydrant valves, Hose reels with accessories, Branch Pipes, Hose Boxes, Hose Pipes, shall be counted in Numbers.
- Butterfly valves, Non return valves, Strainers with flanges, and accessories shall be counted in numbers. Hardware, gaskets, required for jointing in the valves shall be included in the flanges of the valves.
- Cable shall be measured in Running meters.
- No additional payment for arranging scaffolding tools tackles etc. for work.

11.0. TESTING-

Hydraulic test:

Before testing all lines shall be flushed with clear water.

The entire piping shall be tested to a hydrostatic test pressure of 1.5 times of working pressure for a period of 24 hours at the end of which there shall be no loss in pressure. Leaks and defects in drawings revealed during the testing shall be rectified and retested to the satisfaction of EIC.

System may be tested in suction with prior written permission of engineer and such section securely capped.

Contractor shall conduct pressure tests for establishing head for external yard hydrants at ground level.

Start and stop of all pumps set in required settings.

12.0. COMMISSIONING OF FIRE FIGHTING SYSTEM-

SCOPE OF WORK-

Work under this section shall consist of pre-commissioning, commissioning testing and providing guarantees for all equipment, appliances and accessories supplied and installed by the contractor under this contract.

GENERAL REQUIREMENT

Work under this section shall be executed without any additional cost. The rates quoted in this



tender shall be inclusive of the works given in this section.

The contractor shall provide all the tools, equipment, metering, and testing devices required for the purpose.

On award of work, the contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under the contract.

PRE-COMMISSIONING

On completion of the installation of all pumps, piping, valves, pipe connections devices the contractor shall proceed as follows-

FIRE PROTECTION SYSTEM

Check all hydrant valves and close if any valve is open. Check that all suction and delivery connections are properly made.

Test run and check rotation of each motor and correct the same if required.

PIPE WORK

Check all clamps, supports and hangers provided for the pipes.

Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specifications if any leakage is found. Rectify the same and retest the pipes.

COMMISSIONING AND TESTING

FIRE HYDRANT SYSTEM

Pressurize the hydrant system by running the main fire pump and after attaining the required pressure shut off the pump.

Open bypass valve and allow the pressure to drop in the system. Check that the jockey pumps cuts-in and cuts-out at the pre-set pressures. If necessary, adjust the pressure switch for the jockey pump. Close by-pass valve.

Open hydrant valve and allow the water to flow into the firewater tank in order to avoid wastage of water. The main fire pump should cut in at the present pressure and should not cutout automatically on reaching the normal line pressure. The main fire pump should stop only by manual push button. However, the jockey pump should cut out as soon as the main pump starts.

When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant valves simultaneously and allow the hosepipes to discharge water into the fire tank to avoid wastage.

The electrically driven pump should run continuously for eight hours so that its performance can be checked that pump is able to operate continuously at the duty point as specified.

Any test, which would be desired by the fire officer, may also have to be conducted by the contractor to him satisfactory.



Check each landing valve, male and female couplings, and branch pipes for compatibility with each other. The contractor shall replace any fitting which is found to be incompatible and does not fit into the other properly. Landing valves shall also be checked by opening and closing under pressure.

13.0. HANDING OVER

All commissioning and testing shall be done by the contractor to the complete satisfaction of the Engineer-in-Charge, and the job handed over to the client.

The contractor shall also hand over to the client all maintenance and operation manuals and all items as per the terms of the contract.

INFORMATION TO BE FURNISHED BY THE TENDERER ALONG WITH THE TENDER

1 TECHNICAL DATA SHEET FOR PIPES AND FITTINGS

- a Material
- b Standard
- c Type of Pipes
- d Class & Pressure Rating
- e Connection between pipes & Fittings

2 FITTINGS

- a Material
- b Standard
- c Type of Fitting
- d Class & Pressure Rating
- e Connection between pipes & Fittings

3 Nuts & Bolts

- a Material
- b Standard

4 Gaskets

- a Material
- b Make

5 Painting For Above Ground Piping

- a Material
- b Standard / Specification
- c Number of Coats

6 Anticorrosive treatment for underground piping



-
- a Material
 - b Standard / Specification
 - c Thickness

7 NON RETURN VALVE

- a Make
- b Material of body
- c standard
- d pressure rating
- e Moc of internal parts
- f Tested pressure
- g End connection

8 SLUICE VALVES

- a Make
- b Material of body
- c standard
- d pressure rating
- e MOC of internal parts
- f Tested pressure
- g End connection
- h Type of spindle

9 BUTTERFLY VALVES

- a Make
- b Pressure rating
- c Type of operation (lever/gear)
- d Standard
- e Material of body
- f Material of seat
- g Tested pressure

10 POT-TYPE STRAINERS

- a Type
- b Material of body
- c Material of mesh
- d Size of the holes
- e Size of the Mesh
- f End connection
- g Size of the drain



11 HYDRANT VALVES

- a IS specification
- b Type of Hydrant Valve
- c Flow Rate at 7 Kg/cm²
- d Inlet Connection
- e Companion flanges with fasteners
- f Test Pressure (Body)
- g Test Pressure (Seat)

MATERIAL OF CONSTRUCTION

- a Stand post column
- b Hydrant valve body
- d Washer, Nuts Bolts
- e Hand wheel
- f Adaptor
- g Chain
- h Cap
- i Companion Flange
- j Gaskets
- l Manufacturer / Supplier
- M ISI Marked
- n Approved by TAC /CFO
- o Catalogues / literatures

