



## **NORTH DELHI MUNICIPAL CORPORATION**

### **ANNEXURE – B**

#### **CONSTRUCTION OF CONVENTIONAL UNDERGROUND MULTILEVEL CAR PARKING AT CENTRAL MARKET PARK, ASHOK VIHAR, NEW DELHI**

#### **TECHINCAL SPECIFICATIONS**

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## **TECHNICAL SPECIFICATIONS**

### **CONSTRUCTION OF CONVENTIONAL MULTILEVEL UNDERGROUND CAR PARKING AT CENTRAL MARKET, ASHOK VIHAR, DELHI**

#### **GENERAL SPECIFICATIONS:**

1.0 The following General Specification shall be followed in conjunction with other provisions of Tender Documents such as description of items, general & special conditions of contract and any other document made part of tender document.

The civil work in general shall be carried out as per CPWD specifications, 1996 (Volume I to VI) (updated with correction slips issued up-to last date of submission of tender) and Text of revised CPWD Specifications for Cement Mortar, Cement Concrete and RCC Works unless otherwise specified in the nomenclature of the individual item or in the particular specifications for civil works, (updated with correction slips issued up-to last date of submission of tender).

Electrical works shall comply to the CPWD specifications ( part-I Internal works) 2005 & ( part-II external works) 1994 and the requirements of Indian Electricity Rules, 1956 and Indian Electricity Act – 1910 as amended up-to date.

Mechanical ventilation works, shall conform to the CPWD specifications latest versions and for the items specifications not available in CPWD specifications, manufacturers specifications shall be applicable.

1.3.1 Fire detection and fire fighting works shall be carried out as per CPWD specifications and conforming to the requirements of fire department as well.

1.3.2 Car parking management, security system, intelligent vehicle access control system and signages etc shall conform the specifications provided in the tender document and as per manufacturer's specifications.

2.0 For Items not covered under any of the specifications stated above, the work shall be carried out as per Manufacturer's Specification / as per the direction of Engineer-in-Charge.

## **SPECIFICATIONS FOR CIVIL WORKS**

The work of construction of multilevel underground car parking shall be executed as per CPWD specifications. It is understood that the contractor has visited the site and has become familiar with site conditions before submitting their offer.

### **The construction drawings:**

The good for construction drawings shall be issued to the contractor in the phased manner as per requirement of construction sequence and program submitted by the contractor and accepted by the engineer in charge.

### **SCOPE OF WORKS**

The scope of work shall be as described hereunder but not limited ,  
for completing the project as per drawings and as directed by engineer in charge:

**1. REINFORCED CEMENT WORK** :Exposed RCC surface of retaining wall, columns and ceiling at basement parking at (-1), (-2 ) and ( -3 ) Level shall not have any paint finishes. Accordingly, contractor shall ensure that concrete is free from any type of honey combing, superfluous mortar , damages / chipping to corners, edges etc.

**DOOR FRAMES** : Aluminum frames at all locations except toilet and W C shutters

**DOOR SHUTTER** : Wooden flush shutter in ticketing room, driver rest room,BMS room& utility room etc.

**FIRE RATED SHUTTER** : Lift/ staircase lobby and Ventilation rooms

**FLOOR FINISH** : Cement concrete( vaccum dewatering process) at ramps, driving ways& parking.

: Vitrified tile at toilet, BMS room& ticketing room

: Kota stone at lift/ stair lobby, driver waiting & utility room

: Cement concrete in ventilation room .

## **6. WALL CLADDING/ DADO**

: Ceramic glazed tile up to 2850 mm/ ceiling in toilet  
: Stone cladding at external surface of wall of stair mumty, entry/ exit wall, toilet, ticketing & drivers waiting.

: stone cladding at both sides of boundary wall.

: Aluminium composite panel ( ACP) at entry/ exit ramp roof canopy and Lift lobby & toilet  
Block walls.

: Marble cladding at lift wall/ architrave

## **7. PAINT FINISHES**

: Plastic emulsion at Ticketing & BMS Room

: Oil bound distemper in balance area.

: Synthetic enemul at boundary wall & stair railings

The finishes mentioned above are indicative. The execution of works shall be carried as per drawings issued for construction purposes and as per direction of engineer in charge.

## **PARTICULAR SPECIFICATIONS :**

The specifications for non scheduled items contained in the schedule of rates shall be followed as under:

### **1. BASEMENT WATERPROOFING BY CRYSTALLIZATION BOX TYPE IN-DEPTH METHOD**

#### **1.1 GENERAL**

This is one of the latest techniques available for long term solutions for leakage or water proofing. In this method, blend of Portland cement, graded quartz sand & proprietary ingredients which undergoes **catalytic reaction** in presence of moisture & free lime in the fresh cement concrete mixture & due to which insoluble crystalline complexes are formed. Such crystals continue to grow as long as moisture is present and it may often attain several feet in length. Those growing crystals seal the capillaries and minor shrinkage cracks during its lengthening process & it may even penetrate against strong hydrostatic pressure which is the integral part of concrete. This water proofing method remains effective for the life of structures as it fills permanently the cracks sealing from water & water borne chemical penetration. Once moisture is completely exhausted in this catalytic reaction in concrete, such crystals still remain ready to be reactivated by water seepage through new cracks developed

even years later through natural settling or any other reasons during entire life span of the structure.

The contractor shall furnish Guarantee of water proofing for 10 years after completion of the work as per guarantee clause.

## **1.2 CHEMICAL CRYSTALLIZATION BASED WATERPROOFING SYSTEM FOR**

### **BASEMENT / RETAINING WALL**

#### **1.2.1 Horizontal basement Area:-**

The bottom of the foundation shall be leveled both longitudinally and transversally or stepped as directed by the Engineer. Before the PCC is laid, the surface shall be slightly watered and rammed. When rock or other hard strata is encountered, it shall be freed of all loose and soft materials, cleaned and cut to a firm surface either level, stepped, or serrated as directed by the Engineer.

The Crystallization based chemical treatment shall be done over the PCC laid as per specification in the manner specified below. Further, it may be ensured the top surface of the PCC is finished smooth by cement slurry in the green PCC. In case of any honeycomb in the PCC, It shall be filled with water proofing mixed modified mortar and made smooth. The application of crystallization chemical can be applied at least 24- 48 hours of laying of PCC. The surface shall be thoroughly cleaned and water saturated wet before application of chemical.

The crystallization chemical (approved make) shall be mixed in clean water in proper consistency and applied at the rate of minimum 1.0 kg per sqm or as per manufacturer's guidelines by brush or spraying as per direction of engineer in charge. The crystallization treated surface shall be allowed to set for at least 8- 10 hours. The area of treatment shall be completely barricaded and curried for at least 48 hours. There after 2 days placement of reinforcement for basement raft/ foundation can be started. All construction joints in the entire thickness of raft shall be treated with crystallization chemical before start of next pour of the concrete. The joints between PCC and raft along periphery, PCC and & columns and raft shall be treated with chemical mixed modified mortar.

All earth filling work to be done above the raft slab shall be commenced only after entire basement construction i.e. raft and retaining wall is completed, waterproofing is

completed and the area is tested for leak proof ness and necessary grouting is done and after the area is cleared.

Necessary ground water pressure release system shall be designed and installed, if directed, in the bed PCC including provision of pressure release pipes, grouting the same with cement slurry admixed with expandable additives after development of substantial dead loads as directed by the engineer.

### **1.2.2 Retaining Wall Area:**

The external face of the retaining wall shall be thoroughly cleaned and all concrete projections chipped. Protruding binding wires, wooden pieces, etc. shall be totally removed. The bolt holes, pipe sleeves, puddle flanges, cable duct etc. shall be plugged properly using micro concrete/ Patch n plug mortar admixed with approved chemical water proofing compound in the proportion recommended by the manufacturer.

The treatment can commence after 48 hours of casting the retaining wall. In case the wall surface is dry, it shall be properly wet before treatment.

The construction joints etc. shall be treated as detailed below:

All constructions joints shall be cut in U shaped groove of approx. size 10mmx 10 mm and filled with Crystallization chemical modified mortar after applying the chemical mixed slurry.

Similarly, in case of honeycomb in retaining wall the unsound concrete shall be removed till the sound concrete is achieved and the cavity shall be filled with chemical mixed modified mortar as detailed above. The similar treatment shall be done for tie holes left in walls after deshuttering. The treatment can be done from both positive as well as negative side. However, it shall be preferred at positive side of the wall.

After above preparatory activities, the in- depth Crystallization chemical shall be mixed in clean water in proper consistency and applied by brush / spray application at the rate of minimum of 1.0 kg per sqm or as required as per guidelines of manufacturers.

The treatment of retaining wall shall be started from the toe of raft so as to make as box type treatment. The treatment shall be allowed to set for 8-10 hours. After that curing to commence at least for 3 days.

All back filling work to be done after atleast seven days using mooram / excavated soft soil free from rocks / boulders , taking adequate care to avoid damage to water proofing treatment.

**1.3 Test certificates:**

The contractor shall furnish test certificates of the crystallization chemical supplied .

The engineer in charge shall also get material supplied at site at the approved laboratory for each lot or as approved by engineer in charge.

**1.4** The measurements shall be done correct to two decimal points in square meter. No deduction shall be made for the cut out/ opening up to 0.1 sqm.

**1.5 WATERPROOFING GUARANTEE CLAUSE**

The contractor shall be fully responsible for and shall guarantee proper performance of the entire waterproofing system for a period of 10 (Ten) years from the final completion of works. In addition, specific 10 years written guarantee (to be furnished in a non-judicial stamp paper of value not less than Rs.100/-) in approved proforma shall be submitted for the performance of the system, before final payment and shall not in any way limit any other rights the Employer may have under the contract.

All water-proofing work shall be carried out through an approved applicator (specialised agency) of manufacturer approved by the Engineer in charge. The Contractor and the specialised waterproofing agency shall be jointly responsible for waterproofing treatment until the expiry of the above guarantee period.

PROFORMA FOR PERFORMANCE GUARANTEE FOR  
WATER PROOFING WORKS

*(On non-judicial stamp paper of value Rs. 100/-)*

*(Name & Address of Employer)*

.....  
.....  
.....

**We hereby guarantee the Entire Waterproofing System,** which we have carried out in the Complex described below :

**Building :** .....

**Location :** .....

**Employer :** .....

For a period of 10 (Ten) years from the certified date of completion, WE AGREE TO repair or replace to the satisfaction of the Employer, any or all such work that may prove defective in workmanship or materials within that period, ordinary wear and tear and unusual abuse or neglect excluded, together with any other work, which may be damaged or displaced in so doing. In the event of our failure to comply with the above-mentioned conditions within a reasonable time, after being notified in writing, we collectively and separately, do hereby authorize the Employer to proceed to have the defects repaired and made good at our expense, and we shall pay the cost and charges thereof, immediately upon demand.

Signature of the Contractor

Signature of the witness

For M/s. ....

Address .....

Date :

Date



## **2. BOULDER SOLING WORK**

### **Material :**

The boulder procured shall be of naturally occurred stone of the nominal single sizes ranging from 40 mm to 150 mm. It shall be hard, strong, dense, durable and clean. The flaky and elongated pieces shall be avoided.

The fine sand shall be as per CPWD specifications . The sand shall be filled in the voids and whole mass shall be watered and compacted properly.

### **Laying :**

The soling stone of different sizes shall be laid by hand packing by skilled workers. The soling shall be laid in layers of thickness not exceeding 300 mm.

The sequence of laying shall be such that the bigger size of stones are placed at bottom and successive smaller size is hand packed. It is ensured that the maximum voids are filled with stone aggregate. Thereafter, sand is filled , watered and compacted by hand rammers or surface vibrator as per direction of engineer in charge.

**Measurements:** The compacted soling mass shall be measured in cubic meter correct to two places of decimal.

**Rate:** The rate shall include the cost of all material and labour involved in the operations described above.

## **3. GLASS REINFORCED CONCRETE TILE FLOOR/ PAVEMENT**

### **Material :**

The glass reinforced designer cement concrete tiles shall be 25 mm thick in the size of 300mmx300mm or 400 mmx400 mm in pattern/ design as approved by engineer in charge. The tolerance in size and thickness shall be +/- 5 mm. The minimum compressive strength of the tiles shall be 400 kg/ cm<sup>2</sup>. The material shall only be procured from the approved vendors.

### **Laying :**

The tiles shall be wet and laid over the sub base of lean concrete. The sub base shall be spread with cement slurry @ 3.3 kg/ sqm. Thereafter, tiles shall be laid over 20 mm thick cement mortar in the proportion of 1:6 (1 cement : 6 coarse sand ). While laying the tiles, zero gap shall be maintained. The tiles with damaged corners etc. not to be used in the work. The joints between tiles shall be filled with white cement mixed with matching pigment approved by engineer in charge. The necessary gradient shall also be maintained in laying of tiles. After laying of tiles, all superfluous cement mortar , grouts/ pigment shall be neatly cleaned and water washed.

**Measurements:** The GRC tile work shall be measured in square meter correct to two places of decimal.

**Rate:** The rate shall include the cost of all material and labour involved in the operations described above. However, the sub base of lean concrete shall not be covered in the item.

#### **4. METAL CLADDING WORK**

Material :

The metal cladding shall be done with 4 mm thick aluminium composite panel consisting of 0.5mm thick aluminium inner & outer skin and 3 mm thick LDPE based virgin core. The alloy of aluminium shall be 3105-H 24 grade conforming to BS: 1470.

The top surface of panel shall be finished with minimum 30 microns PVDF coating (Polyvinylidene di fluoride) and coating shall conform to AAMA 2650 for exterior grade finish. The reverse side of the panel surface shall have polyester base coating to protect against possible corrosion.

Weight of the panel shall be 5.5 kg/ sqm and tensile strength of 4.9 Kg.mm<sup>2</sup>.

**Fabrication and fixing :** The panel shall be cut and bent in the profile shown in the drawing issued. The panel with irregularities, waves , peel off area shall be sorted out and not put to use in the work. The profile cut shall true in shape, straight, and smooth cut. The panel in profile shall be fixed to the M S sub structure frame work. The panel joints of width of approximately 25 mm shall be filled with weather silicone sealant of texture approved by engineer in charge.

Aluminum flashings shall be provided at the bottom.

**Measurements:** ACP cladding work shall be measured in square meter correct to two places of decimal.

**Rate:** The rate shall include the cost of all material and labour involved in the operations described above. However, M S sub structure frame shall not be covered in the item and paid separately.

## **5. DRAIN BOARD FOR ROOF PARKS:**

The drain board shall be of PVC , 7.3 mm high danodren shall used to drain the water which pass through geo textile provided. The compressive resistance shall be of 120 KN/sqm and drainage capacity of at least 4.8 liters per sqm.

**Laying:** The roll of the drain board shall be cut in sizes as per requirement of area to be laid. Minimum overlapping of 100 mm shall be provided in the board in laying.

**Measurements:** Drain board after laying shall be measured in square meter correct to two places of decimal.

**Rate:** The rate shall include the cost of all material and labour involved in the operations described above.

## **6. FIRE RETARDANT DOOR SHUTTERS**

### **Material**

The Metal fire door shall quality all three criteria's i.e. Stability, Integrity and Insulation criteria as (per IS: 3614 )

The FR insulation filler used for the fire door will be rock wool / mineral wool of density not lees than 96 kg/m<sup>3</sup>.

The door frame and panel shutter shall be manufactured using 16 gauge prime galvanized steel sheets.

The fire seal will be of size 10mm x 4mm imported shall be used for smoke sealing will be from Astroflame or Pemko.

The internal flanging of the door would have the C channel of size not less than 52 mm of 1.6mm thickness on all the perimeter of the door and horizontal and vertical sections also.

The hinges for fixing the shutter shall be of Dorma/ Ingersoll rand of size 100x75x 3 mm, stainless steel and D type pull/pushof size 250mm long & 19 mm diameter.

**Fixing :** The fire door shutter supplied from the approved vender shall be fixed in true alignment of the door opening.

**Rate:** The rate shall include the cost of all material and labour involved in the operations described above.

**Measurements:** Fire rated door shutter shall be measured in square meter correct to two places of decimal. Area of door opening shall be measured.

**Fire rated glass for vision panel.**

The thickness of the fire rated glass should not be less than 5mm.

The visible transmission of the fire rated glass should not be less than 90%.

The fire rated glass should be able to withstand hose stream test.

The glass should be tested as per BS: 476 part -2 1987 and ISO: 3001.

The size vision panel shall be as specified in the schedule of rates which shall excluding hide portion in the rebate. These shall be measured in number.

**Panic Exit Devices:**

The fire rated double leaf panic bars of Ingersoll Rand Briton / Dorma PHA series shall conform along with the door as per IS: 3614 part II. They shall be measured in pair for double leaf doors.

**Landscaping Work :**

1. The Contractor shall submit his drawings for proposed plan in accordance with BOQ items for approval of Engineer-in-Charge for approval before commencement.
2. The plants, shrubs and climbers shall be of sound health.
3. The contractor shall engage the experienced workers in planting work and ensure that the planting work is done in proper way.
4. The plants, shrubs and climbers brought at site shall be inspected for their healthiness before their planting

## **THE SPECIFICATIONS FOR ELECTRICAL, FIRE ALARM SYSTEM, PUBLIC ADDRESS, CCTV, LIFT ETC.**

### **Sub Station Equipment**

The work of substation and other connected work shall be carried out as per General Specifications for Electrical Works (Part-IV - Substations) 1982 as amended up to date and General Specifications for Electrical Works (Part I-Internal) 2005 and General Specifications for Electrical Works (Part-II-External) 1995 as amended up to date.

### **Section 1. Package Substation**

The complete package substation shall be factory assembled with separate access to transformer, HT and LT compartments. It shall be possible to install the package substation in congested areas with blocked walls on two sides.

The substation enclosure shall be made from 2mm thick CRCA sheet steel with Load bearing members of 3mm thick CRCA sheet steel. The enclosure shall be tested for internal Arc with stand capacity as per IEC-61330. The enclosure should not require any artificial cooling through exhaust fans etc. it should be naturally Air-cooled.