12 HOSE PIPES

DESIGN PARTICULARS

- a Type of Hose
- b Relevant IS Standard
- c Diameter
- d Length of Hose
- e Test Pressure
- g Proof Pressure
- h Bursting Pressure
- i Type of Coupling
- j Relevant standard of coupling



- k Size of coupling

MATERIAL OF CONSTRUCTION

- a Hose pipe
b coupling
c Manufacturer / Supplier
d ISI Marked
e Approved by TAC /CFO
f Catalogues / literatures

13 BRANCH PIPE AND NOZZLE

- a Size of the branch pipe
b Specifications
c Size of the nozzles
d MOC of Branch pipe
e approved by tac
f Type of manufacturing

14 HOSE BOX

- a Size Box in mm
b Material of construction
c Sheet Thickness in SWG
d Above item accepted by TAC / CFO
e Manufacturer / Supplier

**15 HOSE REEL AND ACCESSORIES
DESIGN PARTICULARS**

- a Type of Hose Reel
b Relevant IS Standard
c Diameter
d Length of Hose
e Test Pressure

MATERIAL OF CONSTRUCTION

- a Hose
b Reel Drum
c Shut off Nozzle
d Manufacturer / Supplier
e ISI Marked
f Approved by TAC /CFO
g Catalogues / literatures



16 FIRE BRIGADE INLET CONNECTION

17 PRESSURE GAUGE

- a Type
- b Make
- c Dial Size
- d Range
- e Moc of internal parts
- f End connection type
- g Type of end connection

18 PRESSURE SWITCH

- a Type
- b Make

DESIGN PARTICULARS

- a Type
- b Reference Standard
- c Construction
- d Equipment Mounting
- e Accessories
- f Applicable standard
- g Contact rating
- h Over range protection

LIST OF MAKES

Sr. No.	DESCRIPTION	VENDOR
1.	Butterfly Valves	Lehry/ Advance / Sant / Zoloto/NVR
2.	CI NRV	Lehry/ Advance / Sant / Zoloto/NVR

Signature of Bidder/JV Firm



3.	Pipes	Jindal Hissar / Tata / Surya / Apollo
4.	Fittings	Sant/NVR/ United Forging / Metal Lloyds
5.	C I Gate Valve with Tamper Switch	Lehry/ Advance / Sant / Zoloto/NVR
6.	Pot / Y Type Strainer	Lehry/ Advance / Sant / Zoloto/NVR
7.	Hydrant Valve / Swati	Newage- Surendranagar / Shah Bhogilal / Winco
8.	Hose Monsher/Swati	Newage-Surendranagar /Shah Bhogilal /
9.	Branch Pipe & Nozzle Swati	Newage-Surendranagar / Shah Bhogilal / Winco /
10.	Hose Reel Drum Swati	Newage-Surendranagar / Shah Bhogilal / Winco /
11.	PVC Hose	Duplon / Revlon/ Matras
12.	Pressure Switch	Switzer /Danfoss / Indfos
13.	Pressure Gauge	H. Guru / Fiebig / Waree / MASS
14.	Wrapping & Coating	IWL / STP (Shalimar Tar Products) / Tikidan
16.	Power Cable	Finolex / Polycab / KEI /RR Kabel
17.	Control cable	Finolex / Polycab / Caliplast/ RR Kabel
18.	Ball Valve	Lehry/ Advance / Sant / Zoloto/NVR
19.	Extinguishers Fire/Kanex/Safex	Minimax / Fire Age/ Cease
20.	Passive Fire Protection	Hilti / Promat /3M / Fischer(Inner)
21.	Auto Glow Signages	Prolite / Glowlite / Autolite
22.	Anchor Fasteners	Hilti/ Fischer/ Mupro
23.	Paint	Asian Paints / Berger / Nerolac
24.	Pump Sets	Kirloskar / WILO / LUBI
25.	Motors	Siemens / Kirloskar / ABB / Crompton/Lubi
26.	Push button station	Schneider / Siemens/ L&T/ Legrand /ABB
27.	Welding electrodes	Advani / ESAB/Ador
28.	Air release valves	Leader / Hawa / Bajaj



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- | | | |
|-----|---|---|
| 29. | Expansion Bellows / Flexible Connectors | Easy flex / Resistoflex / Mupro |
| 30. | Diesel Engine | KOEL / Crompton / Eischer |
| 31. | M.S /FRP Hose Box
Swati | Newage-Surendranagar/ Shah Bhogilal / Winco / |
| 32. | Pipe Clamps | Hilti/ Fischer/ Mupro / Chilly |
| 33. | Structural Steel | Jindal / Tata / SAIL |
| 34. | Cable Tray | Labh / Electech |
| 35. | Electrical Panel | Swati switchgear/Sun Automat /Shiv Shakti
Engineer/ Active Engineers |

Note: The above LIST OF APPROVED MAKES states the Manufactures / Brand name that can be accepted to be used in construction. However, it is mandatory for the BIDDER to List out the make / mSanufacture the Material, while quoting for the job.



TECHNICAL SPECIFICATIONS OF ACCESS CONTROL SYSTEM (ACS) TROPICANA GARDEN

Functional Overview

- a) The Enterprise Security (Access) Management System shall allow multi-Zone configuration which will be capable of connectivity with Normal/RFID based readers .
- b) It shall include (but not be limited to) the following:
 - (1) Access control
 - (2) Alarms management
 - (3) Mobile App management.
- c) The System shall provide a means to control access through nominated doors having electric locking door status monitoring and token or Mobile access control readers. Access rights associated with a presented access token or mobile credential shall be checked for validity based on identifier, access area, access time and any other access management function defined in this specification, as stored in intelligent field controllers. Access shall be granted or denied dependent on the access privilege. Access rights shall be programmed in a variety of ways to allow flexibility as defined elsewhere in this specification.
- d) The System shall monitor the condition of inputs. The System shall be able to be programmed to apply a variety of conditions to the way in which these inputs are monitored and shall enunciate the condition of such inputs in accordance with such programming.
- e) The System shall provide an integrated software facility for the design and production of photo ID cards & Mobile Credentials
- f) The System shall be OPC AE (Alarms and Events) and OPC DA (Data Access) compliant, enabling integration of event, status and override data **with external OPC compliant automation and business systems.**
- g) The System shall allow data exchange with other applications using XML protocols for schedule changes and card record changes.
- h) The System shall support the BACnet communications protocol if required to communicate to other ELV System
- i) The System shall support a Web Service to allow an external system create remove and modify cardholders, including assigning access rights.
- j) The System shall support a Web Service to allow an external system to create and modify visits and visitors.
- k) The System shall support APIs to allow external systems to receive events from The System, and pass events to The System.
- l) The System shall support the Simple Network Management Protocol (SNMP) protocol.
- m) Connection to Intelligent Field Controllers (IFCs) shall be achieved using cabling supporting the TCP/IP protocol. The network connection must be on-board the IFC. Interface transceiver units (Ethernet to RS485,



- n) All system **software upgrades shall be downloadable through the network to the IFC**, readers and I/O devices.
- o) All data communication between The System and IFCs shall be encrypted using an industry **standard symmetric encryption algorithm equivalent to 256-bit AES or stronger**.
- p) All data communication The System and IFCs shall use an industry standard asymmetric encryption algorithm for mutual authentication and session key negotiation. This algorithm **shall be equivalent to 1024-bit RSA or stronger**. Session keys shall be re-negotiated on a regular basis at intervals no longer than 30 hours.
- q) All data communication **between IFCs and Edge Devices such as readers and I/O devices shall be encrypted using an industry standard symmetric encryption algorithm equivalent to 128-bit AES or stronger**.
- r) All data communication between IFCs and Edge Devices such as readers and I/O devices shall use an industry standard asymmetric encryption algorithm for mutual authentication and session key negotiation. This algorithm shall be equivalent to elliptic curve ECC P-256 or stronger. Session keys shall be re-negotiated on a regular basis at intervals no longer than 30 hours.
- s) The System shall report all events to the operator(s) as configured and shall produce and maintain a log of all system events, alarms and operator actions.
- t) The System shall provide a means for an operator to extract information relative to the event log and system configuration and produce this information in the form of printed reports, emailed reports directly from The System itself, screen displays or exported files.
- u) The System shall provide for a Windows based User Interface with Site Plans and interactive icons representing the location and real-time status of Access Control, and Alarm Monitoring equipment.
- v) The System shall provide emergency evacuation reporting.
- w) The System shall be designed and manufactured by a reputable company who shall be certified under the ISO 9001:2008 (or later) quality procedures.
- x) Where applicable, equipment shall have the following approvals:
 - (1) FCC Part 15
 - (2) CE approval BS EN 50130-4 Alarm Systems Electromagnetic Compatibility (Immunity)
 - (3) CE approval BS EN 55022 Emissions
 - (4) UL294 Access control
 - (5) ULC-ORD-C1076
- y) Encoders and readers shall also meet:
 - (1) CE ETS 300 683 Short Range Devices
 - (2) C-Tick AS/NZS 4251 Generic Emission Standard



(3) C-Tick RFS29

- z) The System software shall be written in a fully structured, fully validated and commercially available language that provides a strictly controlled development environment.
- aa) The user interface for operational management of site security shall be developed using Microsoft .NET and Windows Presentation Foundation (WPF) development tools.
- bb) Comprehensive backup and archiving facilities shall be incorporated as an integral part of the system software.
- cc) IFCs must support peer to peer communications for input and output communications between IFCs. **Systems that require the main server for communications between panels are unacceptable.**

2) Central Control and Security (Access) System Management Software

- a) The Central Management System (CMS) shall use the Microsoft Windows operating system as defined previously. The version of Microsoft Windows shall be a currently supported version.
- b) The system database shall be a version of Microsoft SQL Server appropriate for the system size required. The version of Microsoft SQL Server shall be a currently supported version as defined previously.
- c) The system shall be OPC enabled in accordance with the current OPC specification for OPC AE (Alarms and Events) and OPC DA (Data Access).
- d) The central server shall employ a high quality personal or server computer incorporating current generation design and components. It shall be of a Microsoft approved model for operation with current versions of Microsoft Windows operating systems. The PC specifications, including processor speed, internal memory and hard disk size shall be specified by the supplier and must be sufficient to meet or exceed the specified system requirements.
- e) The system shall be capable of supporting a minimum of 20 PC based operator workstations simultaneously running. Operator workstations running terminal emulation software will not be accepted.