There should be proper provision of Internal Lighting of MV and LV compartments. Sufficient space should be available inside the package substation for any operating personnel to operate and work on MV and LV equipment in case of a need for performing any maintenance activity.

Safety notices and faults indicator outside the package substation to indicate any fault.

Package sub station must be delivered in one single indivisible volume to avoid assembly of components at site.

The package substation will have the followings:

### **H.T. Side :-**

The H.T. Side panel shall be SF6 insulated single board comprising of two ring switch type isolators and one tee off SF6 insulated vacuum circuit breaker having an arrangement for incoming and outgoing connections. All live and switching parts are enclosed in 2 -mm thick stainless steel tank filled with SF6 gas.

3 way 11kV indoor non extensible free standing 630 Amps metal clad SF6 insulated Isolators comprising of fault making/load breaking switches and one number 400A Tee off circuit breaker complete with all accessories as follows :-

Self powered IDMT relay for circuit breakers

The ring switches and Tee-off circuit breaker are provided with integrated earthing switches with making capacity.

Live capacitive cable indicator for ring switches

SF6 Gas pressure indicator

Pad locking facility

Shunt trip coil rated for 230 V AC

HT connections of RMU through fully insulated cable and sealing kits.

### **Transformer**

The transformer shall be 400 KVA and 630 KVA ONAN Cooled oil cooled having no load winding ratio 11000/433 volts. The connections between HT Switchgear and transformer shall be through fully insulated cable and sealing kits. The transformer shall be corrugated tank hermetically sealed transformer with off load tap changer of +5% to -5% @ 2.5%. If required, the Transformer can be 33kV/433V also. Cooling can also be Dry Type with OFTC.

### **LV Switchgear**

The LV switchgear shall be provided with Air Circuit Breaker on Incomer and MCCBs as outgoing of suitable rating. LV switchgear shall have provision for with drawing ACB/MCCBs and shall have provision for rear connections through insulated bus bars to transformer LV. All ACB and all MCCBs shall be of three pole design. Additionally Automatic Power Factor Correction Panel can also be incorporated for maintaining the Power Factor to desired levels.

### **Earthing**

The work shall be carried out as per relevant specifications. Earthing shall be done in the presence of Engineer-in-charge or his authorized representative.

### **Single Line Diagram of PSS**

### **SPECIFICATION OF TRANSFORMER**

Voltage Ratio	11kV/433V
Type of construction	Hermetically Sealed ONAN; OR Dry Type
Insulation	Class A
Tapping on HV	Off Load + 5% to -5% @2.5% each step
Enclosure	Housed in Pre stressed Enclosure, Having degree of Protections IP- 23D.
Applicable standard	IS: 2026 - amended up to date
HV Termination	Suitable for XLPE Cable bottom entry
LV Termination	Suitable for connection with LV Switchgear
Fittings	(i)Lifting Lugs (ii) Roller (bi-directional) Winding Temperature indicator with Contacts to be provided for Alarm & Tripping.
Testing	Routine acceptance test as per IS- 2026 to be witnessed by representation of engineer-In-Charge at his discretion.



11. Installation to be installed in enclosure Power cable from Transformer to HV Panel to be provided.

**SPECIFICATION FOR H.V. Switchgear**

- |  |  |
|--|--|
| 1. Applicable standard                               | IS: 13118 amended up to date   |
| 2. Rating  | 12KV, 20 kA  |
| 3. Circuit Breaker                                   | SF6 insulated HT isolators as Incomer and Vacuum Circuit Breaker as Outgoing                                       |
| 4. Operating Mechanism                               | Manual charging  |
| 5. Tripping arrangement                              | Shunt trip with self powered relay   |
| 6. Bus bar   | Copper bus bar suitable for 400 Amps Provided with heat shrinkable sleeve.   |
| 7. C.T.  | Double core, Cast Resin  |
| (a) 15 VA Burden for protection with 5P-10 accuracy  |  |
| (b) 15 VA Burden for metering with Class-I accuracy. |  |
| 8. Relays & Accessories                              | Microprocessor based self powered relay For overcurrent and earth fault protection.                                |
| 9. Indicating Lamps/Push Button                      | All standard indicating lamp like phases, ON/OFF breaker charged etc. heater switch,                               |
| 10. Cable Termination                                | XLPE HT Cable of size 3 x 185 sq.mm. (Incoming) entry bottom. Insulated HT cable with Sealing kits to transformer. |

## **TECHNICAL SPECIFICATION FOR DIESEL GENERATING SET**

### DIESEL ENGINE

Reliable rugged diesel engine AIR /Water cooled, electric start, four stroke multi cylinder, conforming to relevant IS/BS with 10% overloading for one hour in any twelve hours. The engine will be fitted with following accessories:

#### COOLING SYSTEM

- Blower / Radiator
- Automatic belt tensioning device / Centrifugal water pump

#### EXHAUST SYSTEM

- Exhaust manifold
- Flexible pipe for silencer

#### FUEL SYSTEM

Fuel pump

Fuel injectors

Fuel filter

#### LUB OIL SYSTEM

Lub oil pump

Lub oil filter

#### AIR SYSTEM

Air intake manifold

Air cleaner assembly

#### GOVERNOR

Mechanical

#### STARTING SYSTEM

Electric starting – 12V

Battery charging alternator

## COUPLING ARRANGEMENT

Flexible coupling

Flywheel to suit flexible coupling

Flywheel housing

## ENGINE INSTRUMENT PANEL

Starting switch with key

Lub oil pressure gauge

Battery charging ammeter

## **SAFETIES**

**Low lub oil pressure**

**High water temperature (Only for water cooled engine)**

## MANUALS

Engine operation and maintenance chart

Parts catalogue

Engine routine test certificate

Engine warranty card

## ALTERNATOR

Synchronous three phase alternator of make suitable for continuous operation at 1500RPM generating 415V at 0.8 power factor (lag) suitable for 50Hz, Three **phase**, 4 wire, system. The alternator shall be self excited, self regulated, foot mounted fitted with ball and/or roller bearings. The alternator will generally conforming to BS:2613/ IS:4722.

## **ACCESSORIES**

### **BASE FRAME**

Heavy duty base frame of sturdy design made of M.S. channel with necessary reinforcement and pre drilled holes

### **FUEL TANK**

Daily service fuel tank made out of 14SWG MS sheet suitable for 100Litres complete with drain plug, air vent, inlet and outlet connection

### **BATTERY**

One no. Battery of 12V each in dry and uncharged conditions with its leads of Exide/Kirloskar make.

### **AUTOMATIC MAINS FAILURE PANEL**

The panel will be made out of fabricated sheet steel suitable for indoor mounting installation, hinged front panel door for easy accessibility and suitable rated bus bars complete with internal wiring, fuses with suitable provision for connecting incoming and outgoing cables.

The panel will be fitted with following instruments:

Alternator contactor of suitable rating with over load relay and HRC fuses for short circuit protection

Main contactor of suitable rating

One ammeter

One voltmeter

One frequency meter

One set of mains supply voltage monitor to identify low voltage/ complete failure and initiate necessary signal for operation of automatic control gear.

Set of push buttons for Start, Stop, Reset, Acknowledge

Master switch for Auto/Manual/Test/Off

One set of indicating lamps for indicating

- Load on mains
- Load on set

- Set fails to start
- Low lub oil pressure
- Battery charger ON

One hooter

Battery charger for charging battery when set is not in operation, connecting to the load side so that it will energized from the mains. The battery charger will comprise of the following:

- Transformer of suitable capacity
- Rectifier
- D.C.ammeter
- D.C.voltmeter
- Charger rate selector switch for trickle or boost charging

All control fuses will be so located as to be easily accessible for replacement

Relay section will comprise of the following

- Automatic starting of D.G.set in the event of mains voltage failure/ falling below a preset value
- When the main supply is restored, it's quality will be monitored for a period of set time, then load is automatically transferred on the mains and the D.G.set will shut down after a preset idle running period
- In the event of failure of diesel engine to start on failure of mains supply on one attempt, two more starting impulse will be automatically given and if still the engine does not start due to some defects within thirty seconds of first starting impulse, it will get disconnected and locked out automatically and audio and visual signal will operate
- In the event of failure of diesel generating set due to faulty starting, the mains supply contactor will get energized without any delay on the restoration of mains supply

The circuitry will make use of minimum number of relays and control wiring will be neatly provided with adequate size of copper conductor cable of suitable cross section voltage grading and tag number at either end.

In the manual operation the diesel generating set will be started by the attendant by pressing start push button irrespective of the conditions of the main supply. Thus with this

arrangement it will be possible to exercise routine test of the diesel generating set on the load without interrupting the supply of essential circuit.

In the test mode of operation conditions similar to mains failure will be simulated by operating the master switch on the Test.

By pass system with the help of two nos. changeover switch of suitable rating

### **Acoustic Enclosure:**

Acoustic enclosure shall be powder coated and fabricated out of 16 SWG CRCA MS sheet. The silent canopy shall be of nut bolt type construction. Critical processes of punching is done on CNC machines to maintain dimensional accuracy of holes within 0.1 mm. Powder coating is done after seven-tank surface preparation process of sheet metal. Canopy panel and doors shall have inside lining of FIRE-RETARDANT foam as acoustic material. Four hinged doors shall be provided to canopy, one door shall have glass window for control panel.

### **Base Frame:**

Base frame is fabricated either in ISMC channel or in sheet metal. The base frame will be primer coated and painted. The base frame is rugged in construction and designed for mounting Diesel engine and alternator close coupled, with cross members mounted on AVM. The base frame shall have provision for mounting of acoustic enclosure & control panel on it. The base frame is having provision of lifting hook for convenient lifting of complete set, i.e. along with canopy, engine and alternator.

### **Color Scheme**

The base plate and top is powder coated with OXFORD BLUE/PEPSI BLUE, the canopy is powder coated with IVORY color.

### **Performance Parameters**

The average sound level, when measured in green field condition (ISO 3744 OR 8528 PT 10) at 1-meter distance from all four sides shall be less than 75-dBA averages or as per CPCB norms.

The average stabilized hot air temperature rise with in the canopy is maintained with in 10° C over and above ambient temperature.

### **CANOPY FEATURES**

Canopy fabricated on machines with dimensional accuracy of 1mm.

Canopy is powder coated after passing through seven tank processes.

Canopy is lined with acoustic foam, which is non-igniting /Fire Retardant (confirming to BS 4735/BIS 7888).

No grouting required on the ground, only a level surface capable of withstanding the DG weight.

Designed for installation in open-air conditions.

Lockable doors provided.

Lockable fuel filling arrangement provided external to the canopy.

Residential Silencer is housed in the canopy.

Externally accessible emergency stop button.

The exhaust gases shall be taken out through a suitable flexible pipe to prevent any back pressure on the engine.

### **Thermal Insulation:**

The exhaust system and noise suppressor shall be provided with thermal insulation by using fire retardant/non igniting foam conforming to BIS7888/BS 4735 to prevent excess heat radiation on the engine and safe for operator

### **Noise suppressor: (Silencer)**

Absorption type Non resistance Residential Silencer insulated from inside with glass wool shall be provided to suppress exhaust noise from the engine.

### **Wiring and Lighting:**

PVC copper wire concealed in flexible conduit with florescent tube light/bulb with MCB shall be provided.

**Surface Treatment-Painting:**

The enclosure surface shall be suitably treated for degreasing, de-rusting and phosphating. High quality powder coat treatment/paint shall be used.

Canopy lights: one no. DC bulb to be fitted with suitable toggle switch and wiring.

Temperature rise inside the canopy

The maximum permissible temperature rise above the ambient shall be 10°C.

Emergency Push Stop Button

The canopy shall have provision of emergency push button, which shall be housed in a protective enclosure with a glass front.

**Performance:**

The sound level shall be less than 75 dbA at a distance of 1 meter. The temperature difference between ambient and air inlet at air cleaner within the enclosure will be maintained well within 5-7 deg centigrade. The measurement of noise will be as per ISO 3744/ISO 8528 (part 10) standard. This meets CPCB norms.

All other requirements that are essential to make the DG set compliant to CPCB norms for noise reduction shall form part of technical requirements.



## **SPECIFICATION FOR INTELLIGENT FIRE ALARM SYSTEM**

### **PART 1.0 -GENERAL**

#### **Description**

The fire alarm system shall include furnishing, installation, and connection of the Analog/Addressable Microprocessor based LCD/LED Fire Alarm Control Panel consisting of system cabinet(s), main chassis with power supply, with or without UDACT dialer, stand-by batteries, initiating and indicating, optional city tie/reverse polarity module, optional relay modules, detection and signaling devices, and any auxiliary modules, remote annunciator assemblies, and miscellaneous peripheral devices to form a complete coordinated system ready for operation as shown on the drawings or herein specified.

The fire alarm system shall comply with requirements of NFPA Standard No. 72 for protected premises signaling systems except as modified and supplemented by this specification. The system field wiring shall be supervised electrically. The system and all associated equipment shall be fully approved and listed by the following agency and regulatory controls:

#### System:

Must comply with applicable National, State, and/or local Building code recognized at time of installation.

Must comply with NFPA 101 70, 72 fire alarm installation standard recognized at time of installation.

Installation must comply with requirements of Local Authority Having Jurisdiction.

#### Devices & Control equipment:

- a. Equipment described here in must be UL listed under the current issue of the standard indicated:

- b. Manual fire alarm stations No. 38
- c. Heat detectors: No. 521
- d. Smoke detectors for Fire Protective Signaling Systems: No. 268
- e. Audible signal devices: NO. 464
- f. Control Units for Fire Protective Signaling systems: No. 864
- g. Visual Notification Appliances: 1971
- h. Power Supplies for Fire Protective Signaling Systems: No. 1481
- i. Smoke Detectors for Duct Applications: No. 268A
- j. Water flow Indicators for Fire Protective Signaling Systems: No. 346

**Submittals and Shop drawings:**

Sufficient information shall be clearly presented and shall include manufacturer's name, model numbers, power requirements, equipment layout, device arrangement and complete wiring.

Sequence and description of operation.

Product Data for each type of equipment, initiating device, signal device, peripheral device and cable provided on the project.

Shop drawings shall include battery calculations, floor plans and wiring diagrams.

**Operation Manual :**

Operation manual shall include:

Installation instructions for use by installing contractor.

Operational instructions or manual for use by building personnel, including name and phone number of service representative.

Maintenance instructions as required for use by building personnel.

Copy of approved shop drawings.

**Basic System**

The fire detection system shall be capable of integrating multiple control command

centers and remote network annunciators. Each panel shall be capable of fire detection, equipment supervision and control, alarm management, and historical data collection and archiving, and of integrating multiple annunciator units and remote command centers, each capable of alarm display and system control functions. Up to 254 units may be networked together utilizing "Peer to Peer" communication technology. Systems that are of the OEM nature (under private label) and not fully field programmable will not be considered. The fire detection system shall consist of the following:

Network capability of up to 254 units

Touch screen color graphics capability

Stand alone capability of each control unit on loss of data channel

Conventional and Analog Devices

250 software groups/zones

14.5" wide cabinet construction to ensure fitting between wall studs

Portable Operator's Terminals (POT)

Up to 16 Class "B" or 8 Class "A" intelligent SLC's

Up to 16 Class "B" or 8 Class "A" conventional zones (IDC's)

8 Class "B" or 4 Class "A" notification circuits (NAC's)

Minimum 10Amp power supply

Field programmable

Alarm/Trouble/Supervisory LED's per circuit

Individual ground fault detection and reporting by circuit

80 character back-lighted LCD read-out

60 characters dedicated to user text messaging per device/circuit

The system shall permit expansion of both capacity and functionality through the addition of units, modules, addressable devices and detectors.

High-speed data transfer rates for alarm reporting, quick report generation from multiple systems/transponders and upload/download capability between network systems. The maximum response time shall be 5 seconds between initiation of alarm and signal output. Each control unit shall support a minimum of 1584 addressable devices in Class "A" Loop wiring & 3168 addressable devices in Class "B" Loop wiring. The entire "peer-to-peer" network shall have a minimum capacity of 402336 intelligent points.

Each unit shall have sufficient memory to support its own operating system and databases including:

**Fire Management**

**Alarm Management**

**Historical/Trend Data**

**Maintenance Support Applications**

**Custom Processes**

**Operator I/O**

**Expandability:** The system shall be expandable in nature and shall permit easy expansion through the addition of software applications, additional units and devices.

**Serial Communication Ports:** provide data communication ports for simultaneous operation of devices such as industry standard printers, programming terminal, personal computer, transponder and annunciators.

**Integrated on-line Diagnostics:** Each unit shall continuously perform self-diagnostics, communication diagnostics and diagnostics on all subsidiary equipment.

**Surge and Transient Protection:** Each unit shall provide isolation and transient protection at all network terminations and all field point terminations to suppress induced voltage transients where required.

## 1.5 System Software

All necessary software to form a complete operating system as described in this specification shall be provided.

The software programs specified in this section shall be provided as an integral part of the unit and shall not be dependent upon any higher level computer for execution.

Status Change Report: All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.

Report Routing: Alarm reports shall be archived for future recall.

Alarm Messages: In addition to the point's description and the time and date, the user shall be able to print, display or store a custom alarm message to more fully describe the alarm condition or direct operator response.

Each control unit shall be capable of storing a library of at least 1000 events. The event log shall have the ability to be printed via a parallel printer port built-into the FACP.

The FACP shall have a parallel printer port which allows the internal software the ability to print the following reports:

**System event log**

**Sensitivity for all devices**

**Relation routing, this shows all input and output relationships of the entire system**

Alarm Verification: The alarm verification feature shall be used to delay acceptance of alarms until they can be confirmed, and shall meet all applicable code requirements and standards. Any or all circuits may be selected for verification through field configuration, which shall be done without removal of an EPROM. If a circuit is selected for alarm verification, it will only verify two-wire smoke detectors. Contact devices, such as manual stations, connected to a verified circuit will be discriminated and will not be verified.

When the unit detects an alarm on an initiating circuit programmed for alarm verification, the unit shall automatically reset the power to that circuit.

If the alarm condition is still present after a pre-set time period of 30 seconds, then the system will automatically enter the Alarm mode.

History Mode: The system shall be able to store and display at least 1000 system events that have occurred in a non-volatile buffer memory. Display of these events shall be accomplished on-site through the use of the front control panel indicators and switches.

Field Configurable: The system shall be fully configurable and expandable at the owner's site without the need for EPROM programmers. All configurations shall be accomplished through downloading of programs from a computer. Reconfiguration shall not require knowledge of any programming languages or require any special training. All programs shall be stored in non-volatile memory. Entry into program mode shall require a special key and a special password entered into the front panel.

Releasing Function: The notification appliance circuit shall be software configurable for Continuous Output, Strobes, Door Holders and releasing functions. The panel will support Abort and Hold operation as well as have Cross Zoning.

The software residing in the FACP shall be capable of reporting initiating devices even if they are not in the database. In the event that an initiating device, which is not in the database, reports an alarm state, the FACP shall turn on all Notification Appliance Circuits. This ensures all devices are active, whether they are programmed in the database or not. Panels which do not respond to un-programmed devices in alarm shall not be considered equal.

## **1.6 Networking**

If utilized or for future use, the network shall be Style 7 wiring, with each control unit talking directly with two other units and the network will be a closed loop. Units which require a host or head end controller will not be accepted.

The network will be "peer-to-peer" with each unit generating commands to other units as required.

System architecture in networked configuration shall eliminate dependence upon any single control unit for alarm reporting and control execution. Each control unit shall operate independently by performing its own specified control, alarm management, and historical data collection. The failure of any single component or network connection shall not interrupt the operation of the balance of the system.

Control units on the network shall be able to send control commands directly to any other unit on the network without dependence upon a central processing unit.

Optionally, each unit can, through programming, send operating commands, such as Acknowledge, to other units on the network.

Prioritization: Each unit shall send commands to other units on the network based upon the priority of the initiating signal. Alarm events/commands shall be sent before supervisory conditions, which will be sent before commands for a Trouble condition.

In case of a partial communications failure, each unit will continue to send commands to those units it can still communicate with.

Each unit will be able to work in a stand-alone mode in case of a total loss of network communications.

Any control unit in the network can be made the master unit of the network by software changes only.

Each control unit will have error detection, correction, and retransmissions to guarantee data integrity.

Remote Annunciators/Command Centers will be an equal peer in the network.

## **1.7 Sequence of Operation**

A. When a fire alarm condition is detected by one of the system initiating devices, the following shall occur:

All automatic programs assigned to the alarm point shall be executed and the

associated indicating devices and relays activated.

The System Alarm on appropriate unit will indicate an alert condition.

The corresponding zone(s) in alert alarm will be indicated.

Second stage operation shall occur when a key is inserted into the key-operated switch of any manual pull station causing all fire alarm speakers/bells to sound the general alarm (evacuation) at a rate of 120 strokes per minute throughout the building.

If the fire alarm condition is not acknowledged at the unit within five (5) minutes of the sounding of the first stage alarm, the fire alarm system shall automatically indicate a second stage alarm causing all bells in the building to sound the general alarm (evacuation) throughout the building. Activation of the second stage shall be identified at the operator's workstation.

Activate all control by event functions related to the alarm.

Send signal to U.L. Certified monitoring central station.

Fan systems, i.e., shutdown, exhaust and pressurization operations to be initiated.

Doors with hold open devices shall be signaled to release.

When a trouble condition is detected by one of the system initiating or indicating circuits, the following functions shall immediately occur:

System Trouble will be indicted on the unit and system annunciator(s).

A local trouble-sounding device in the unit and annunciator shall be activated. This sound shall be distinct from the alarm sound.

The trouble for the corresponding initiating or indicating circuit shall be indicated on the unit.

The appropriate message will appear on the LCD display.

## **1.8 Conventional Interface Module**

Any Initiating Circuit may be configured to be a Supervisory Circuit. If so configured,



it will not activate the System Alarm indication when a supervisory condition is detected but will instead activate a separate supervisory indication. Open-circuit conditions will be reported as trouble and must be differentiated from supervisory conditions.

Each circuit shall be definable in software as an alarm or supervisory circuit.

## **1.9 Analog Module**

Each network control panel shall be capable of supporting 8 class "A" or 16 class "B" SLC circuits within one cabinet.

Each Intelligent Loop circuit shall be capable of supporting up to 198 (Class A or Class B) intelligent devices consisting of 99 intelligent detectors and 99 addressable modules per loop. The basic unit shall be capable of supporting up to two (2) modules. Each module has four (4) class A or eight (8) class B circuits.

One analog interface module shall monitor and control up to four Class A or eight Class B loops of intelligent detectors and addressable modules. The analog interface board shall contain its own microprocessor control.

The analog interface board shall communicate and provide power to all devices on its loop over a single pair of wires. For Class B operation, the loop is not returned and branch circuits ("T-tap") connections may be made off of the loop. Class A operation shall be available.

The analog interface board shall receive analog information from all intelligent detectors and shall process this information to determine normal, alarm, supervisory or trouble conditions. The analog information may also be used for automatic test and determination of maintenance requirements.

It shall be possible to display on the control unit LCD display, the current analog value of any addressable device, as well as the programmed trip points.

Communication with all connected devices shall be performed every 5 seconds or less. Average time to detect an alarm shall be less than 5 seconds (longer for alarm

verification detectors).

## **PART 2- FIRE ALARM EQUIPMENT**

### 2.0 Control Panel

The CPU shall communicate with the operator interface, LCD display, LED display and control all other modules in the unit. Removal, disconnection or failure of any control unit module shall be detected and reported by the Central Processing Unit.

The CPU shall contain and execute all control-by-event programs for specific action to be taken if a fire situation is detected in the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs. The CPU shall also provide a real time clock for time annotation on the display and remote optional printer.

### 2.1 Notification Circuits

The Control Unit shall provide up to 8 fully supervised Class B notification circuits. The notification circuit capacity shall be 1.0 amperes maximum per circuit. If a short circuit trouble occurs on one of the notification circuits it will not affect the operation of the remaining circuits.

### 2.2 Function Relays

The Control Unit shall provide 4 sets of Form "C" relay contacts rated at 2 A at 30 VDC. These relays may be programmed to activate on alarm from any initiating zone or any combination of initiating zones, analog devices or addressable modules.

### 2.3 System Relays

The Control Unit shall provide 3 sets of Form "C" relay contacts rated at 2 A at 30 VDC. These relays have a fixed operation, alarm, supervisory, and trouble.

### 2.4 Operator Display

The operator display shall provide all controls and indicators used by the system operator. The display shall contain, and display, as needed, custom alphanumeric message for all intelligent detectors and addressable modules. Such message information shall be stored in programmable non-volatile memory.

The display board shall provide an 80-character alphanumeric Liquid Crystal Display (LCD). It shall also provide 3 x 24 Light Emitting Diodes (LED's) for zone alarm indication and a further 24 LED's for system indication such as AC POWER; SYSTEM ALARM; SYSTEM TROUBLE; DISPLAY TROUBLE; GROUND FAULT; TROUBLE ACKNOWLEDGE; ALARM ACKNOWLEDGE and SIGNAL SILENCE.

Factory programmable system indications and keys shall be available for unique functions. Keys shall be referred to as "Hot Keys".

The operator display shall provide a 20-key touch keypad with control capability to command all system functions, and entry of any alphabetic or numeric information. The keypad shall include means to enter a minimum of two different passwords to prevent unauthorized manual control.

Conventional LED lamp indication shall be provided for all zones. Separate alarm, supervisory and trouble, indication shall be available on a per zone basis. Operator intervention shall not be required for display of all zones in alarm condition.

Ground fault indication shall be displayed on a circuit basis.

## 2.5 One Person Test

The control unit shall include a special one-person test feature, which will allow a single person to test all initiating devices and indicating appliance in a system without returning to the panel to Reset the system. A special password shall be required to enter the test mode. The serviceman shall be able to pre-select the initiating and indicating circuits that are to be included in the one person test mode. The Walk-Test shall include a special audible indication that a trouble has been detected on an analog device, for the serviceman to check proper system

wiring.

Historical Data and Trend Analysis: A variety of historical data collection utilities shall be provided to automatically sample, store, and display system data.

In network configuration it shall be possible to download programming information from the master to the slave units.

## 2.6 Communication Ports

The system shall provide the following interfaces:

Two ports for System networking

One port for dialer/city tie, PC or Voice Evac connection

One port for service and field programming

One port for Printer

## 2.7 Power Supply

The power supply for the unit and all fire alarm peripherals shall be integral to the control unit. The power supply shall provide all control unit and peripheral power needs as well as a minimum of 300 mA of regulated 24 VDC power for external devices.

All circuits are Power Limited using positive-temperature-coefficient thermistors, circuit breakers, or other over-current protection.

Input power shall be 240 VAC 50 Hz. The power supply shall provide an integral battery charger. Internal battery capacity shall be sized as required to meet UL and NFPA requirements.

The Main Power Supply shall provide a battery charging circuit consisting of a fully automatic standby battery charger, rate compensated, capable of maintaining battery in fully charged state and be capable of recharging batteries to 70% of alarm capacity within 12 hours. Provide for normal operation of entire system for 24 hours with power remaining to sound alarms for 5 minutes.

Provide charger with following supervised functions: circuit protection for shorts,

open, disconnected or reversed polarity battery connection, supervision or protection of high or low voltage, overcharging and charger failure. Automatic load shedding or battery disconnects on deep discharge to prevent battery damage.

Maintenance free, long-life batteries, 24 V, rechargeable, gelled electrolyte, totally sealed, fully charged with all interconnections ready for service.

## 2.8 Mechanical Design

The control unit shall be housed in a cabinet designed for surface mounting directly to a wall or vertical surface or semi flush with integral trim ring. The back box and door shall be constructed with provisions for electrical conduit connections. The door shall provide a key lock and shall include a glass opening for viewing. The back box shall be 14.5" wide for between stud mounting.

The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

The control panel will not require fans or other means of active cooling.

## 2.9 System Components

### NOTIFICATION DEVICES

#### A. Audible/Visual Devices

The notification devices shall be of a low profile design and combination that provides a selection of high or low dBA as well as field selectable candela options of 15,30,60,75 and 110 candela. Each device shall have input terminals of 12 to 18 AWG and be provided with a tamperproof Re-entrant Grill. Notification devices must have capability of switching for Temporal 3, Chime, or Whoop Tones. Device shall have capability of silencing the horn while allowing strobes to remain flashing.

Alarm signals shall comply with UL, 464, UL 1971, UL 1638 and the Americans with Disabilities Act (ADA). Audible signals shall sound in accordance with a

Code 3 temporal pattern. Strobes shall have a flash rate of 1 hertz. Where so indicated and required to comply with standards, increased candela intensities shall be provided.

B. Exterior Audible/Visual Alarm Signals:

Audible signals shall be horns that shall provide a sound level of at least 85 dBA, measured 10 feet from the horn on axis. Visual signals shall have 75 candela xenon strobes behind protruding clear lenses. The word "FIRE" shall be imprinted on the appliance. Audible and visual signals shall be mounted as per manufacture instructions using proper listed back box; the exterior signal appliances shall be listed for outdoor use and shall be weather-proof.

C. Interior Audible/Visual Alarm Signals:

Audible signals shall be horns that shall provide a selectable sound level consisting of at least two levels separated by a minimum of 4 dB within the range of 89 to 99 dBA, as measured 10 feet from the horn on axis. Visual signals shall have xenon strobes behind clear lenses with the word "FIRE". Device shall be of the selectable candela type.

D. Voice Evacuation Speakers:

1. All speakers shall operate on 25 VRMS or with field selectable output taps from 0.25 to 2.0 Watts.
2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).
3. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
4. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.

E. Detection Devices:

A. Addressable Devices - General

1. Addressable devices shall provide an address-setting means using rotary decimal switches.
2. Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type address switches. Devices which use a binary address or special tools for setting the device address, such as a dip switch are not an allowable substitute.
3. Detectors shall be Analog and Addressable, and shall connect to the fire alarm control panel's Signaling Line Circuits.
4. Addressable smoke and thermal detectors shall provide dual (2) status LED's. Both LED's shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LED's shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of the detector LED's can be programmed off via the fire control panel program.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity can be automatically adjusted by the panel on a time-of-day basis.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base which includes a tamper proof feature.
8. The following bases and auxiliary functions shall be available :
  - a. Sounder base rated at 85 DBA minimum.
  - b. Form-C Relay base rated 30VDC, 2.0A
  - c. isolator base
9. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be

initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (example: ION, PHOTO, THERMAL).

#### B. Addressable Manual Alarm Pull Station

1. The alarm pull station shall be a low profile design, with terminal or pigtail connection. It shall have 10AMP SPST, SPDT, or DPDT Gold Plated contacts and be single or double action. The pull station shall be equipped with Allen wrench or key lock/reset.
2. Addressable manual alarm pull station 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.
3. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

#### C. Intelligent Photoelectric Smoke Detector

1. The detector shall use the light-scattering principal to measure smoke density and shall send data to the FACP indicating analog level of smoke density. Detectors shall be Analog and Addressable, and shall connect to the Fire Alarm Control Panel using Signaling Line Circuits. The addressable smoke detectors shall utilize a decade (numbered 0-99) type address switch. Devices that use binary address or special tools for setting the device address shall not be allowed.

The detectors shall provide dual status LED's. Detectors shall be ceiling mount and shall include a separate twist-lock base that includes a tamper proof feature. The following features must also be capable for the detector: Sounder base rated at 85 dBA minimum, Form C relay, or Isolator base.



The detector shall provide a test means for simulation of alarm condition and report that condition to the main control panel. This test may be initiated by activation with a magnetic switch.

Detector must store internal identity type indicating the device is a photo type at the panel.

D. Intelligent Laser Photo Smoke Detector

1. The intelligent laser photo smoke detector shall be a spot type detector that incorporates an extremely bright laser diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.
2. The laser detector shall have conductive plastic so that dust accumulation is reduced significantly.
3. The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.03 percent per foot.
4. The laser detector shall not require expensive conduit, special fittings or PVC pipe.
5. The intelligent laser photo detector shall support standard, relay, isolator and sounder detector bases.
6. The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.
7. The laser photo detector shall include two bicolor LED's that flash green in normal operation and turn on steady red in alarm.

E. Intelligent Ionization Smoke Detector

1. The detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.

F. Intelligent Multi Criteria Acclimating Detector

1. The intelligent multi criteria Acclimate detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.
2. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
3. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

#### G. Intelligent Thermal Detectors

1. The heat detector shall be an intelligent addressable device rated for 135 degrees and have a rate-of-rise element. The detector shall connect to the FACP using a Signaling Line Circuit. The heat detector shall utilize a decade (numbered 0-99) type address switch. Devices that use binary address or special tools for setting the device address shall not be allowed.

#### H. Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.
3. The sampling tubes shall be in 3, 5, or 10-foot lengths as required. When required, provide a remote indicator light.

#### I. FILTEREX

1. The detector shall be designed to provide early warning smoke detection in environments where traditional smoke detectors are not practical.
2. The detector shall have a filter system to remove particles down to 25 microns.
3. This filter system shall remove unwanted airborne particles and water mist. This shall allow the detector to operate in environments where traditional smoke detectors would have nuisance alarms.
4. The filter system shall consist of 2 filters one of which is field replaceable.
5. The filter system shall have an intake fan to draw air and smoke through the filters into the sensing chamber.
6. The filter system shall be supervised so that if the filter is clogged or the fan fails the control panel reports trouble.
7. The filter system shall be powered from 24 VDC separate from the SLC communications.
8. The detector shall utilize a photoelectric sensing chamber.

#### J. Addressable Dry Contact Monitor Module

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

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

K. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

L. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation.
3. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.
4. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

M. Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

#### N. Isolator Module

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

### **PART 3 -INSTALLATION & TESTING**

#### 3.1 Installation

##### 1. Conduit:

Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

All wiring shall be installed in conduit or raceway, unless otherwise indicated on drawings. Conduit fill shall not exceed 40 percent fill as per NEC. Conduit size shall be  $\frac{3}{4}$  inch minimum.

Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions shall be installed as per the manufacturer's installation requirements

Conduits shall not enter the Fire Alarm Control Panel, except where conduit entry is specified by the manufacturer.

Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.

## 2. Wire:

All wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer

Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70. All field wiring shall be completely supervised.

The Fire Alarm Control Panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the Main Power Distribution Panel as FIRE ALARM. Fire Alarm Control Panel Primary Power wiring shall be 12 AWG. The Control Panel Cabinet shall be grounded securely to either a cold water pipe or grounding rod.

## 3. General Installation:

Installation shall conform to the wiring diagrams submitted as shop drawings and to the manufacturer's instructions.

Installation of equipment, devices, wire and cable terminations, programming, adjusting, testing and demonstration shall be performed by a qualified installer to perform fire alarm system work. Final connections shall be made under the supervision of an authorized manufacturer representative.

#### 4. Verification Testing

Provide the service of a factory-trained technician authorized by the manufacturer of the system to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA and the manufacturer.

Check for correct connections and test for short circuits, ground faults, continuity, and insulation.

Close each sprinkler system flow valve and verify supervisory alarm at the FACP.

Verify activation of all flow switches.

Open initiating and indicating device circuits and verify trouble signal activation.

Ground all circuits and verify response of trouble signals.

Check for audibility of tone at all alarm notification devices.

Check installation, supervision, and operation of all smoke and duct smoke detectors.

Verify the proper alarm and trouble receipt and processing of signals at the FACP and any remote annunciators.

Perform all tests in accordance with the manufacturer's testing procedures.

Correct any deficiencies discovered as a result of the testing and retest the work affected by such corrections.

#### 3.2 Final inspection and instruction

A factory trained representative of the manufacturer shall demonstrate that the system functions properly.