- f) The system shall automatically log and time/date-stamp all events within the system including intruder alarm set/unset events, access control events, operator actions and activity.
- g) The central control software shall be easy to use, make extensive use of menus and windows and require a minimum of operator training to operate the system proficiently. Systems requiring a script/program language approach to configure the system will not be accepted.
- h) The central control must be capable of receiving simultaneous alarm signals from a number of remote locations without loss or excessive delay in their presentation to the operator. Any authorized operator should be allowed to acknowledge, view and/or process an alarm from any screen.
- i) The central control shall be fitted with a real time clock, the accuracy of which shall be preserved over the period of main power supply failure. Synchronization between the central control and Ethernet connected IFCs shall be automatic and not require operator intervention.
- j) Operator selection of processing tasks shall be via menu selections. Authorized Operators shall be able to process alarms, produce reports and modify database records without degrading system performance.
- k) The following is the minimum operational and monitoring facilities required. The ability to:
 - (1) Program either a group or individual card readers with access control parameters, without affecting other card readers.
 - (2) Program the access criteria for individual Cardholders or groups of Cardholders.
 - (3) Store at least 64 non-access control data fields for each cardholder. The names of these 'Personal Data' fields shall be user-definable.
 - (4) Authorize or de-authorize a Cardholder in the system with the result reflected immediately throughout all readers in the system.
 - (5) Enable a 'Card Trace' against selected Cardholders so that an alarm is raised each and every time that cardholder presents their access card or token.
 - (6) Pre-program holidays so that different access criteria apply compared to normal working days. The system must have a capacity to set at least 400 holiday days.
 - (7) Recognize and manage regional holiday requirements
 - (8) Define as many access zones as there are card readers fitted.
 - (9) Allow or disallow individual Cardholder access to any one, or group of card readers, in real time.
 - (10) Log all system and operator activity to hard disk as they occur.
 - (11) Program alarm response instructions into the system so that these are presented to the Operator when processing an alarm event.



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- (12) Enable an Operator to enter messages against alarm events. This shall be configurable to be compulsory based on the operator who is logged on.
- l) The central control shall display a one-line plain language event message for every activity event (alarm or otherwise) occurring in the system. All activity logged shall be time and date stamped to the nearest second (hh:mm:ss). On having the appropriate operator authorization it shall be possible to drill down into the properties of each component that makes up that event for future details. The event message shall advise:
- (a) Time of event created at the Intelligent Field Controller.
 - (b) Time of the event received at the central control system.
 - (c) Action.
 - (d) Successful or unsuccessful.
 - (e) If the transaction is unsuccessful, the reasons for the denial.
- (1) This includes but is not restricted to the following items:
- (a) All card attempts.
 - (b) All door alarms.
 - (c) All operator activity including log on, log off, alarm response messages and any alteration of system data files.
 - (d) All alarm monitoring activations.
 - (e) All communications link failures.
- m) Time schedules for different 'day types' shall be configurable.
- n) Regional holidays shall be configurable to allow for regional variations.
- o) The system shall provide a detailed operator help file. This help file shall provide operators with text, audio and video help instructions and tutorials.
- p) The system shall allow for searching of items configured within the system based on the following:
- (1) Item characteristics.
 - (2) Related items.
 - (3) Times related to events including the item.
- q) **Configuration Graphical User Interface**
- i) The system access shall be via a Graphical User Interface (GUI)
 - ii) All functionality shall be managed via the GUI
 - iii) Drop-down menus or intuitive buttons shall be provided to select all configuration functions.



- iv) System items (hardware items and software items) shall all have an associated properties menu to allow item configuration.
- v) Configuration or operation using scripting or other forms of text-based programming will not be accepted.

r) Operator User Interface

- i) In addition to the User Interface defined above, the Operator User Interface shall be provided as follows:
 - (1) Full screen, user configurable viewers, designed specifically for the task and the information needs of the operator.
 - (2) Default viewers shall be provided covering the primary site management functions of:
 - (a) Events
 - (b) Alarm management
 - (c) Mobile App management.
 - (d) Access management
 - (e) Site monitoring
 - (f) Calendars and day schedules
 - (g) Macros
 - (h) Operator Management
 - (i) Site wide system changes
 - (j) Reports
 - (3) The system shall allow customised viewers to enable operators to access information relevant to their task.
 - (4) The Operator User Interface shall be fully configurable by an operator with authorisation to configure viewers.
- ii) Each viewer shall consist of a navigation area and a panel area as detailed below.
 - (1) The navigation area shall provide a list of system information associated with the specific viewer.
 - (a) It shall be possible to select and order the columns of data associated with alarm and cardholder viewers.
 - (b) Incremental searching shall be provided based on preselected data columns for cardholder viewers.
 - (c) Selection of a line item in the navigation area shall cause the associated file data to be populated.



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- (d) Alarm viewer headers shall display the number of unprocessed alarms for each alarm.
 - (2) One or more data tiles shall be provided to display detailed data associated with the navigation area item selected.
 - (a) Tiles shall be able to be created based on a range of default tiles provided for this purpose.
 - (b) Each tile shall be configurable with the required data fields as determined by the function of the tile
 - (c) Tiles shall be maximized by single click operation.
 - (d) When a tile has been maximized, other tiles shall remain visible in thumbnail format, allowing single click to restore them.
 - (e) Where applicable, minimized tile icons shall display dynamic content.
 - iii) The event viewer shall have the following capabilities:
 - (1) Allow the operator to view events in real time.
 - (2) The displayed data columns shall be configurable.
 - (3) The columns shall be sortable.
 - (4) Auto scroll capability.
 - (5) Allow the operator to view historic events, even when they have been processed from the main viewer window.
 - (a) Filter based on time/date.
 - (b) Filter based on the source of the event, i.e. door, input, output etc.
 - (c) The filtered events shall appear in the event window in the same manner as real time events.
 - (d) Display a count of the number of events which were found.
 - (6) Display information relevant to the event that has been selected. This is applicable to the real time event viewer and the historic event viewer:
 - (a) Instructions for the operator.
 - (b) Details of the event.
 - (c) Site plan.
 - (d) Cardholder image (where appropriate to the event).
 - (e) Video camera feed (where appropriate to the event).Optional
 - (f) Recent event history for the door (where appropriate to the event).
 - (g) Recent event history for the cardholder (where appropriate to the event).