Instructions for operating the system shall be provided in a hands-on demonstration as stated elsewhere in the specification or as indicated on the drawings.

Written operating instructions shall be provided.

Record of Completion indicating certification of the fire alarm system installation and testing shall be submitted to the Consultant at completion in accordance with Tender Requirements. A copy of all Record of Completion certificates together with Inspections and Testing Forms shall be delivered to the Owner's Representative. Photocopies shall be included in the Operating and Maintenance Manuals.

#### Warranty

The FACP shall have a 2 year manufacturers warranty against product defects. This warranty shall be for material only. Installation and labor shall be warranted for a period of 1 year or as indicated elsewhere in this specification.



**PUBLIC ADDRESS, EMERGENCY EVACUATION AND CCTV SURVEILLANCE**  
**SYSTEM**

**A General Requirement**

1. The primary objective of the system is to provide clear announcements during public addressing and one-way voice communication during an emergency; the secondary function shall be to provide background music where required.
2. The system shall be capable of fulfilling the following requirements:
  - a. Clear, un-distorted announcements to selected areas during public addressing;
  - b. Clear, un-distorted paging to all zones; either individually or collectively. Selection of groups of zones shall be programmable from time to time; and
  - c. Background music to selected areas when the other functions are not selected.
3. The loudspeakers shall be wired up in zones and with supervision
4. The zones shall further be grouped according to function so that it shall be possible to make an announcement by depressing just one switch on the call station.
5. When the zones are selected for public addressing, a chime shall first be heard, followed by the announcement. The system shall have a range of tones such that it shall be possible to programme different tones for call stations.

- 6 It shall be possible for the system to function with different call stations in operation, provided there is no conflict in the zones being called by the call stations. An emergency call station shall be provided for emergency.
- 7 The controller shall have a system of priorities such that no conflict occurs when zones from different call stations pressed simultaneously.
- 8 The system shall comply with country Public Address Evacuation Code of practice or IEC 60849 for the one-way emergency voice communication system in all aspects.

## **B SYSTEM REQUIREMENT**

- 1 For general office and public areas, the system shall be capable of delivering a sound pressure level of 85 dB at the listening level.
- 2 Paging announcements shall be possible from any of the microphone call stations, or from the microphone paging station to any zones within the network systems.
- 3 Call station shall be using CAT 5 cable with RJ 45 connector to transmit calls.
- 4 The central controller shall have a means of monitoring, to continuously monitor the system from the microphone of the call station onwards; any faults shall be displayed on the central unit.
- 5 A built-in amplifier monitoring circuits shall continuously monitor the functioning of the power amplifiers and shall automatically switch in a spare power amplifier in case of failure of any of the amplifiers.
- 6 All speaker lines shall be supervised for open circuit fault, short circuit fault, and short to ground fault. Upon detection, the status of the fault shall be indicated in the Central Monitoring.
- 7 The system shall also have the means to cut-off the music sources during emergency paging and shall enable the emergency announcement to be heard in these areas.

## **C SYSTEM SPECIFICATIONS**

1. The Public Address System shall be the integrated solution for BGM and emergency voice alarm system (EVAC). The voice alarm system shall be designed for public address and emergency evacuation. All the essential EVAC functionality – such as system supervision, spare amplifier switching, loudspeaker line surveillance, digital message management and a fireman’s panel interface – shall be combined. The Public Address System shall be flexible and easy to operate
2. The main equipment shall be housed in standard 19-inch equipment racks.
3. Cabling between a call station and the central network Controller shall merely comprise CAT 5 cable, while standard loudspeaker cables shall be used between the power amplifiers and the loudspeakers.
4. Cabling within the main equipment shall be via CAT 5 cable with purpose built connectors located at the back of each equipment.
5. The system shall be designed to handle maximum 180 zones from Call Station zone selection or from controller or remote control panel with different commands simultaneously; as such, there shall be a system of priorities to cope with conflict situations.
6. It shall be possible to program different priorities on different user keys of the microphone call station; it shall also be possible to expand to 180 zones selection buttons and to be paged from different call stations simultaneously provided there is no conflict situation.
7. The system shall be flexible in design that allows adding and removing of equipment anywhere in the network without affecting the performance of other units to meet the complete tender requirements.

8. A paging call station shall comprise a table stand fitted with a high performance condenser microphone mounted on a flexible system for easy adjustability. It shall include LED's, for monitoring and 'engaged' and 'ready-to-talk' indication, and cascaded keypads with 8 button user-keys each.
9. Each call station shall have a built-in amplifier for line level output, plus a compressor / limiter in order to maintain signal strength regardless of changes in the speaking distance from the microphone. A built-in Speech filter improves intelligibility and prevents clipping of audio input.
10. Each user key on the call station shall be programmable via the Central Configuration PC. Call Station shall be capable of being programmed with a priority hierarchy, signal tones, digitally stored messages and routing instructions prior to a call. Each user key when depressed shall activate a zone or group of zones of speakers according to type of announcement to be made.
11. Supervised control inputs and audio inputs shall provide the interface between the inputs and the central PA/EVC/BGM system. Each input is supervised and freely programmable for any system actions with priorities setting.
12. The central controller shall manage the operation of the system; that is, detection of the user keys being depressed, routing of the microphone and attention signal tones, setting of the priority levels and switching of the loudspeaker volume control override circuits. It shall also acts as the 'watchdog,' continuously checking the system hardware.
13. A digital message module shall be stored in the central controller for broadcasting of message in case of emergency. The status of these messages shall be monitored.
14. For evacuation and emergency procedures, signals shall be programmed to precede an pre-recorded announcement from a call station, or they shall be

- capable of being broadcast independently by an activation from fire alarm system.
15. Signals shall be capable of being programmed to precede an announcement from a call station or may be used independently as alarms for evacuation or emergency procedures.
  16. Multi-program applications shall be made easy, with several channels being used simultaneously to distribute music or radio broadcasts. The system controller shall be capable of altering music programme allocation where necessary.
  17. Whatever signal is being transmitted, the emergency and alarm calls shall always have top priority. They shall be broadcast immediately and at full volume, even in those zones where loudspeaker are currently switched off or set at a low volume.
  18. All equipment shall be housed in standard 19" racks; as far as possible, all inter-connections shall be by means of standard cables and connectors, for ease of service ability.
  19. The contractor shall supply, install and wire up the proposed loudspeakers. All speakers shall be designed for music and public address application. They shall have a minimum opening angle of 60° at 4,000 Hz or higher.
  20. The uniformity of sound pressure level distribution at 1.5 metres above the floor level shall not vary beyond  $\pm 4$  dB for frequency up to 4,000 Hz and not more than  $\pm 8$  dB for frequency up to 8,000 Hz.
  21. The ceiling loudspeakers so chosen shall have uniform frequency response ranging from 100 Hz to 16,000 Hz within  $\pm 3$  dB variations
  22. Each loudspeaker assembly shall incorporate a flush-mounted baffle, a 100V line matching transformer and a high efficiency loudspeaker in order to keep the operating power at a minimum
  23. Each loudspeaker shall be capable of generating an on-axis sound pressure level of at least 91 dB at 1 metre distance, with 1W input.
  24. The remote volume control units shall be sufficiently rated to handle the total number of ceiling loudspeakers it has to serve and shall have a speech restoration

circuit, which shall permit announcements always at full volume regardless of the control setting.

- 25 The horn speakers shall have a minimum frequency response of 400 to 3,900 Hz, while the surface mount speakers and the column speakers shall have a minimum response of 200 Hz to 12,500 Hz.

## **EQUIPMENT SPECIFICATIONS**

The central controller shall be the integrated solution for BGM and emergency voice alarm system (EVAC). The voice alarm system shall be designed for public address and emergency evacuation. All the essential EVAC functionality – such as system supervision, spare amplifier switching, loudspeaker line surveillance, digital message management and a fireman’s panel interface – shall be combined.

### **1 Central Controller:**

It shall have the following functions:

- 1.1 The system shall provide for emergency call (EMG), business call and BGM audio, up to 60 zones, 8 call stations and two remote control panels. The voice alarm system shall be a one channel /two channel system. It shall be compatible with BGM sources and 100 V booster amplifiers. It shall be capable of connecting to EVAC compliant loudspeakers and accessories for an integrated public address and voice alarm solution.

The system shall be fully IEC 60849 compliant. It shall have full system supervision, loudspeaker line impedance supervision, a supervised emergency microphone on the front panel and a supervised message manager for 255 pre-recorded messages and chimes. It shall be possible to merge messages to allow even more flexible use of pre-recorded announcements and evacuation messages. It shall be possible for each message to have any length within the total available capacity. The memory shall have a capacity of 16 MB. It shall be possible to upload from a PC via USB into the memory, after which the unit shall operate without PC connection. The standard WAV-format shall be used for the

messages and sample rates of 8kHz up to 24kHz with 16-bit word length (linear PCM) shall be supported.

Volume override relay contacts shall be provided for each zone separately for overriding local loudspeaker volume controls. All current override schemes shall be supported (3-wire and 4-wire override schemes i.e. standard 24V and failsafe). Upon a call or an activated trigger input these contacts shall be activated for the appropriate zones, together with an additional voltage free contact (Call Active) for control purposes.

A 24Vdc output shall be available to supply power to external relays, so no external power supply shall be required for that purpose. A LED VU-meter shall allow for monitoring of the master output.

The maximum allowed total cable length between the controller and the last router in the chain shall be 1000 meters. The maximum allowed total cable length between the controller and the last call station in the chain shall be 1000 meters. The maximum allowed total cable length between the controller and the RC panel shall be 1000 meters.

The controller and each connected router shall have 12 trigger inputs to start business and emergency messages. Each shall be configurable for a message consisting of a sequence of up to 8 wave files. It shall be possible for wave files to be used in different combinations with other messages, optimizing flexibility and used storage space.

As the basis of the voice alarm system, the controller shall have all the essential functionality for compliance with IEC 60849 standard, including full system supervision, loudspeaker line impedance supervision, a supervised emergency microphone on the front panel and a supervised message manager. The messages shall be mergable to allow even more flexible use of pre-recorded announcements and evacuation messages. The controller shall be used as a stand-alone system with up to 6 zones, or expanded to up to 60 zones using

additional 6-zone routers. Up to 8 call stations shall be connectable. Interconnections shall be made using standard RJ45 connectors and CAT5 cable.

It shall be possible to connect 480 watts per router. The audio output shall use standard analog audio 100 V line switching for full compatibility with public address equipment and EVAC-compliant loudspeakers. The system shall be configured using DIP switches for basic functionality and a PC for more advanced functions. It shall be possible to specify 16 priority levels.

A built-in 240 W booster amplifier shall provide the power for the emergency call channel and BGM. It shall be possible to add additional booster amplifiers as spare, to provide two-channel operation or if the total power requirement exceeds 240 W (maximum 480 W per 6 zones). All booster amplifiers shall be supervised.

The maximum/rated output power of the internal booster shall be 360 W / 240 W.  
max mains inrush current shall be 8A @ 230 Vac / 16A @ 115 Vac.

The frequency response shall be 60 Hz – 18 kHz (+1/-3 dB, @ -10 dB ref. rated output. The distortion shall not exceed 1% at the rated output, 1 kHz. The controller shall have tone controls to allow for adjustment of the BGM sound. It shall have separate bass and treble controls. The controller shall have two BGM source inputs and a microphone/line input with configurable priority, speech filter, phantom power and selectable VOX activation. It shall be possible to select 16 priority levels for microphone, call stations and trigger inputs for optimum system flexibility. It shall have two connectors to connect the call stations. It shall have 12 input triggers with 6 supervised trigger inputs. Furthermore it shall have one tape output on cinch connectors. The trigger outputs shall be on floating relays with a rating of 250V 7A. The controller shall have an emergency active relay, a fault relay and two general-purpose relays, for control purposes. The fault relay shall be failsafe.



The output section shall have six transformer-isolated 100 V constant voltage outputs for driving 100 V-loudspeakers in six separate zones. All zones shall be individually selectable from the front panel and the BGM output level in each zone shall be individually settable in 6 steps. The BGM output shall be connected to the 70V line, thus it shall be possible to connect a total load of 480 Watts in a two channel system combined with a 480 Watt booster.

The output of the booster shall be also available as a separate output on 100V and 70 V. A separate 100 V Call Only output shall be provided for addressing an area where BGM is not required but where priority announcements are. Six configurable volume override output contacts shall be available for overriding local volume controls during priority calls. A LED VU-meter shall monitor the output.

The voice alarm router shall be an expansion unit adding 6 zones as well as 12 input- and 8 output contacts to the voice alarm system. It shall be able to use the booster built in the voice alarm controller. It shall provide outputs and inputs for one or two boosters in a multi amplifier one- or two-channel system. It shall provide dual channel operation for calls and BGM simultaneously to a maximum of six different zones, using two booster amplifiers. Also single channel operation shall be possible with only one booster.

The router shall have a set of relays for zone-switching the power amplifier output(s) to different loudspeaker groups. Each of the zones shall be switched between the call channel (upon call-station selection or all-call microphone or emergency activation), the BGM channel (upon front panel selection), or off. The zone power handling capacity of the router shall be 480 Watts. The router shall also have 12 input triggers. 6 triggers shall be supervised for EMG purposes.

The 6-zone call station shall be a stylish high quality call station with a stable metal base, a flexible microphone stem and a unidirectional condenser microphone. It shall be intended for making calls to selected zones. The special design shall

allow for neatly flush mounting in desktops. Using dipswitches on the bottom of the call station, the call station ID shall be selectable. The call station shall have selectable gain, speech filter and limiter for improved intelligibility.

On each call station it shall be possible to select 6 zones with the possibility to connect a call station keypad to increase the number of zones or zone groups that can be selected.

It shall have LED indications for zone selection, fault and emergency state. The call station extension shall provide seven additional zone and zone group keys

On each call station it shall be possible to select 6 zones with the possibility to connect up to 8 call station keypads to increase the number of zones or zone groups that can be selected. Selected zones are indicated with LEDs on the call station, three additional LEDs give visible feedback on the active state of the microphone and the system. Green indicates microphone active, amber indicates that the system has detected a fault (IEC 80649) and red indicates that the system shall be in the emergency state.

The power supply voltage range shall be 18 – 24V with a current consumption of less than 50 mA. The nominal sensitivity shall be 85 dB SPL (gain preset 0dB). The nominal output level shall be 700 mV. The maximum allowable sound pressure level shall be 110 dB SPL. The microphone shall have a limiter. The distortion shall be less than 0.6% at maximum input. The equivalent input noise level shall be no more than 30 dB SPLA. The frequency range shall be 100Hz – 16kHz. The speech filter shall be a 315 Hz, high-pass, 6-dB/oct filter. The output impedance shall be 200 Ohms. The stem length with microphone shall be 390 mm.

Mains voltage shall be both 230Vac and 115Vac,  $\pm 15\%$ , 50 / 60Hz (selectable) Power consumption of the Controller shall not exceed 600 Watts; the router shall not exceed 50Watts. Battery backup provisions shall be implemented, the battery voltage shall be 24Vdc,  $+20\%$  /  $-10\%$ .

All low-level connections and volume override shall be on MC1, 5/XX-ST-3, 5 type connector blocks. All high level connections except mains shall be on MSTB 2,5 /XX-ST. The input contact shall have supervision based on a series and parallel resistor.

The router and controller shall be rack mountable with removable rack mounts. The router shall be not higher than 2U. The controller shall be not higher than 3U. The rack mounting kit shall be included.

The operating temperature range shall be -10°C to +55°C. The storage temperature range shall be -40°C to +70°C.

The system shall comply with the following standards:

EVAC compliance	acc. to IEC 60849
EMC emission	acc. to EN 55103-1
EMC immunity	acc. to EN 55103-2
Safety	acc. to EN 60065

**Comply with country code of practice and consultant requirement in all aspect**

The Public Address system shall be from single brand supplier.

The controller, router, call station, call station keypad, amplifier, volume control, speaker shall be from a single brand System.

**Amplifier**

**Booster Amplifier**

Booster amplifier shall be of 480W with direct 100V input for power expansion with Input level control .

It shall have following technical specifications

Specification:

Rated Output Power	:	480W
Frequency response	:	60Hz to 15 Khz
Distortion	:	<3%
Impedance	:	20Kohm
Sensitivity	:	1 V balanced
S/N ratio	:	> 80dB

### **Horn Loudspeaker**

Horn Loudspeaker shall have 15W RMS housed in weatherproof IP 65 Housing. Frequency response 500 Hz to 5 Khz. SPL 103 dB.

## **SPECIFICATIONS FOR LIFTS**

### **1.0 GENERAL:**

These specifications are intended to cover the complete installation of the elevator plant in the first class work men like manner and include all work and material as specified. The supply and installation of lift is on turn key basis. Any item not mentioned in the detailed specifications but required to be provided stands included in the contract amount and nothing extra shall be payable for that.

The work shall conform to IS:1860-1980, IS:4666-1986 or revised upto date.

### **2.0 STANDARDS:**

The following BIS Standards and Codes of Practice with upto date amendments shall apply to the equipment and the work covered by this contract.

Electric Traction Lifts – Guide line for outline dimensions IS 14665 (Part-1) – 2000

Electric Traction Lifts – Code of practice for installation IS 14665 (Part-2) – 2000

Electric Traction Lifts – Safety Rules IS 14665 (Part-3) – 2000

Electric Traction Lifts – Components IS 14665 (Part-4) – 2000

Code of practice for electrical wiring installations (system voltage not exceeding 650 volts) IS 732:1963

In addition the relevant clauses of the following, as amended upto 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 elevators

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.

### **3.0 DRIVING MECHANISM:**

#### **3.1 Elevator Machine:**

The elevator machine shall be suitable for 415 volts, 3 phase, 50 Hz Cycles AC supply with a voltage variation of +10% and –20% and shall be placed in the head room area inside the hoistway mounted on the guide rails.

Permanent magnet synchronous gearless motor shall be considered. The elevator machine shall have high efficiency and low power consumption and shall be designed to withstand peak currents in elevator duties.