s) **Site Plans**



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- t) It shall be possible to manage and monitor alarms, overrides, the general status of site items and open doors through the Graphical User Interface with the use of interactive real time dynamic site plans and icons.
 - u) Site plan usage shall support touch-screen technology.
 - v) All site plans stored on the server PC shall be automatically updated if amended at any of the networked workstations.
 - w) External drawings shall be imported into the system from external drawing software.
 - i) The ability to import following drawing formats, as a minimum, shall be supported:
 - (1) BMP
 - (2) WMF
 - (3) EMF
 - (4) JPEG
 - (5) GIF
 - (6) DXF (version 3 or above)
 - x) It shall be possible to assign icons to system functions and place these at any position on a site plan.
 - y) Provision for drawing lines and areas to form 'objects' shall be available. These objects shall be able to be associated with system items allowing system item status to be visually indicated by the object.
 - z) It shall be possible to place free text onto a site plan.
 - aa) Site plans shall be 'nested' allowing a single action (mouse click on a current site plan icon) to move from one site plan to another.
 - bb) The following functions should, as a minimum, be able to be executed by clicking on Site Plan icons:
 - (1) View the current status of a Door, Input or Output.
 - (2) Override a Door, Input or Output.
 - (3) Monitor and acknowledge an Alarm.
 - (4) Open an access controlled door.
 - (5) Move from one site plan to another.
 - (6) Activate an Intercom.
 - (7) Override an alarm, access or perimeter fence zone state.
 - (8) Generate a report.
 - cc) Icon names shall use the item name by default but a shortened name shall be selectable so as not to clutter the site plan with text.



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- dd) The size of the Icons shall be scalable.
- ee) A pre-designed set of icons covering basic access control functions shall be provided.
- ff) It shall be possible to design and load icons from external software for use in the system.
- gg) It shall be possible to design macro buttons to reside on site plans. On activation, macro buttons must be capable of performing multiple overrides for any site items simultaneously.
- hh) It shall be possible to click and drag over an area within a site plan or individually select items on a site plan in order to override their state in one action.
- ii) It shall be possible to search for, select and navigate through available site plans within a single window (tile) and to view, move backward or forward through the list of recently visited site plans.
- jj) It shall be possible to display the number of cardholders within zones in real-time. This should be in the form of a numerical display on the site plan.
- kk) By default, the numerical display shall be green when the zone is empty and red when it is occupied.
- ll) It shall be possible to alter the size, font and colour of the numerical display.
- mm) It shall be possible to display the names of the cardholders within the zones along with the entry time and a user definable field such as contact number, department, card expiry details etc.
- nn) It shall be possible to change the location of a cardholder via the software so as to reduce or increase the cardholder count within a zone without the need to physically present the card to a reader.
- oo) The system shall allow access zones to be monitored 'on the fly' whereby the operator can drag and drop an access zone icon from a list or the site plan onto the cardholder monitoring area to view the number of cardholders within that area.
- pp) The system shall be capable of maintaining a text file in real-time which contains details of the cardholders within the zones. This may be used by third party software to monitor cardholder location for tracking or evacuation purposes.
- qq) The operator shall be able to generate a report by selecting an item on the site plan.
- rr) The report shall be in context to the icon that was selected.
- ss) The report shall be exportable from within the report builder to the following formats:
- (1) Adobe PDF files (.PDF)
 - (2) Microsoft word file (.DOCX)
 - (3) Microsoft XPS file (.XPS)
 - (4) Microsoft Excel file (.XLSX)



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- (5) Pages saved as image files (.JPEG)
 - (6) CSV file with headers (.CSV)
 - (7) CSV file without headers (.CSV)
- ii) It shall be possible to email the report directly from within the report builder.
- iii) **ACCESS CONTROL SYSTEM**
- iv) The system shall provide complete flexibility and be capable of programming an unlimited combination of access control, security alarm and I/O parameters subject only to performance and memory limitations within the Intelligent Field Controller (IFC).
 - v) For ease of programming cardholders shall be grouped into access groups sharing the same access criteria.
 - vi) Individual cardholders may be assigned with an extended door unlock time, as may be required by cardholders with a disability.
 - vii) It shall be possible to assign an individual cardholder to an access group on a temporary basis with predetermined start and finish times.
 - viii) During the period of temporary access, the cardholder shall have the rights of the group to which they have been assigned in addition to any permanent access rights they may have been assigned.
 - ix) The access group details page shall display both permanent and temporary access members with the status of temporary members shown as:
 - (1) Pending (with the start and finish times)
 - (2) Active
 - (3) Expired
 - tt) Any cardholder or access group in the system shall be able to be programmed to have access to any combination of controlled doors in the system with each period of access for each door controlled to within the nearest minute.
 - uu) The IFC shall check entry based on ALL of the following criteria:
 - (1) Correct site code
 - (2) Authorized card in database
 - (3) Correct issue number
 - (4) Authorized door / access zone
 - (5) Authorized time of day
 - (6) Valid card holder competencies (refer to the 'Identity Analytics - Competencies' section)
 - (7) Correct PIN (If PIN entry is required)



(8) Double entry (anti-passback, anti-tailgating or escort modes).

vv) Anti-passback mode shall be able to be configured in any of the following modes:

- (1) Disallow second access to an area if a valid exit has not previously been registered and generate an alarm (hard anti-passback).
- (2) Allow second access to an area if a valid exit has not previously been registered but generate an alarm (soft anti-passback).
- (3) Exclude specific Access Groups from the rules defined in (a) and (b) above.
- (4) Anti-passback rules shall be able to be reset by either:
 - (a) Automatically after a preset period after valid entry.
 - (b) Automatically at a standard time each day
 - (c) Automatically on exit from site
 - (d) Manually as an override.
- (5) Must support Global Anti-passback allowing multiple access zones to be linked for the purpose of anti-passback, across multiple IFCs utilising encrypted peer-to-peer communications.
- (6) The IFCs shall not rely on the server for anti-passback operation. Global anti-passback shall work across multiple IFCs, even if the server is off line.

ww) Anti-tailgate mode shall be able to be configured in any of the following modes:

- (1) Disallow exit from an area if a valid access has not previously been registered and generate an alarm (hard anti-tailgate).
 - (2) Allow exit from an area if a valid access has not previously been registered but generate an alarm (soft anti-tailgate).
 - (3) Exclude specific Access Groups from the anti-tailgate rules.
 - (4) Anti-tailgate rules shall be able to be reset by either:
 - (a) Automatically after a preset period after valid entry.
 - (b) Automatically at a standard time each day
 - (c) Manually as an over-ride.
 - (5) The IFCs shall not rely on the server for anti-tailgate operation. Global anti-tailgate shall work across multiple IFCs, even if the server is off line.
- ii) Every incorrect PIN attempt shall be notified at the central control as an alarm condition.
 - iii) Each reader shall be capable of automatically switching the access mode of a door at different times of the day based on control parameters received from the Security Management System (The System). The following access criteria modes are required:



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- (1) Free access: Door is unlocked. No card entry required.
 - (2) Secure access: Door is locked. A successful card attempt is required for valid entry. Door re-secures after access attempt.
 - (3) Secure + PIN access: Door is locked. A successful card attempts and correct PIN number is required for valid entry. Door re-secures after access attempt.
 - (a) The PIN number should be set for a minimum of between 4 to 8 digits in the system configuration.
 - (b) Cardholders may choose how long their PIN number is, as long as it meets the minimum length requirement.
 - (4) Override from reader Members of certain Access Groups shall be able to change the access and PINs mode of the door at certain times.
 - (5) **Dual Authorization: Access is granted when two different but legitimate cards are presented within a given time frame.**
 - (6) Escort : A second card is required to be presented from a cardholder who is nominated in the 'Escort Access Group'.
 - (7) Shared PIN Number: The System Operator determines what the PIN number will be and programs this into the system. Access is allowed through the door when the correct 4 Digit PIN is entered.
- iv) Cardholder access reporting to The System and logging in the audit trail shall be configurable in two modes:
- (1) Only when there has been a successful presentation of a valid access card or token AND the door open sensor has detected the door has actually been opened.
 - (2) Whenever there has been a successful presentation of a valid access card irrespective of whether the door has been opened.
- v) Readers with integrated PIN pads, or fingerprint readers using identification shall provide an 'Entry under Duress' facility.
- vi) Duress shall be initiated by the cardholder either by the addition of a unique number to their PIN number, or by incrementing the last digit of their PIN number by one. Duress on fingerprint readers shall be initiated by the cardholder presenting their pre-enrolled 'Duress finger'.
- vii) There must be NO indication of a Duress entry at the reader.
- viii) A critical priority 'Duress Alarm' shall be displayed at the Security Management System.
- ix) It must be possible to configure the system such that duress or other selected critical alarms pop to the front of the display, ensuring immediate operator attention. The existence of other incoming alarms shall be visible to the operator but must not interrupt their current task.
- x) Zone counting shall be available to provide real-time counting of cardholders in access zones.



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- xi) The result of the number of cardholders in the zone being outside of the specified range(s) shall generate an event or an alarm, depending on system configuration.
 - xii) The minimum and maximum numbers of cardholders in a zone before an event is generated shall be configurable.
 - xiii) It shall be possible to set up a 'grace time' (in seconds) to allow the zone count to be outside the minimum within the mid-range or outside the maximum number of cardholders, without generating an event.
 - xiv) It shall be possible to assign a specific message for each of the below minimum, mid-range or above maximum conditions.
 - xv) It shall be possible to set up the system to prohibit one cardholder being allowed in a zone by:
 - (1) Requiring two valid but different cards to access a zone should the zone count reports zero cardholders in the zone.
 - (2) Requiring one card to access a zone should the zone count report two or more cards in the zone.
 - (3) Requiring one card to exit from a zone should the zone count report three or more cards in the zone.
 - (4) Requiring two valid but different cards to exit from a zone should the zone count report two people present.
 - (5) Prohibiting exit from a zone and generate an alarm if the zone count reports one person present.
 - xvi) It shall be possible to increment and decrement zone counting based on physical inputs not related to access events.
 - xvii) It shall be possible to increment and decrement zone counting based on logical inputs not related to access events.
 - xviii) It shall be possible to schedule an Access Zone for a 'First Card Unlock' mode, whereby the Access Zone is scheduled to go to Free Access, but only when a suitably privileged card is badged at the reader. All other cards will be granted access, but will not be able to set the door to Free Access unless they have the 'First card Unlock' privilege.
 - xix) It shall be possible for suitably privileged cardholders to toggle the access mode of a reader between Free Access and Secure by badging their card at the reader twice in quick succession.
 - xx) It shall be possible for suitably privileged cardholders to log on to a reader with a keypad either by a card badge or PIN number and change the access mode of the reader to either Free or Secure.
 - xxi) In addition to unlocking a door when granting access, it shall be possible to activate an additional output or macro which is uniquely related to the cardholder or access group to which they belong.