Means of manual rescue operation of the elevator car shall be made by providing lever in the maintenance access panel located at the top most landing. In case the elevator is stuck in between the floors, when the lever is pulled the elevator shall start moving in the upward or down ward direction depending upon the weight inside the car. When the elevator reaches the floor level the indication is given by the LED and the lever be placed back in its position. The door of the elevator car can be opened form outside.

#### **3.2 Brake:**

The electromagnetic brake shall be spring applied and electrically released. It shall come into action after the elevator has come to a complete halt to hold the car in position. The brake shall

operate automatically with the safety devices and failure of the mains. It shall be released electrically. It shall be possible to release the brake manually – such release requiring the action of manual force to move the elevator in short stops.

### **4.0 CONTROL:**

The elevators shall have state of art microprocessor based AC variable voltage variable frequency(ACVVVF) drive. The elevator shall be provided with Simplex Selective Collective Control. The control system shall regulate the car and shall provide service to all floors as different traffic conditions arise minimizing unproductive factors. The system shall respond automatically to UP and DOWN peak, balanced or light traffic etc. Complete detail of these features shall be furnished along with the tender. Some of the technical parameters

required are innumerate below. Tenderers shall categorically confirm their compliance or otherwise in the tender.

- a) Starting Current - 1.2 – 1.8 time full load running current
- b) Power saving - 50 – 55%
- c) Leveling accuracy -  $\pm 5$  mm
- d) Acceptable Voltage Fluctuation - + 10 to -20%
- e) Rate of acceleration/deceleration (M/S<sup>2</sup>) - 0.6 – 1.5.
- f) Maximum jerk (M/S<sup>3</sup>) - 0.7 – 2.0
- g) Maximum vibration in car horizontal/vertical - 86 dB
- h) Maximum noise level in car during travel - 50 dBA

Maximum door noise level while closing and opening at a distance of 1 mtr from car door  
- 55 dBA

The controller shall be wall/floor mounted, vertical, totally enclosed cubicle type with hinged doors on the front to provide easy access to all components in the controller. The cubicle shall be well ventilated such that the temperature inside never exceeds the safe limits of the components at ambient room conditions in the machine room. The controller shall be placed in the headroom area inside the hoist way.

The controller shall operate within the supply voltage variation of plus 10% to minus 20% of the nominal voltage. An inbuilt voltage stabilizer/CVT (surge protector) shall be provided in the controller for the purpose.

The controller shall be complete with relay protection against the following:

- a) Overcurrent
- b) Under voltage
- c) Single phasing
- d) Phase reversal
- e) Earth leakage
- f) Over voltage

The controller shall be designed to cut off the power supply, apply the brake and bring the car to

a rest in the event of any of the above failures occurring.

The tenderer shall state clearly the form of protection provided for each equipment. If any devices of the electro mechanical type are used the same shall be equipped with arc chutes to prolong the life of contacts. Tenderers shall stipulate the type of devices used and the material of the contacts.

Tenderer shall support their offers with complete details of experience, number of elevators installed and operational in India, collaboration for equipment design and manufacture etc.

### **5.0 CAR ENCLOSURE:**

The elevator car enclosure including car door, hoistway doors and return panel shall be with painted steel finish. Height of the car below the false ceiling shall be 2200 mm and the height of the door shall be 2000 mm as specified. The enclosure shall have PVC flooring finish. Enclosure shall have painted steel ceiling with indirect lighting or standard design of ceiling as approved by Project Manager. The enclosure shall have fixtures and fittings including provision of car ventilation as detailed in technical parameters.

### **6.0 DOORS:**

#### **6.1 Car Door:**

The car entrances for elevators shall be protected by minimum 900mm W x 2000mm H (Refer Data sheet) automatic power operated, center opening, horizontal sliding doors with painted steel finish as per standard design of the manufacture (details to be furnished alongwith the tender).

#### **6.2 Hoistway Landing Doors:**

The hoistway landings for elevators shall be protected by minimum 900mm W x 2000 mm H (Refer Data sheet) automatic power operated, center opening door with painted steel finish as per standard of manufacture (details to be furnished alongwith the tender). For specific requirement please refer detailed specifications.

#### **6.3 Car & Hoistway Door Protection:**



A multiple infra red electronic door detector with minimum 100 criss cross beams shall be provided to regulate the closing motion of the doors for entry of the passengers. When a person is entering the car while the doors are closing the detector shall sense the same and hold the doors to permit entry. Additional electro-mechanical pressure sensing device shall be provided above the door opening to avoid accidents in case of failure of infra red door detector device.

#### **6.4 Car & Hoist way Door Operation:**

The equipment shall be complete with electric door operator for opening and closing of Car & Hoist way landing door. The equipment shall consist of a DC gearless motor on the elevator car to operate the door when the car is stopping at a landing. The car & hoist way doors shall be mechanically connected such that both move simultaneously for opening and closing.

The hoist way landing door shall be provided with an interlock such that.

- a) It shall not be possible for the car to be started or kept in motion until all the landing doors and the car door are locked in the closed position.
- b) It shall not be possible to open the landing door from the landing unless the elevator car is within the particular landing zone.
- c) The car doors & hoistway landing doors open automatically as the car is stopping at a landing. The closing of the car and landing door must occur before the car is set in motion.
- d) It shall not be possible to open the car door from inside the car in case the car is stationed in between the floor levels, by providing mechanical car door lock.

#### **6.5 Door Hangers and Tracks:**

The car and the landing doors shall be provided with two point suspension sheave type hangers complete with tracks. Sheaves and rollers shall be steel with moulded nylon collar and shall include shielded ball bearings. Tracks shall be of suitable steel section with smooth surface. The

landing doors shall be complete with headers, sills, frames etc. as required.

#### **7.0 CABIN FAN:**

A Noiseless pressure fan or blower shall be provided in the elevator cabin with supply grill matching with the interior of the car.

### **8.0 EMERGENCY LIGHTS:**

In addition to normal lighting an emergency light unit using sealed Inverter based Maintenance free battery power pack with charger and fluorescent lamp to operate automatically and to illuminate the car in case of power failure shall be provided in each elevator car.

### **9.0 AUTOMATIC RESCUE DEVICE:**

Each elevator shall be provided with an electronic state of art Emergency Battery Drive for automatically rescuing trapped passengers from the elevator during power failure. The rescue device

shall automatically bring the elevator car to the nearest landing and open the door so that the trapped persons can walk out of the elevators. The elevators shall resume normal operation on restoration of power supply.

### **10.0 OPERATION BUTTONS AND INDICATIONS:**

The following operation buttons and indications shall be provided:

#### **10.1 In each Elevator Car:**

Full height Stainless steel panel of suitable thickness flush mounted shall be provided on one side of the door having:-

- a) LED Illuminated push buttons of micro pressure type corresponding to the floors served.
- b) Door open and door close button.
- c) Emergency stop button.
- d) Emergency alarm button.
- e) Two position key operated switch for 'with attendant' and 'without attendant' operation.
- f) Ventilation fan ON/OFF switch with auto OFF when there is no call after 120 seconds.
- g) Built in intercom of the hands free type as well as space for providing EPABX telephone instrument and 5 pair telephone trailing cable to communicate from car to machine room receiver and car to Central Monitoring Station (at remote location) and vice-versa.

- h) Dynamic car direction display.
- i) Car position indicator.
- j) Audio/Visual overload warning indicator.

## **10.2 At Landings:**

### **Terminal Landings**

- LED illuminated type single push buttons with travel indication arrow in satin finish stainless steel facia plate.
- Digital car position indicator in stainless steel finish facia plate.

### **Intermediate Landings**

- Two LED illuminated type push buttons with travel indication arrow in hairline finish stainless steel face plate.
- Digital car position indicator in stainless steel finish face plate.

## **11.0 SAFETY DEVICES:**

All safety devices statutorily required by Elevator Inspector, including but not restricted to the following shall be provided:

### **11.1 Terminal and Final Limits:**

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landings, and final limit switches shall be furnished to automatically cut off power should the car travel beyond the terminal landings.

### **11.2 Interlocking:**

Adequate interlocking is to be provided so that the car shall not move if the landing doors are even partially open and also the elevator is overloaded.

### **11.3 Car Safety and Governor:**

The car safety shall be provided to stop the car whenever excessive descending speed is attained.

#### **11.4 Emergency Stop Switches:**

An emergency stop switch for use by maintenance personal shall be provided in each elevator car.

#### **11.5 Self Leveling:**

The elevators shall be provided with self leveling features of  $\pm 5$ mm accuracy.

#### **12.0 FIREMAN SWITCH:**

Each Elevator shall have a Fireman switch with glass front for access by the Fireman. The operation of this switch shall cancel all calls to this elevator and will stop at the next nearest landing if traveling upwards. The doors will not open at this landing and the elevator will return to the ground floor. In case the elevator is traveling downwards when the fireman's switch is operated it will go straight to the ground floor bypassing all calls enroute. The emergency stop button inside the car shall be rendered inoperative.

#### **13.0 GUIDE RAILS:**

The car rails should be 'TEE' section, duly machined, tongued and grooved. Counter weight rails shall be 'TEE' section, duly machined, tongued and grooved. The guide rails shall have sections, the properties of which shall comply with the requirement of the relevant IS code. The guides shall be capable of withstanding forces resulting from the application of the car or counter weight safety devices.

#### **14.0 BUFFERS:**

The suitable heavy duty spring buffers shall be placed below the car and counter weight but in the pit & arranged to sustain any shock, should the lift over travel past the terminal limits. Buffers shall be mounted on RCC foundation blocks. Dowels for the purpose shall be left while casting the pit floor alternatively floor reinforcement could be exposed by chipping for welding additional reinforcement for dowels.

#### **15.0 ROPES:**

These will be self lubricated, round standard steel wire ropes manufactured from high grade steel and special flexible material and shall conform to the relevant Indian Standards. The number and size of the hoistway ropes shall be so selected that it have the combined breaking

strength calculated with a minimum factor of safety of 10 times the combined weight of car with full load and also have adequate traction for the elevator. The governor ropes shall also be wire ropes.

#### **16.0 SILLS:**

The sills to be provided should be aluminium grooved, with self supporting sill M.S. angle of adequate size.

#### **17.0 AC MOTOR:**

The make, type and capacity of hoisting motors should be mentioned. The motor should be suitable for elevator service (S4 duty) with high starting torque & low starting current. Thermistor shall be embedded in starter windings to indicate the temperature rise in the motor.

#### **18.0 ELECTRIC POWER:**

The available system of electric supply is 415 Volts +10% -20% between phases and 240 Volts between phase and neutral – 3 phase, 4 wire AC 50 Hz system. In addition, for illumination and control, power at 240 volts AC single phase 50 Hz shall also be available. 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 elevators shall be indicated in the tender. Power shall be provided at one point in top landing at a point to be indicated by the tenderer. All subsequent electrical systems shall be the responsibility of the tenderer.

#### **19.0 ALARM BELL:**

A butterfly operated emergency alarm bell, including wiring to be provided and connected to a properly marked push button in the car operating panel. The alarm bell shall be located at the ground floor, at the floor landing outside and adjacent to hoistway or as desired by Project Manager.

The alarm unit shall be solid-state siren type, operated by Inverter based maintenance free batteries to give a waxing and warning siren when the alarm button in the car is pressed

momentarily.

#### **20.0 HOISTWAY GATE INTERLOCKS:**

Each Hoistway gate shall be provided with an approved interlock and which shall prevent the movement of the car away from the landing unless all gates are closed and locked. The interlock

shall also prevent opening of gate except at the landing where the car is stopping or has stopped.

#### **21.0 COUNTER WEIGHT:**

The counter weight shall be made of iron ore and consist of structural steel frame which shall travel between rigid guides and also shall be capable of withstanding buffer impacts. The counter weight shall have weight equal to that of the complete elevator car and approximately 50% of the contact load. Suitable metallic counter weight guard of required length shall be provided at the bottom of the hoistway.

#### **22.0 HITCHES PLATES:**

Self aligning hitches plates of better roping shall be provided.

#### **23.0 TRAVELING CABLES:**

Fire retardant traveling cable shall be used and shall conform to IS:4289 – 1967 with latest amendment. The firm can also use flat traveling cables (imported only) with the approval of the consultant.

#### **24.0 GUIDE RAILS SHOES:**

To prevent car shaking automatic adjustable guide rails shoes should be used. The firm should use teflon guide ribs on lubricated guide rails.

#### **25.0 REVERSE PHASE RELAY:**

Reverse phase relays should be provided on the controller which should be designed to protect the lift equipment against phase reversal and single phasing and phase failure.

**26.0 CONTROLLER:**

Single automatic push button control shall be used. The design of the controller should be such that it can be mounted on a wall and is dust protected, providing sufficient protection against lizards, rodents etc.

**27.0 TECHNICAL PARAMETERS:**

Technical parameters in attached data sheets give requirement of various parameters of passenger elevators. 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 these technical parameters are not duly filled in by the tenderers are liable to be summarily rejected.

SR.NO	DESCRIPTION	SPECIFICATION
1)	Designation of Lifts	PASSENGER
2)	No. Of Elevators	1
3)	Type and Capacity	8 PASSENGER – 544 KGS
4)	Speed	1.0m/s
5)	Drive	V3F16
6)	Location of M/c Room	MONOSPACE
7)	Travel	10.5 Mts
8)	Serving	-3, -2, -1 TO Ground Floor
9)	No. Of Stops	4
10)	Required Well Size	1800mm (W) x 1900mm (D)
11)	Power Supply	415 V Three Phase 50 Cycles AC
12)	Auxiliary	Single Phase 220V 50 Cycles AC
13)	Car size	1100mm (W) x 1300mm (D)
14)	Pit Depth	1600 mm
15)	Head Room	4500 mm
16)	<b>CAR ENCLOSURE</b>	
	Car Ceiling	ENAMEL PAINTED STEEL CEILING
	Car Panels	<b>AS PER LX3-SPRING, SUMMER, MONSOON AND WINTER</b>
	Car Flooring	PVC FLOORING
	Car Illumination	FLUROSCENT LIGHT
17)	No. Of Entrance	ONE LOCATION FRONT
18)	Car Entrance	CENTER OPENING POWER DOORS IN ENAMEL PAINTED FINISH
19)	Door Safety	FULL HEIGHT INFRA RED CURTAIN
20)	Landing Entrance	CENTER OPENING POWER DOORS IN ENAMEL PAINTED FINISH
21)	Clear Opening	800mm (W) X2000mm (H)
22)	Control	FULL COLLECTIVE SIMPLEX



23)	INDICATORS	
	Car	7 SEGMENT, 25 MM INDICATORS
	Landing	7 SEGMENT, 25 MM INDICATORS

**FEATURES:**

1. Direction & Position Indicator In Car
2. Emergency Alarm
3. Facial Plate
4. 2 Phase Fireman Drive
5. Hands Free Press & Speak Intercom
6. Full height infra red safety curtains
7. Pit Ladder
8. Signal Fixtures In Stainless Steel Finish
9. Emergency Light With Rechargeable Battery
10. Adjustable Guide Shoes
11. Micro Movement LED Based Buttons
12. +10% To-20% Volt. Fluct. Withstand Capacity
13. Load Weighing Device.
14. Automatic Rescue Device

## TECHNICAL SPECIFICATION FOR MECHANICAL VENTILATION SYSTEM

### (A). EQUIPMENTS:

#### 1.0 EXHAUST FANS :-

##### 1.1 Axial Flow Fan :

Fan shall be complete with direct driven motor, motor mountings and vibration isolation, suspension arrangement as per approved for construction shop drawings.

- a. Casing shall be constructed of heavy gauge sheet steel. Fan casing, motor mount and straightening vane shall be of welded steel construction. Motor mounting plate shall be minimum 15 mm thick and machined to receive motor flange.

An inspection door with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be bonderized, primed and finish coated with enamel paint.

- b. Rotor : hub and blades shall be cast aluminum or cast steel construction, blades shall be die-formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Fan blades mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control may be manually readjusted at site upon installation, for obtaining actual air flow value, as specified and quoted.
- c. Motor shall be energy efficient squirrel-cage, totally enclosed, fan cooled standard frame, constant speed, continuous duty, single winding, suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, provided with class 'F' insulation. Motor shall be specially designed for quiet operation. The speed of the fans shall not exceed 1000 RPM for fans with impeller diameter above 450 mm, and 1440 RPM for fans with impeller diameter 450 mm and less. For lowest sound level, fan shall be selected for maximum efficiency or minimum horsepower. Motor conduit box shall be mounted on exterior of fan casing, and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit.
- d. Drive to fan shall be provide through belt drive with adjustable motor sheave and standard sheet steel belt guard with vented front for heat dissipation. Belts shall be of oil-resistant type.
- e. Vibration isolation : The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of rubber-in-shear type.

**f.** Accessories : The following accessories shall be provided with all fans.

- i. Outlet cone for static pressure regain.
- ii. Inlet cone.

Fan silencers may be provided where specifically called for in schedule of quantities. Fan shall be factory assembled and shipped with all accessories factory mounted.

**g.** For smoke evacuation system, the fan should be capable to withstand for 2 hours 250°C.

## **1.2 Inline Fans :-**

Fan shall be direct-driven centrifugal fan encased in a sheet metal housing of 22 Gauge GSS with necessary inspection cover. The fans are selected to operate at best efficiency and direct driven with totally enclosed motor suitable for operation on 220/380 V 50 cycle A/C supply depending upon their sizes. Flanges shall be provided on both sides of inline fan to facilitate easy connection. Flexible anti vibration joints shall be provided to arrest vibration being transferred to other equipment connected to inline fan.

### **a. Fan Blades :**

Fan blades shall be constructed of galvanized sheet steel.