xxii) It shall be possible to 'lock down' specific areas of a site such that cardholders who would usually have access, are denied access. Cardholders with suitable privileges such as security personnel will still have access. The 'lock down' should be activated and/or cancelled by the following methods;

- (1) Clicking an icon on the site plan.
- (2) Automatically, based upon an event within the system.
- (3) Automatically, based upon an input activation.

3) HARDWARE COMPONENTS

1. INTELLIGENT FIELD CONTROLLERS

- The Intelligent Field Controller (IFC) shall be the main controller in the field. The Security Management System (The System) shall communicate directly with all IFCs.
- Each IFC shall be intelligent such that in the event of failure of power or communications to The System, for whatever reason, the system shall continue to allow or deny access based on full security criteria.
- The IFC shall store on-board all the security and access parameters to operate completely independently from the central control server. Systems that rely on the central control server for access decisions will not be considered.
- The IFC shall buffer activity data and immediately transmit it to the central control server upon reestablishment of communications.
- **Should communications fail with The System, each IFC shall be capable of buffering up to 80,000 events.**
- All events shall be time-stamped at the IFC at the time of occurrence.
- **The IFC shall be capable of storing up to 500,000 card records with associated access criteria.**
- The system shall monitor input circuits and enunciate whether the circuit is Normal, Alarm, Open Circuit Tampered or Short Circuit Tampered as separate conditions.
- **The IFC shall include tamper protection for the front and the back of the panel.** The front panel shall be tamper protected for door open, and the rear of the panel to detect if the panel has been removed from the wall. These shall use optical tamper detection. Mechanical tamper devices are not acceptable.
- The IFC shall incorporate **an ARM 9 processor with at least 256 Megabytes of non-volatile FLASH EEPROM.** The IFC shall incorporate boot code in a protected sector of the flash memory. For software upgrades, all system software shall be downloaded from the central server over the network
- The IFC shall continue to operate for at least 8 hours in the event of a mains supply failure.
- The system shall be capable of automatically detecting and reporting a power failure, low battery and battery not connected.
 - IFCs shall automatically restart and resume processing following a power failure.
 - IFCs shall be fitted with 'watchdog' hardware and software to provide automatic detection and restart should the processor lock up.
 - The IFC shall contain its own real time clock. **The clock shall be synchronized with the central control server clock at least once per hour.** The accuracy shall be such that the time difference between IFCs shall not vary more than 0.5 second at any time.



- The IFC shall be allocated to a time zone appropriate to the IFC location to cater for regionally and globally located IFCs.
- **The IFC shall have an on board Ethernet (TCP/IP) connection and driver supporting 10BaseT and 100BaseT operation. Third party plug-in RS485/Ethernet modules will not be accepted.**
- The IFC shall be provided with a pre-configured IP address to allow off-line initial configuration via a web browser application when required.
 - The IFC shall support DNS (Domain Name Server) operation.
- Should the primary DNS not be available, the IFC shall be able to automatically establish contact with a secondary or tertiary DNS.
 - Should excessive network broadcast traffic occur (resulting from a denial of service attack or similar), an alarm shall be generated.
- **All data communication between The System and IFCs shall be encrypted using an industry standard symmetric encryption algorithm equivalent to 256-bit AES or stronger.**
- Communication between The System and IFCs shall be on-line and monitored for interruption.
- It shall be possible to view the IFC status and configuration for commissioning and diagnostic purposes without the use of the central server software or other proprietary software. This may be achieved by the use of a conventional web browser. In high security applications, it must be possible to disable this feature at the IFC.
- The IFC shall support logic functionality by way of configurable 'Logic Blocks'.
 - The IFC logic functionality shall be able to be run independent of The System being online.
 - The following items shall be useable as inputs to Logic Blocks:
 - Physical Input states
 - Output states (both physical and logical)
 - Door states
 - Other Logic Block states
 - Up to 10 Logic Block input items shall be configurable in AND/OR combinations to cause an output to operate.
 - The Logic Block output timing shall be configurable to at least the following:
 - Delay on
 - Delay off
 - Latched
 - Pulse time
 - Maximum on time
 - Passthru
 - The IFC Logic Block output shall be able to trigger actions across multiple IFCs, independent of The System being online
- A separate alarm message shall be transmitted to The System for at least the following alarm conditions. The alarm message shall be displayed in plain language text.
 - Tamper
 - Tamper Return to Normal
 - Unit Stopped Responding
 - Card error
 - Maintenance Warning
 - Alarm Sector State Change
 - User Set
 - User Unset
 - Card Trace
 - Wrong PIN