### **b. Motor :**

Fan motor shall be standard (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans of 38cm dia, or larger and 1440 rpm for fans suitable for 415 ± 6% volts, 50 cycle 3 phase power supply. Smaller fans shall be suitable for 220-240 volts, 50 cycle single phase power supply. Motors shall be suitable for either horizontal or vertical service as indicated in drawings and schedule of quanti

## **B Air Distribution System :-**

### **1.0 Scope :**

The scope of this section comprises supply, fabrication, installation and testing of all sheet metal work comprises the general requirements for the following :

#### **1.1 Sheet metal ducting.**

- A. General :
- B. Governing Standards :
- C. Material for Ducting :
- D. Duct Connectors and Accessories :
- E. Fabrication Standards :

- F. Selection of G.I. Gauge and Transverse Connectors :
- G. Duct Construction :
- H. Support System :
- I. Installation :
  - Tools and Tackles for Site Work :
  - Installation Practice :
- J. Documentation and Measurement for Ducting :
- K. Testing :
- L. Fire and Smoke Dampers :

- 1.2 fresh air and exhaust air outlets.
- 1.3 Material of construction for the above.
- 1.4 Methods of installation and finishing requirement.
- 1.5 Grilles, Diffusers, Splitters and fire dampers etc.
- 1.6 Supports/hangers.
- 1.7 Air balancing.

The above will be in accordance with these specifications and the general arrangement as shown in the drawing.

## **2.0 General :**

### **Work includes**

- i. The work under this part shall consist of furnishing labour, material, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the HVAC system ready for operation as per drawings.
- ii. Unless otherwise specified all duct work and related items shall be in accordance with these specifications.
- iii. Duct work shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers.

## **3.0 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)

It is not acceptable that two different governing standards. (i.e. as SMACNA and IS) SMACNA will be the governing standards.

## **4.0 Material for Ducting :**

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

Galvanizing shall be of 120 gm per sq. m surface area. (Total coating on both sides)

- iii. 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.
- iv. 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.

## **5.0 Duct Connectors and Accessories :**

All transverse duct connectors (flanges/cleats) and accessories/related hardware are such as support systems shall be zinc-coated (galvanized).

## **6.0 Fabrication Standards :**

- i. All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be Rolastar 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 installation.
- ii. Refer SMACNA , Section 1.12 COMMENTARY ON ALUMINUM DUCT page. no. 1.58 to 1.60.
- iii. Galvanizing can be up to 180 gms/ sqm if so required for other applications. More than this is not recommended for any application with Indian ram material as heavier zinc coatings tend to flake off.
- iv. Coil lines to ensure location of longitudinal seams at corners/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.
- v. 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.
- vi. All edges to be machine treated using lock formers, flingers and roller for turning up edges.
- vii. Sealant dispensing equipment for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified.

## **7.0 Selection of G.I. Gauge and Transverse Connectors :**

- i. It is not always beneficial to over engineer the specifications on the grounds of safety. For e.g. While some may propose higher gauges than the minimum

specified for a size. It should be realized that this adds to the self-weight and sag and therefore introduces additional leakage to the system.

- ii. Further heavier gauges subjected to low range operating pressure causes rapid vibrations in static pressure caused by turbulence that will make that vibrate violently.
- iii. All transverse connectors shall be the 4-bolt slip-on flange system (such as ROLAMATE™ supplied by Rolastar). We recommend to use C&S/SS cleats for duct size upto 750mm.
- iv. We recommend having duct construction in compliance with 1" (250 Pa) w.g. static norms as per SMACNA.
- v. The specific class of transverse connector and duct gauge for a given duct dimensions will be as per Table 1 below for the 1" (250 Pa) pressure class.
- vi. 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.

<b>STANDARDS FOR SELECTION OF ROLAMATE FLANGE CLASS AND DUCT GAUGES AT 1200 MM SPACING</b>						
<b>Duct Dimension</b>	<b>Duct Pressure in Inches / (Pascals)</b>					
	<b>1''(250)*<sup>5</sup></b>	<b>2''(500)</b>	<b>3''(750)</b>	<b>4''(1000)</b>	<b>6''(1500)*<sup>4</sup></b>	<b>10''(2500)</b>
<b>(in mm)</b>	<b>Reinforcement Class - Duct Gauge</b>					
upto 250	<b>*<sup>3</sup>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>
251-300	<b>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>	<b>E-24</b>
301-350	<b>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>	<b>E-22</b>
351-400	<b>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>	<b>E-22</b>
401-450	<b>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>	<b>H-20</b>
451-500	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>	<b>E-24</b>	<b>E-24</b>	<b>H-20</b>
501-550	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>	<b>E-24</b>	<b>H-24</b>	<b>H-20</b>
551-600	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>	<b>E-24</b>	<b>H-22</b>	<b>H-20</b>
601-650	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>	<b>E-24</b>	<b>H-22</b>	<b>H-20</b>
651-700* <sup>2</sup>	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>	<b>H-24</b>	<b>H-22</b>	<b>H-18</b>
701-750	<b>E-26</b>	<b>E-26</b>	<b>E-24</b>	<b>H-24</b>	<b>H-22</b>	<b>J-18</b>
751-900	<b>E-26</b>	<b>E-24</b>	<b>H-22</b>	<b>H-22</b>	<b>H-20</b>	<b>J-18</b>
901-1000	<b>E-26</b>	<b>H-24</b>	<b>H-22</b>	<b>H-20</b>	<b>J-18</b>	<b>J-16</b>
10 01-1200	<b>E-24</b>	<b>H-22</b>	<b>H-20</b>	<b>J-18</b>	<b>J-18</b>	
12 01-1300	<b>*<sup>3</sup>H-24</b>	<b>H-20</b>	<b>J-18</b>	<b>J-18</b>	<b>J-16</b>	

13 01-1500	<b>H-24</b>	<b>H-18</b>	<b>J-18</b>	<b>J-16</b>	<b>NOT DESIGNED</b>
15 01-1800	<b>H-22</b>	<b>J-18</b>	<b>J-16</b>		
18 01-2100	<b>*<sup>3</sup>J-20</b>	<b>J-20</b>			
2101-2400	<b>J-18</b>	<b>J-18</b>			
2401-2700	<b>J-18</b>				

**Note :**

1. SMACNA- Sheet Metal and Air conditioning Contractors' National Association Inc- "HVAC Duct Construction Standards- Metal and Flexible"-1995, U.S.A.
2. Reading Guide- For duct sizes between, say, 651 mm and 700 mm, when the pressure class is 1" w.g. static, we require a Rolamate "E" class flange and duct gauge of 26. For the same size range but with static pressure at 4" w.g. a Rolamate 'H' class flange with duct gauge of 24 should be used.
3. The Rolamate flange classes available are designated E, H and J. For E & H class of Rolamate use gasket size 10 mm wide and 4.5 mm thick. For Rolamate J-class use 15 mm wide and 6 mm thick gasket.
4. For pressure class 6" w.g. static and above contact Rolastar to confirm the gasket type and size requirement.
5. For non-critical comfort cooling applications (1" w.g. pressure class), optional "C & S" or "C & SS" cleat joints can be used. Upto 450 mm duct size use "C & S" cleats. 451 to 750 mm duct size use "C & SS" cleats. Over 750 mm duct size use Rolamate flanges.

A higher class flange can always be substituted for a lower class (e.g. class "J" for class "H" , class "H" for class "E").

**8.0 Duct Construction :**

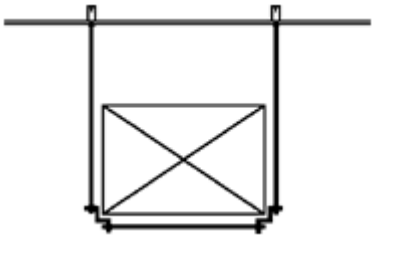
- i. The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.
- ii. Dimensional Tolerances: All fabricated dimensions will be within +/- 1.0mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be +/- 1.0 mm per metre.
- iii. 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.
- iv. Ducts shall be straight and smooth on the inside. Longitudinal seams shall be airtight and at corners only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness.

- v. 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.
- vi. Plenums shall be shop/factory fabricated panel type and assembled at site.
- vii. The deflection of transverse joints should be within specified limit for rectangular duct deflection as given in SMACNA. Page no. 7.6.
- viii. Reinforcement of ducts shall be achieved by either cross breaking or straight beading depending on length of ducts.
- ix. Duct Sizes- 19” (483 mm) wide and larger which have more than 10 sq.ft. of unbraced panel shall be beaded or cross broken unless ducts will have insulation covering or acoustical lined. This requirement is applicable to 20 g (1.00 mm) or less and 3” W.G. (750 Pa) pressure or less. Ducts for 4” W.G. (1000 Pa) or more do not require beads or cross-breaks.”

## 9.0 Support System :

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

### Supporting Schedule for Horizontal Duct

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

- i. 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.
- ii. 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.



## **10.0 Installation :**

### **10.1 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) :

- i) Electric Pittsburgh Seamier–used for closing Pittsburgh joints.
- ii) Electric Slitting shear–to make cut-outs.
- iii) Drilling machine with drill bits – for drilling holes in sheet metal work.
- iv) Hammer drill machine with drill bits – for drilling holes in building structures for anchors.
- v) Hoisting system – for lifting the duct assembly upto mounting heights.

### **10.2 Installation Practice :**

- i. All ducts shall be installed as per tender drawings and in strict accordance with approved shop drawings to be prepared by the Contractor.
- ii. The Contractor shall provide and neatly erect all sheet metal work as may be required to carry 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.
- iii. All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or 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.
- iv. Ducting over false ceilings shall be supported from the slab above, or from beams. In no case shall any duct be supported from false ceilings 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.
- v. 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.

- vi. 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.

### **11.0 Documentation and Measurement for Ducting :**

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

- i. 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.
- ii. Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.
- iii. 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.

### **12.0 Testing :**

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

### **13.0 Fire and Smoke Dampers :**

- i. All Fresh air ducts shall be provided with Motor operated Fire and Smoke damper. Fire dampers, shall be provided with approved make, and shall have fire rating of at least 90 minutes as per UL555/1995 tested by CBRI.
- ii. The dampers frame and the blades shall be fabricated out of 16 gauge G.I. sheets. The damper blades on both ends shall be pivoted using chrome-plated spindles in self-lubricating bronze bushes. Stop sealed shall be provided on top and bottom of the damper housing. To prevent smoke leakage, side seals shall be provided.
- iii. The normal position the damper shall be held in open position with the help of a stainless steel spring through a thermal link. The thermal link will be UL stamped. This link will be set to operate at 165 deg. F.
- iv. Smoke & fire damper shall have similar construction as above. However, these dampers will be motorized types having electric actuator, actuated by

smoke sensor and electronic heat detector factory set at 165 deg. F. The dampers shall be provided with spring return system to ensure damper closing incase of power failure and open the same in case of power being restored.

- v. Fire and smoke dampers shall be mounted in fire rated wall with a duct sleeve of 400 mm/500 mm long depending upon the wall thickness. The sleeve shall be factory fitted on fire damper. The joints at sleeve end shall be slip on type. Minimum thickness of GI sheet shall be 18 Gauge.
- vi. Each damper shall be provided with its own control panel, mounted on the wall suitable for 220V AC supply. This control panel shall be suitable for spring return actuator and shall have at least the following features :
  - Potential free contacts for AHU fan ON / OFF and remote alarm indication.
  - Accept signal from external smoke/ fire detection system for tripping the electrical actuator.
  - Test and reset facility.
  - Power supply ON.
  - Alarm.
  - Damper open and close position.
- vii. Actuator shall be mounted on the sleeve by the damper supplier in his shop shall furnish test certificate for satisfactory operation of each motor operated damper in conjunction with its control panel. Control panel shall be wall mounted type.
- viii. It shall be HVAC Contractor's responsibility to co-ordinate with the Fire Alarm System Contractor for correctly hooking up the motor operated damper to fire detection / fire management system. All necessary material for hooking up shall be supplied and installed by HVAC Contractor under close co-ordination with the fire protection system contractor.
- ix. HVAC Contractor shall demonstration the testing of all dampers and its control panel after necessary hook up with the fire protection / fire management system is carried out by energizing all the smoke detection with the help of smoke.
- x. HVAC Contractor shall provide fire retardant cables wherever required for satisfactory operation and control of the damper.
- xi. HVAC Contractor shall strictly follow the instruction of the damper supplier or avail his services at the site before carrying out testing at site.

- xii. Fire / Smoke damper shall be provide with factory fitted sleeves however, access doors shall be provided in the ducts within AHU room in accordance with the manufacturer's recommendation.
- xiii. The Contractor shall also furnish to the owner, the necessary additional spare actuators and temperature sensor ( a minimum of 5% of the total number installed ) at the time of commissioning of the installation.

#### **14.0 Fresh and Exhaust air Registers :**

- a. Fresh and Exhaust air Grille :

Supply and return air registers shall be made of high quality extruded aluminium profiled construction with the advantages of corrosion resistance and rigidity. Extruded aluminium registers shall be either anodized or powder coated and 20 to 30 mm wide flanges on four sides as specified in schedule of quantities.

Supply and return air registers shall have two sets parallel aerofoil blades with one set mounted horizontally on the front and other set vertically at the rear.

Frame shall be separated from aerofoil deflection blades by nylon bushings to ensures quiet, smooth and rattle free operation.

Deflection blades shall be designed in such a manner that it can be adjusted manually and individually, to provide air deflection in both horizontal and vertical planes.

Core shall be suitable for clip fixing type, permitting its removal without disturbing the flanges.

Maximum effective pressure areas should be achieved when the blades are positioned at 0° position.

The registers shall be suitable for fixing arrangement having concealed screws.

Foam gasket shall be sealed around the back of the frame to avoid air leakage.

Supply air registers shall be provided with key operated opposed blade all extruded aluminum construction volume control damper in black anodized finish.

All supply and return air registers sizes and color shall be as per approved shop drawings.

### **15.0 Access Doors with Removable Door Frame :-**

Access door shall be installed in the duct wherever splitter damper, fire damper or supply air plenum is installed. Duct access doors and frame shall be fabricated from 22 gauge galvanized steel sheet and structure shall be designed to withstand high pressure differences. Frame for access door shall be provided with 3 mm thick neoprene gasket all around to avoid air leakage. Door panel shall be internally insulated with approved insulation material and thickness wherever required. Minimum size of the access door shall not be less than 200mm x 200mm. All access door shall be provided with 4 no zinc plated cam locks and chromium plated handle for easy removal and fixing.

### **16.0 Fresh Air Intake Louvers :**

- a. Fresh air intake louvers wherever required as per shop drawing will be made of extruded aluminum construction duly anodized or powder coated. Bird / insects screen will be provided with the intake louvers.
- b. The lowest louver of the assembly shall extended out slightly to facilities disposal of rainwater without falling on door / wall on which it is mounted.
- c. Wherever specified, the intake louvers & frame shall be provided with factory fitted all aluminum construction volume control dampers in black anodized finish.

### **17.0 Flexible Connections :**

All duct work connections to equipment such as indoor unit shall be with flexible connections, to prevent the transmittance of vibrations from the equipment through the ductwork system. Connections shall not exceed 200mm in length and shall be non porous insulated mould proof type double canvas. Connections shall be secured to make a suitable airtight seal with the ductwork and equipments.

### **18.0 Flexible Duct Works:**

#### **General :**

- a. **Flexible duct shall be used for Fresh air intake only. It shall be non-combustible, flexible metal duct, constructed of corrugated aluminum with water tight lock seams and shall be compressed lengths with one crimped end and one plain end.**
- b. Operating pressure: 6" w. g. pos./neg.
- c. Maximum velocity: 500 FPM.
- d. Temperature Range: -73 deg. C to 221 deg. C.

**19.0 Testing and Balancing :**

- a. After the installation of the entire air distribution system is completed in all respects, all ducts shall be tested for air leaks by visual inspection.
- b. The entire air distribution system shall be balanced using an approved anemometer. Measured air quantities at fan discharge and at various outlets shall be identical to or less than 5% in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these shall be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted for scrutiny and approval, and four copies of the approved air balancing report shall be forwarded with completion documents.

## **FIRE FIGHTING SYSTEM INCLUDING WATER PUMPS**

### **1 WATER SUPPLY PUMPS**

#### **1.1 WATER TRANSFER PUMPS**

Water transfer pumps shall be multistage, vertical stainless steel pumps, having stainless steel casing, stainless steel pump foot and diffusers, stainless impeller, stainless steel shaft, ceramic bearings, tungsten carbide shaft protection bushes and mechanical seal driven by 1.0 kw (Approx), 2900 RPM, 220 Volts, 50 Cycles, AC 3-phase TEFC vertical flange motor. Each pump shall be capable of operating with in a performance pressure characteristics range sufficient below and above the required working pressure.

Pumps and motors shall be mounted on a common MS structural base plate.

Each pump shall be provides with a totally enclosed fan cooled induction motor of H.P and R.P.M specified in schedule of quantities.

Each pumping set shall be provides with a Gun Metal “Bourden” type pressure gauge with gunmetal isolation cock and connecting piping.

Appropriate vibration eliminating pads shall be provides with each pump.

The pump set shall be provided with gunmetal gate valve of appropriate sizes on delivery. a non-return valve of appropriate size and a pressure gauge with cock shall be provided on the delivery line.

Suction and delivery lines of the pumps shall be provided with double flanged reinforced Neoprene flexible pipe connectors. Connectors shall be suitable for a working pressure of each pump as specified in Schedule of Quantities.

## **1.2 SUMP PUMPS**

Pumps shall be submersible type as indicated in data sheet.

Pump shall be integral with submersible motor on a common shaft. The pumps shall have 2900 rpm synchronous speed unless stated otherwise in the data sheets.

The pump set shall be installed in vertical position in sumps with level controller cum operated float switches.

Pump casings shall be aluminum and impellers of SS. All pumps shall have combination ball and roller bearings and shaft seals should be mechanical. Motor shall be submersible and shall be rated for minimum hp specified or the BHP absorbed in the operating range of the pump.

## **1.3 LEVEL CONTROLLER**

Contractor shall provide and install low voltage transistorised level controllers as specified in Schedule of Quantities. Each level controller shall be provided with required number of PVC sheathed stainless steel probes with necessary wiring and conducting.

## **1.4 WATER TRANSFER PUMPS**

To cut off water transfer pumps on low water level in water tank and high water level in overhead water tank and start sump on low water level in overhead water tank.

## **1.5 INSTALLATION AND TESTING**

All pumps shall be laid out generally in accordance with the shop drawings (submitted by contractor and approved by engineer-in-charge / consultant / architect) achieving economy of space and piping.



All pumps shall be tested for the rated performance in the presence of the employer's representative and got approved.

**1.6 Mode of measurement**

Measurement for pumps shall be in the units as per item description.

**1.7 CATALOGUES & MANUAL**

The Contractor shall furnish the operation & maintenance manual/ technical literatures in duplicate to engineer-in-charge.

**FIRE HYDRANT SYSTEM**

**2. Scope of work**

The scope of work shall cover supply, fabrication, installation, testing and commissioning of the fire hydrant system covering the following but not limited to:

Fire Hydrant pumps, electric and diesel driven as shown in the equipment schedule, drawings and as required.

Jockey pump, electric driven as shown in the equipment schedule, drawings and as required.

Engine Control Panel.

Hydrant mains, external ring and yard hydrants.

Wet risers in the building as specified and shown on drawings.

Landing valves, hose reels, hose cabinets etc.

Fire brigade breaching, siamese connections and connections to pumps and appliances.

The contractor shall get the Fire Fighting System approved by the Chief Fire Officer of Delhi Fire Service.

## **2.1 Standards**

The fire hydrant installation shall conform to and meet with the requirements set out by the following:

As relevant IS Code of practice for the safety of buildings (General) fire fighting equipment and its maintenance.

As relevant IS Code of practice for installation of internal fire hydrant in multi-storeyed building.

Compliance with the local fire brigade and the fire enforcing authorities as specifically laid down by them.

## **2.2 Fire pump**

The fire pump shall be single stage / double stage suction centrifugal type with split casing type and direct driven by electric motor or diesel engine as specified. The pump rating and performance shall conform to the equipment schedule and meet the TAC duty requirements.

Pump casing shall be of close grained cast iron with bronze impeller. The shaft sleeve shall be brass or SS 304 and the trim shall be brass or bronze.

Pump shall be capable of delivering 150% of the rated capacity at 65% of the rated head and the no-delivery head shall be not more than 140% (150% in case of end suction type) of the rated delivery head. The pump casing shall withstand 1.5 times the no-delivery pressure or 2 times of the duty pressure whichever is higher.

The pump shall be either electrically driven or diesel driven with direct flexible coupling.

The electric drive motor shall be squirrel cage induction conforming to IS 325 - 1978 and rated for continuous duty (S1). Motor shall have not less than class F insulation and minimum enclosure of IP22. The starter shall be air cooled fully automatic star delta or auto transformer type. Starters shall conform to IS 8544 and rated for AC-3 duty conditions.

Drive rating shall be based on the largest of the following:

- a) Rated pump discharge at rated head

- b) 150% of rated discharge @ 65% of rated head
- c) Maximum power absorbed by the pump in its operating range i.e. no-delivery to free discharge.

The diesel engine shall be naturally aspirated (non-turbocharged) and electrically started. The engine shall be complete with starting batteries full-wave selenium rectifier charger, isolator, leads, mounting frame etc. Engine rating shall be same as for the electric motor. The detailed specifications of the engine are at Clause no 6.0.

### **2.3 Accessories**

The Fire Pumps shall be complete with the following accessories:

- a) Suction and discharge eccentric reducers
- b) Pump coupling guard
- c) Common base frame, fabricated mild steel or cast iron.

Each pump shall have independent set of pressure switches. The pressure switch shall be snap action SP DT switch rated 10A @ 220 V operated through a stainless steel diaphragm. The switch shall have a pointer for manual adjustment of set point, and all electrical connections shall be terminated in a screwed terminal connector. The entire unit shall be encased in a cold drawn steel (heavy gauge) enclosure. The diaphragm shall be designed for a maximum operating pressure of the system. Each pressure switch shall be provided with a pressure gauge in parallel as shown on the drawings and all gauges and pressure switches shall be mounted in an instrument panel with necessary control piping and drainage facility.

### **2.4 System operation and control panels**

The fire pump shall be started automatically on loss of pressure and the operation sequence of the booster and fire pumps shall be as follows:

- a) Jockey Pump shall start when the system pressure drops by 0.35 kg/cm<sup>2</sup> and stop when the system pressure is re-established.
- b) The Fire Pump shall start when the system pressure drops by 1.0 kg/cm<sup>2</sup> and shall continue to run till manually switched off.

c) Jockey and fire pump starting shall be indicated on the panel with a red indication lamp.

The motor starters (direct on line or star-delta) shall consist of electrically actuated contactors. The starter shall be complete with ON-OFF push buttons, timers and auxiliary contacts and shall be fully automatic. There shall be an indicating lamp with each of the pumps and an ammeter and selector switch with the fire pumps. Fire pump starting shall be annunciated through an electric siren.

The starter along with isolator shall be housed in a 14 SWG MS box duly rust inhibited through a process of degreasing and phosphating.

All cabling to and from the pumps to starter and control switch shall be carried out through armoured PVC cables of approved makes. Cables shall be laid in accordance with section "M V CABLING". The pump motors and panels shall be double earthed in accordance with IS 3043-1966 or as shown on drawings and as approved.

## **2.5 Diesel Engine**

The diesel engine shall be of multi cylinder type four stroke cycle with mechanical (airless) Injection, cold starting type.

The engine shall be designed with regard to ease of maintenance, repair, cleaning and inspection. This will also provide interchangeability of parts.

All parts susceptible to temperature changes shall have tolerance for expansion and contraction without resulting in leakage, misalignment of parts or injury to parts.

The engine shall be capable of both automatic and manual start. Generally the engine shall start automatically, but in case of the auto-start system failure the engine shall be capable of manual start. Engine shall be able to start without any preliminary heating of combustion chamber; cranking mechanism shall also be provided. All controls / mechanisms which have to be operated in the starting process, shall be within easy reach of the operator. A day oil tank constructed

from minimum 1.6 mm thick sheet MS sheet of 200 litres capacity shall be provided as per Engine manufacturer's guide line.

A high torque D.C. motor charged by battery shall initiate automatic start of diesel engine. The battery shall hold adequate retainable charge to provide the starting of the diesel engine. Starting power will be supplied from storage batteries. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression. Battery shall be lead acid type of 12 V, 180 Ah capacity.

The battery banks shall be used for no other purpose other than starting of the engine and shall be fully charged at all times with provision for trickle & boost chargers. After start of the engine the charger shall be disconnected, the battery being fed from the engine dynamo.

The engine shall have a speed control device (Governor) which will control the speed under all conditions of load. The governor shall be suitable for operation without external power supply.

The Engine shall have an adjustable governor to regulate engine speed within a range of 10 % between shut-off and maximum load conditions of the pumps. The governor shall be set to maintain rated pump speed at maximum pump load.

The Governor shall have an over speed shutdown device to shutdown the engine at a speed approximately 20 % above rated engine speed with manual reset, so that the automatic engine controller will indicate an over speed signal until the device is manually reset to normal operating position.

The Diesel Engine shall be cooled by a Heat Exchanger and the Contractor shall be made arrangement for continuous supply of such water.

The engine shall be mounted on a base plate of fabricated steel construction. Adequate access shall be provided to the big end and main bearings, camshaft and governor drives, water jackets etc.

The engine shall have a base plate made from MS sections. There shall be reasonable space at the big end, camshaft, water jackets, governor drives and main bearings.

The engine shall be provides with intake and discharge ductwork, inlet filter and silencer, outlet muffler, expansion joints, dampers etc. as necessary for efficient operation. Intake air shall be taken from inside the building in which the engine is located, but the exhaust shall be discharged into the air.

The diesel engine shall be provides with adequate instrumentation. The gauges etc. as required are provides for in the Engine Panel.

## **2.6 Diesel Pump Panel:**

The Panel shall consist of the following:

Engine Starting System:

It shall be provided with a Lead Acid of minimum 180 Ah capacity to provide adeqaute throttle for starting.

Engine Instruments and Control Panel:

It shall be complete with required connections to set and comprising:

Inlet and out let water temperature gauge (dial type)

Lubrication oil pressure gauge.

Lubrication oil Temperature gauge.

Automatic Start Stop Device.

The Engine shall be provided with Manual Start / Stop Switch by means of Push Buttons.

Start Stop and Failure Control Device.

Start key for manual starting.

Stop Push Button for manual stopping of engine.

Starting failure indication by lamp and Horn Unit.

Engine temperature control with failure indication by red lamp.

Engine temperature very high indication by audio alarm and automatic stopping of engine.

Engine set in operation indication by green lamp.

Mains supply available indicated by yellow lamp.

Push Button for Audio Alarm reset.

Push Button Failure Indication by lamps.

The Panel shall also have an Auto / Manual / Test / Off Selector Switch.

## **2.7 Fire hydrants and hose reels**

Hydrants shall be provided internally and externally as shown on the drawings. Internal hydrants shall be provided at each landing of and escape staircase and additionally depending on the floor area as shown on drawings. Landing valve shall be single headed gunmetal valve with 63 mm dia outlets and 80mm inlet conforming to IS 5290-1969. Landing valve shall have flanged inlet and instantaneous type outlets and mounted at 1.0m above the floor level. Instantaneous outlets for the hydrants shall be of standard pattern approved and suitable for 63mm dia fire brigade hoses. Wherever necessary, pressure reducing orifices plate and shall be provided so as to limit the pressure to 3.5 kg/sqcm or any other rating as required by the Local Fire Authority.

Each landing valve shall have a hose reel cabinet as shown on drawings.

- a) Landing valve with single 63 mm dia outlet and 80 mm dia inlet.
- b) First-aid hose reel with 30 m long 25 mm dia high pressure double braided rubber hose ( IS:444 marked ) with 25 m dia Ball Valve.
- c) 2 Nos. 15.0 Meter long 63 mm dia Reinforced Rubber Lined (RRL) hoses with gun metal I.S. marked instantaneous couplings.
- d) One gun metal branch pipe.

The First Aid Hose shall conform to IS 884-1969 and be wound on a heavy duty circular hose reel with a bracket. The hose shall be permanently connected on one end to the Wet Riser through a 25m Ball Valve with necessary hose adapter and a gun metal nozzle at the other end.

Hoses shall be in two lengths of 15.0 m each, of RRL type with instantaneous couplings, neatly rolled into bundles and held in position with steel brackets. Hoses shall be tested and certified by the manufacturer, to withstand an internal water

pressure of not less than 35 kg/sqcm without bursting. The hose shall also withstand a working pressure of 7 kg/sqcm without leakage.

The hose cabinet shall be fabricated from 2mm mild steel sheet duly rust inhibited through a process of degreasing and phosphating. The cabinet shall have double flap hinged doors with 4mm clear glass and shall have necessary openings for riser main and brackets for all internals. The cabinet shall receive two coats of red oxide primer both inside and outside before two after coats of final paint of approved colour shade.

External hydrants shall be as per IS:5490 with hand wheel control and a 80 mm dia pipe stand post. Hydrants shall be located at least 2m away from and within 15m from the building wall.

Each hydrant shall be provided with a hose cabinet containing 2x15m 63 dia RRL hoses with couplings. The cabinet shall contain a branch pipe and nozzle. The cabinet shall be 900 x 600 x 400 fabricated out of 2 m mild steel sheet duly rust inhibited through a process of degreasing, phosphating etc. The cabinet shall receive two coats of red oxide primer, inside and outside, before 2 coats of final painting of approved shade. The cabinet shall be wall-mounted or free standing with its own steel legs depending on the site conditions and as shown on drawings and as approved.

The fire brigade connection shall consist of two / three/four headed as specified in BOQ 63mm dia gun metal outlets with built-in check valve and drain plugs connected to a 150mm dia outlet connection to the water reservoir or to the hydrant main. The fire brigade collecting head shall conform to IS 904-1965.

## **2.8 Test & commissioning**

The Jockey & fire pump starting and stopping shall be tested by opening the test valve and record the following and the valves should be as furnished below:

### **1) Jockey pump start/stop**

System pressure at start-up	:	4.5 kg/sqcm
System pressure at stop	:	5.6 kg/sqcm
Time elapsed from start to stop	:	2 Seconds



**2) Hydrant Pump start**

System pressure at start-up : 4.0 kg/sqcm

**3) Diesel Engine Pump start** : 3.0 Kg/sqcm

Maintained system pressure while discharging the landing valve at the highest point.

a) Pump end : 5.6 kg/sqcm

b) Highest outlet : 3.5 kg/sqcm

c) Intermediate points : 4.5 kg/sqcm

**2.8 Mode of measurement**

Hydrant pump with mounting frame, excluding concrete foundation shall be measured per unit.

Jockey pump same as hydrant pump.

Instrument panel with pressure gauges, pressure switches, control piping etc. shall be measured as one unit.

Control cabling from pressure gauge panel to the respective starters shall be measured in running meter and paid at unit rates.

**2.9 Piping**

External

All External pipes shall be, unless otherwise specified, heavy quality mild steel tubes to IS 1239 using wrought GI steel heavy duty screwed fittings. Flanges shall be provided to mate with valves and other equipment and shall conform to IS 6392. Flanges shall be screwed type. Flanges shall be rated for 2.0 N/sqmm.

Black mild steel pipes, when laid underground, shall be protected against corrosion by two coats of hot bitumen and 2mm thick wrapping of pypkote. Fittings shall be weld able wrought iron, suitable for butt welding and 10% of the welded joints shall be radio graphically tested and found in order. The welded joints shall be random selected for testing in consultation with the Engineer-in-charge. All flanges shall be

slip-on welded type to IS 6392 with a 3mm fibre-reinforced teflon gasket and rated for 2.0 N/sq. mm.

Underground mains shall be laid not less than 750 mm below the ground level and shall be at least 2m away from the building face and supported on concrete pedestals at every 3.5m and held on with galvanised iron clamps. Concrete thrust anchors shall be provided at all bends and tees as shown on drawing and as directed. All excavation for pipe laying shall be carried out with sufficient width for making proper joints. Backfilling shall be done only after the piping is hydro-statically pressure tested. Piping shall be constantly kept clean till tested.

All valves shall be housed in brick masonry chambers over 150mm cement concrete (1:3:6) foundation. The brick walls of the chamber shall be plastered inside and outside with 20mm cement sand plaster 1:4 with a floating coat of neat cement. Chambers shall be 650 x 650 mm clear for depths upto 1200 mm and 1000 x 1000 mm for depths beyond. Each chamber shall have a cast iron surface box approved by the Engineer in-charge.

Piping laid above ground shall be supported on cement concrete (1:2:4) pedestals raising the bottom of the pipe at least 150mm over the ground level and held to the pedestals with galvanised clamps. Pedestals shall be made at 3.0m centre to centre and as shown on drawings. Cement concrete 1:2:4 thrust anchors shall be provided at all tee-off points and change of direction as shown on drawings and as required. Pipes laid on walls and ceiling shall have galvanised steel brackets.

## **2.10 Internal**

All internal pipes shall be, unless otherwise specified, heavy quality mild steel tubes to IS 1239 using wrought steel heavy duty screwed fittings. Flanges shall be provided to mate with valves and other equipment and shall conform to IS 6392. Flanges shall be screwed type. Flanges shall be rated for 2.0 N/sqmm.

Valves shall be suitable for external piping.

All pipes shall be of approved make and best quality without rust marks. Pipes and fittings shall be fixed in a manner as to provide easy accessibility for repair,

maintenance and shall not cause obstruction in shafts, passages etc. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanship manner. Pipes shall be securely fixed to walls and ceilings by suitable supports at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceiling and walls.

All pipes shall be adequately supported from ceiling or walls through structural supports fabricated from mild steel structural e.g. rods, channels, angels and flats generally as shown on drawings. Fasteners shall be shear type anchor fasteners in concrete walls and ceilings and wrought steel spikes of at least 75mm long in brick walls. All pipes supports shall be painted with 1 coats of red oxide primer and two coats of black enamel paint.

All low point loops in the piping shall be provided with 25mm Ball Valves with rising spindle for draining the system. All valves shall have screwed brass caps. Likewise 25mm gun metal air vents shall be provided at all high point loops to prevent air-locking.

All piping shall have flanged joints at about 25m intervals to facilitate easy maintenance.

## **2.11 Pipe Jointing**

All pipes shall be provided with threaded joints up to 50mm diameter and welded joints for pipe above 50mm diameters. Hold tite shall be used for sealing.

All welded joints shall be tested by radiography test.

Joints between CI and GI pipes shall be made by providing a suitable flanged tail or socket piece and MS flange on the GI pipe. Flanges shall have appropriate number of holes and shall be fastened with nuts, bolts and 1.5mm thick compressed asbestos gasket.

## **2.12 Valves and other accessories**

### **Gate Valves**

Sluice / Gate valves shall be used for isolation of flow in pipe lines For sizes upto 65 mm, gate valves shall be outside screw rising spindle type and shall be as per IS: 778 Class-I and Class-II, as applicable. For sizes 80 mm to 300 mm, gate valve shall be as per IS: 780, PN=1.0 and shall be of inside screw and non rising type and cast iron double flanged.

Gate valves shall be provided with a hand wheel, draining arrangement of seat valve and locking facility (as required). Gate valves shall have back setting bush to facilitate gland renewal during full open condition.

The Body, bonnet, Stuffing Box, cap and hand wheel shall be of cast iron to IS:210/70, grade FG 200 / 260. The non rising spindle shall be of solid forged high tensile brass or carbon steel to AISI 304 construction. The Body seating and wedge ring shall be of solid leaded gun metal. The Bonnet gasket shall be of high quality rubber.

The Valve shall be PN 1.0 rated but shall withstand tests of upto  $20 \text{ kg / cm}^2$ . The ends shall be flanged. The batch number of the valve shall be punched on the top of the flange. The spindle shall be removable type, and shall be easily rotated.