- Access Denied
- Duress
- Zone Count Maximum
- Zone Count Minimum
- Door Open Too Long
- Forced Door
- Door Not locked
- Power Failure
- System Reboot
- Intercom
- The IFCs shall communicate with and control the following equipment:
 - Facial Recognition Readers
 - Mobile Access Readers
 - Card access readers with PIN keypads
 - Elevator access equipment
 - Alarm monitoring Input/Output panels and equipment
 - Alarm response equipment
- The IFC shall communicate with remote devices (Facial readers, alarm equipment, elevator readers) using a fully encrypted data communications protocol. Unencrypted ASCII text or similar data transmissions are not acceptable.
- All communications between the IFCs and the remote devices must be check-digit coded to protect data from manipulation during transmission.
- All communications links between the IFCs and the remote devices shall be monitored such that an alarm is raised at the central control if the data being transmitted is corrupted or tampered with in any way.
- All data communication between IFCs shall be encrypted using an industry standard symmetric encryption algorithm equivalent to 256-bit AES or stronger.
- All data communication between IFCs shall use an industry standard asymmetric encryption algorithm for mutual authentication and session key negotiation. This algorithm shall be equivalent to 1024-bit RSA or stronger. Session keys shall be re-negotiated on a regular basis at intervals no longer than 30 hours.
- Communication between IFCs and downstream devices shall support a high speed protocol of at least 1Mbit/second.
- The IFC shall support up to 80 devices comprising a combination of readers, I/O devices and sensors.
- The IFC shall not necessarily support 80 devices of one type.
- Devices connected to the high communication speed port shall contain a unique serial number.
- When connected to an IFC, the serial number of the device shall be reported to The System.
- Once assigned to a function within an IFC, if any attempt is made to substitute readers in the field without authorization, an alarm shall be generated.
- The IFC shall support the Wiegand connections protocol, supporting up to 65,535 Bits.
 - Wiegand formats shall be configurable, allowing for:
 - Number of Bits
 - Facility/site code Bits
 - Card number Bits
 - Parity bit configuration
- The IFC shall have Open Supervised Device Protocol (OSDP) reader support.
- The system shall provide relay output facilities that are system activated in response to alarm activations. Relay functions required are:



- Activate and latch a relay in response to an alarm. Relay to remain latched until alarm processed.
- Activate a relay for pre-set 'pulse' time. The relay to release after the 'pulse' time lapses.
- Relay activation to 'mirror' or 'follow' the alarm input activation.

- a) The system shall incorporate relay outputs that can be activated according to time schedules, rather than alarm event. These outputs may be used to control lighting, heating, or to electronically lock or unlock non-monitored doors.

2. Mobile Access Card Readers

Parameters	Description
Frequency	13.56 MHz + Bluetooth® (Low Energy)
Card Formats	MIFARE Classic & Classic EV1, DESFire® 256, EV1 & EV2, NFC, Wiegand 26/32 Bit, Mobile Credentials
Reading distances	0 - 6 cm / 0 - 2.36'' with RFID / 0 - 20 m / 0 - 66 ft with Bluetooth®
Standards	ISO14443 types A & B, ISO18092 / Certifications: CE & FCC
Power supply	9 - 15 VDC / Consumption: 150 mA/12 VDC max
Color	black or white - Other possibilities for cover customization
Operating temperatures	30°C to + 70°C / - 22°F to + 158°F
Resistance	IP65 Level excluding connector - Weather-resistant with waterproof electronics (Certification CEI NF EN 61086) / Humidity: 0 - 95%
Protection	Reinforced vandal proof structure IK10 / Accelerometer-based tamper detection system
3. M o	

Mobile Credentials

Application based mobile access credentials with a unique number associated with the mobile phone of the user. Option of opening the door via remotely clicking on the app should also be possible. The mobile credential should be used in multiple modes : gesture, tap, wave, show phone etc. All the mobile credentials need to be permanently installed on the phone and should be transferrable within the organisation

4. Facial Recognition Reader

Parameters	Description
Processor	Dual Core ARM + NUP
Operating System	Linux
Display	7 Inch LCD Display
Interface	Inbuilt TCP/IP Interface with Wifi
Cameras	Dual Lens camera with 110db wide dynamic range
Special Feature	Inbuilt Spoof protection (fake face identification)
User Capacity	20,000 Faces in 1:n configuration
Accuracy Level	99.8% accuracy in less than 0.5 seconds recognition time
Transaction Records	200000
Interface 2	Wiegand 26 Bit Interface
Connectivity to Command Control	IoT hardware connectivity for Data Transmission to the Cloud



Center

5. Accessories

Accessories	Specifications
Electro-Magnetic Lock	– Low energy consumption (DC 12V / 24V) – Silent and continuous duty operation – Applicable to wide variety of swing and sliding door – Instantaneous release in the event of emergency – Single Monitored 1200 lbs holding force with LED indicator – Safety feature: LED will be GREEN colour is the door is closed properly. Otherwise, LED will be RED colour.
Emergency Break Glass Unit	– Single pole break glass Unit – 600 Lbs – Current Rating : 12/24VDC, 10A 48VDC, 3A – Colour : Green, white, Red, Yellow – Required accessories like L Bracket, LZ Bracket etc if needed for glass door
Door Contact	– The magnetic contact shall be of flush mount type. – The contacts shall be corrosion resistant and completely hermetically sealed. – 3 million cycles of operation shall not affect the contact – Max. sensing distance 10 mm – 24v Power supply
Push Button	– The push buttons shall be of the momentary contact, push to actuate rated for 5 A at 125/250 VAC and 1 A 220 V DC. – The 'START' push buttons shall be green and shrouded – The 'STOP' push button shall be red and unshrouded – The elements shall be enclosed with 1 'NO' and 1 'NC' contacts – Operating Life Over 100000 times