## **2.13 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. It shall be suitable for line pressures upto  $15 \text{ kg / cm}^2$ . The scale range for cut in and cut out shall be from 0 to  $10 \text{ kg / cm}^2$ .

The Switch shall be suitable for consistent and repeated operations without change in values. It shall be provided with IP:66 water and environment protection.

The enclosure shall be of aluminium and pressure element and wetted parts shall be of stainless steel. The switch shall be snap acting type with 1 number N O / N C contact.

## **2.14 Air Vessel**

Air vessel shall be fabricated from 6 mm thick, 300mm x 1000mm MS plate suitable for  $7\text{kg/cm}^2$  working pressure complete with air release valve, safety valve, pressure gauge etc. as required. The air vessel shall be continuous welded construction and painted with two coats of Postal red enamel outside over a coat of primer and epoxy paint inside.

## **2.15 Pressure Vessel**

The Pressure Vessel shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter acting pressure surges whenever the pumping set comes into operation. It shall be normally partly full of water, the remaining being filled with air which will be under compression when the system is in normal operation.

Pressure vessel shall be fabricated from 8-10 mm thick MS plate with dished ends and suitable supporting legs. It shall be provided with a 50 mm dia flanged connections from pump, one 25 mm drain with ball valve, one water level gauge and 25 mm sockets for pressure switches. The pressure vessel shall be hydraulically tested as required.

The Pressure Vessel shall be for Hydrant Systems. The Pressure Switches shall be mounted on the drain end of each Vessel. The Vessel shall also be provided with an air release valve mounted at the top.

## **2.16 Pressure Gauge**

The Pressure Gauge shall be constructed of die cast aluminium and stove enameled. It shall be weather proof with an IP 55 enclosure. It shall be a stainless steel Bourden tube type Pressure Gauge with a scale range from 0 to  $16\text{ Kg / CM}^2$  and shall be constructed as per IS: 3624. Each Pressure Gauge shall have a siphon tube connection. The Shut off arrangement shall be by Ball Valve.

## **2.17 Ball Valve**

The Ball Valve shall be made from die cast brass and tested to 14 Kg/cm<sup>2</sup> pressure.

The valve shall be internally threaded to receive pipe connections.

The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body- bonnet gasket and gland packing shall be of Teflon.

The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm<sup>2</sup> pressure.

The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree. The lever shall be operated smoothly and without application of any unnecessary force.

## **2.18 Non Return Valve**

Non-return valves shall be cast iron spring action swing check type. An arrow mark in the direction of flow shall be marked on the body of the valve. The valve shall bear IS:531 certification.

The Valve shall be of cast iron body and cover. The internal flap in the direction of water shall be of cast iron and hinged by a hinge pin of high tensile brass or stainless steel. Cast iron parts shall be conform to IS:210 / 70, grade 200 / 260 type.

The gasket shall be of high quality rubber and flap seat ring of leaded gun metal to BS 1400 LG 2C. At high pressure of water flow the flapper shall seat tightly to the seat. The Valve shall be capable of handling pressure upto 15 kg / cm<sup>2</sup>.

## **2.19 Butterfly Valve**

The Butterfly Valve shall be suitable for waterworks and tested to minimum of 16 kg / sq cm pressure. The Valves shall fulfil the requirements of AWWA (American Water Works Association) C 504, API 609 and MSS-SP-67.

The body shall be of cast iron to IS:210 in circular shape and of high strength to take the minimum water pressure of 10 kg / cm<sup>2</sup>. The disc shall be heavy duty cast iron with anti corrosive epoxy or nickel coating.

The valve seat shall be of high grade elastomer or nitrile rubber. The Valve in closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be of EN 8 grade carbon steel.

The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakage.

The Valves shall be supplied with manual gear operated opening / closing system by lever.

## **2.20 Pipe supports**

All pipes whether horizontal or vertical shall be suitably supported using galvanized mild steel clamps/clevis hanger manufactured by M/s Hitech Support (India) Pvt Ltd or equivalent product of good quality as approved by engineer in-charge.

## **2.21 Vertical Pipes**

The pipes running vertical shaft shall be supported by galvanised mild steel rigid clamps fixed to wall with anchor bolts and studs.

When the horizontal distance between the centre line of two adjacent pipes is less than 300 mm a powder coated HITECH/or equivalent rail shall be fixed to wall the pipes independently clamped to the rail with 'U' bolt clamps.

## 2.22 Horizontal Pipes

Pipes running horizontal shall be supported from structural beam/slab by using appropriate galvanised m.s. pipe clevis hangers.

The spacing of supports shall be as follows:

<b>GI Pipes/MS Pipes</b>		<b>CI Spun Pipes</b>	
<b><u>Internal Dia</u></b> <b><u>(mm)</u></b>	<b><u>Spacing (mm)</u></b>	<b><u>Internal dia</u></b> <b><u>(mm)</u></b>	<b><u>Spacing (mm)</u></b>
15	1800	75-150	2700
20,25	2400	200-250	3000
32	2700	300	3600
40-50	3000		
65-80	3600		
100	4000		
150	4500		

Supports for horizontal piping longer than 15m in a stretch shall be provided with swivel clamps. Otherwise, the clamps shall be universal clamps or rigid clamps as required by the project engineer.

Fixing of clamps/rails etc.

All clamps, rails and accessories shall be fixed to the structure (beam, slab, walls etc.) by using approved good quality anchor fasteners of appropriate size.



## 2.23 Painting

All exposed piping for fire fighting shall be distinctly painted 'Fire red' shade 536 to IS:5-1978. Pipes shall first receive two coats of red oxide primer uniformly applied and two coats of oil paint applied thereafter. All pipes supports shall be painted black as specified for support & clamps.

## 2.24 Painting Schedule

All equipment and piping shall be painted in accordance with the following colour code:

Equipment	Colour	Distinguishing Mark
a) Pump motors	Fire Red Shade	No.536 to IS: 5 -1978
b) Internal piping	"	
c) Landing valves & Hose reel cabinets	"	
d) External Hydrants	"	
e) Fire brigade connection	"	
f) Priming tank	"	
g) Air vessel	"	
h) Electric panels	Black & Red	
i) Fire Alarm Panel	Black & Red	
j) Repeater panel	Black & Red	
k) Break Glass Unit	Fire Red	

l) Hooters/Speakers                      Fire Red

m) Sprinkler pipes                      Fire Red

All surfaces to be painted shall be thoroughly cleaned with wire brush to remove completely rust and other extraneous substances. Over the cleaned surfaces one coat of red oxide primer shall be applied completely covering the exposed surfaces. Finishing coat of enamel paint shall be applied one day after the prime coat, after ensuring that the paint is dry. The second coat shall be done before the installation is handed over and after approval to do so from the Engineer-in-charge.

### **2.25      Testing & commissioning**

All piping after installation shall be tested for a hydrostatic test pressure of 10.5 kg/sqcm or 1.5 times the working pressure (whichever is less) maintained for 24 hours. All joints and valves shall be checked for leaks and rectified and retested. During testing all valves except drain & air valves shall be kept fully open.

### **2.26      Makes of materials**

For makes of materials refer to list of approved makes of material.

### **2.27      Mode of measurement**

All external piping shall be measured along the centre line of the pipe and paid per unit length and shall include:

All pipes & fittings

Bituminous coating

All internal piping shall be measured similarly but shall include for the pipe supports and clamps.

All valves, air valves, drain valves together with flanges or tail pieces shall be measured per unit.

All excavation and concrete supports and thrust blocks shall be measured as per drawing and paid for per cum.

The cost of pipe supports described above form part of the rate quoted for piping and no extra shall be payable on the account.

**All painting shall form part of the cost of equipment piping etc. No separate payment shall be admissible.**

## **SPRINKLER SYSTEM**

### **3.0 Pendant type Sprinkler Head**

Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly, yoke and the deflector. The sprinkler shall be of approved make and type with 15 mm nominal dia outlets.

The bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches at 68° C .

The nominal bore shall be 15 mm dia and colour of liquid shall be Red / Yellow.

The Sprinkler head shall be approved by UL / FM.

### **3.1 Upright type Sprinkler Head**

Upright sprinkler heads shall be similar to Pendent type in material construction and performance but designed to throw water Droplets upwards in umbrella fashion, to cool the underside of ceiling and extinguish any fire involving combustibles on the floor below.

The Sprinkler head shall be approved by UL / FM. The nominal bore shall be 15 mm dia and the colour of liquid shall be red.

Upright Sprinkler heads shall be use in lower and upper basement parking areas and above the false ceiling.

### **3.2 Side Wall type Sprinkler Head**

Side wall sprinkler heads shall be similar to Pendent type in material construction and performance but designed to throw water Droplets horizontally.

The Sprinkler head shall be approved by UL / FM. The nominal bore shall be 15 mm diameter and the colour of liquid shall be red.

Side wall sprinkler heads shall be use in staircase landing and along the ramp.

### **3.3 Powder coated Sprinkler with Powder coated Twin plate Rosette.**

Most areas below false ceiling shall be provided with powder coated pendant sprinkler with twin plate sliding rosette. The sprinkler head shall be same as Pendent type above but powder coated white. The sprinkler head shall be provided with a double plate powder coated rosette that shall seal the gap between the false ceiling and he sprinkler head.

The adjustment allowable shall be 12 mm. The lower part shall have flared ends that shall fit tightly into the upper piece.

The Sprinkler head shall be approved by UL / FM. The nominal bore shall be 15 mm diameter and the colour of liquid shall be red.

### **3.4 Installation Control Valve for Sprinkler**

The Installation Control Valve shall be double seated clapper type check valve. The Body and cover shall be made from Cast Iron to IS:210 Grade FG 200. The seat and seat clamp shall be made from bronze to IS: 318, LTB II grade. The sealing to the seat shall be neoprene gasket. The hinges pin and ball shall be from stainless steel.

It shall be vertically mounted and the direction of water travel shall be indicated on the surface. It shall be rated to 12 Kg / cm<sup>2</sup> and tested to 25 Kg / cm<sup>2</sup> pressure.

A By-pass check valve shall be fitted to adjust minor and slow variations in water pressure for balancing so as to avoid any false alarm.

The valve shall also be provided with a Test Control Box. The Box shall house a lever to test and operate the ICV. A brass strainer shall also be provided at the point of water supply to the Alarm gong. A Retarding Chamber shall also be provided. The Chamber shall be able to balance the water pressure in case of water line surges.

Each Installation Control Valve shall have two sets of Pressure Gauges with brass ball valve type shut off.

A Water Motor Alarm. shall also be provided. This shall be mechanically operated by discharge of water through an impeller. The drive bearing shall be weather resistant. A strainer shall be provided on line before the nozzle. The Gong piece shall be constructed from bronze to IS 318, 2 TB II Grade, and base of cast iron. The Motor Housing, Rotor and Housing Cover shall be pressure die cast aluminium.

### **3.5 Flow Switch**

Flow switch shall have a paddle made of flexible material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle / pipe through a connecting socket. The Switch shall be potential free in either N O or N C position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The seat shall be of stainless steel. The Flow Switch shall have IP:55 protection.

The Flow Switch shall work at a minimum flow rate of 100 LPM. Further, it shall have a 'Retard' to compensate for line leakage or intermittent flows.

## **PORTABLE FIRE EXTINGUISHERS & EXIT SIGNAGES**

### **4.0 Scope**

The scope of work covers the supply and installation of portable fire extinguishers. The following types are envisaged in these specifications and provided as shown in the schedule of portable fire extinguishers.

Dry powder extinguisher

Carbon-dioxide extinguisher

Mono ammonia phosphate extinguisher

Water expelling type.

### **4.1 Standards**

The following standards and rules and regulations shall be applicable:

Fire protection manual of the tariff advisory committee, Fire Insurance Association of India

IS:2176 :Portable fire extinguisher Dry power type

IS:2878 :Portable fire extinguisher carbon-dioxide type

Local Fire Brigade/Authority

All standards mean the latest.

### **4.2 Extinguishers**

Dry powder type

The extinguishers shall be 2, 5, 10 kg capacity and cartridge type unless specified otherwise.

The body shall be of cold rolled carbon steel grade D and 1.5mm thick upto 5 kg and 2mm for 10 kg. The construction shall be similar to 'Soda Acid type' but of the following dimensions.

<b>Capacity (kg)</b>	<b>Outside dia (mm)</b>	<b>Filler opening (mm)</b>
2.00	100	45
5.00	150	45
10.00	175	45

The discharge fitting shall be with 500mm 10mm dia hose upto 5 kg and 750 mm 12.5 mm dia for 10 kg with a trigger controlled nozzle capable of discharging 85% of the contents as follows:

<b>Capacity (kg)</b>	<b>Time (sec)</b>	<b>Throw (m)</b>
2.00	8 - 10	2
5.00	15 - 20	4
10.00	23 - 30	6

A carbon dioxide cartridge conforming to IS:4947 shall be fitted in a cartridge holder with an inner shell. A spring loaded piercing device shall be provided in the cap for piercing the seal of the gas cartridge. A syphon tube of copper or PVC shall be provided for upright operation. The cap and neck ring shall be similar to Soda Acid type extinguisher.

All internal and external components and surfaces shall receive anti-corrosive coating of not less than 12 microns shall be applied uniformly as indicated below:

a) Body	Mild steel	Tin alloy
b) Cage for acid	Brass sheets	Lead or tin alloy bottle and spring
c) Discharge fittings	Leaded - Tin	Tin alloy



Bronze

d) Strainer                      Brass sheets                      Lead or Tin alloy

### 4.3 Carbon dioxide type

The extinguishers shall be rated for 2.0 and 4.5 kg by weight or carbon dioxide, unless stated otherwise. The contents shall be with a filling ratio not exceeding 0.667.

The body shall be steel cylinder made according to IS:2872 and approved by the chief controller of explosives.

The discharge head shall be simple and safe to operate conforming to IS:3224 with a safety release to IS:5903 set to 18.0 to 20.0 N/sqmm. A syphon tube of copper or PVC shall be fitted. A non-conducting discharge horn and a high pressure hose (27.5 N/sqmm pressure) shall be fitted with each extinguisher.

The discharge system shall be designed to expel 95% of the contents in continuous discharge as follows:

Capacity (kg)	Time (Sec.)
2.0	8 - 18
3.0	10 - 20
4.5	10 – 24

### 4.4 Mono ammonium phosphate type

The capacities envisaged are 2 kg & 5 kg. The filling pressure shall be 0.95 +/- 0.055 N/sqmm.

The body shall be cylindrical in shape and made of cold rolled carbon steel grade D/DD or hot rolled steel plate with radiographically tested welded construction. Plate thickness shall conform to IS:11108.

Discharge valve mechanism shall be a simple and safe squeeze grip valve. 4.5 kg and above capacity shall have a high pressure (0.5 N/sqmm) hose and non-conducting horn and shall also be provided with a pressure gauge. 95% of the contents shall be discharged as follows:

<b>Capacity (kg)</b>	<b>Time (sec)</b>	<b>Throw (m)</b>
2.00	8 - 16	2
5.00	15 - 24	4

The internal and external components and surface shall be treated for anti-corrosion as for dry powder type extinguishers.

#### **4.5 Water CO2 Fire Extinguisher**

The extinguishing medium shall be primarily water stored under normal pressure, the discharge being effected by release of carbon dioxide gas from a 60 gms cylinder.

The capacity of the cylinder when filled shall be 9 litres +/- 5 %.

The cylinder shall be fabricated from MS sheet, welded at seams, with dish and dome, being of same thickness and of size not exceeding the diameter of the body. The neck shall be externally threaded with leaded tin bronze.

The cap shall be of leaded tin bronze. The siphon tube shall be of brass or GI. The cartridge holder, knob, discharge fittings and plunger shall be of leaded tin bronze and plunger of stainless steel with spring also of stainless steel. The discharge tube shall be of braided nylon, of 10 mm dia and 600 mm length with a brass nozzle.

The extinguisher shall be treated for anti corrosion internally and externally and painted fire red externally. The cartridge shall be IS marked. The Extinguisher body shall be tested to 25 bar pressure for 2 minutes. The Extinguisher shall be IS:940 marked

#### **4.6 Illumination signs/EXIT signage**

The illuminated signs shall have the letters "FIRE EXIT" or "NO FIRE EXIT" painted in red on a 6mm thick white perspex sheet as the front face of a sheet steel enclosure constructed with minimum 1.5mm thick sheet. The MS box shall be powder coated finished in white colour. The Perspex sheet shall be back lit with a rechargeable maintenance free sealed battery integral with a battery charging circuit. The battery back up facility shall operate independent of the mains supply in the event of a mains failure. The batteries shall be of adequate rating so as to support the illumination of the signage for a minimum period of 1 hour without mains power. The preferred dimensions of the illuminated signs shall be 450 mm length and 225mm height with 100 mm high lettering. They shall be suitable for surface or recessed mounting or ceiling hung type as required including all arrangements for suspension, cutting/chasing and making good the defects etc. complete as approved.

#### **4.7 Mode of measurement**

Each extinguisher with its mounting bracket shall be measured per unit and paid for.

## **ELECTRICAL WORK**

### **5.0 Scope**

The scope of this section comprises of fabrication, supply, erection, testing and commissioning of electric panels, wiring and earthing of all equipment components and accessories, including supply, installation and wiring of remote mounted push button stations.

All the electrical cables, termination, wires and accessories are also including in the Scope of Work. The main cable from the main distribution board will be supplied and erected by other Agency.

### **5.1 General**

Work shall be carried out in accordance with the specifications of CPWD specifications, Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date.

### **5.2 Construction Features**

The control panel shall be metal enclosed sheet steel cubical, indoor type, floor mounting/wall mounting type as per BS 5486 Part 1, 190 & IEC 439-1. The control panel shall be totally enclosed, completely dust and vermin proof, Gaskets between all adjacent units and beneath, covers shall be provided to render the joints dust proof. Control panels shall be arranged in multitier formations. All doors and covers shall also have sealing & pad locking arrangement. All mild steel sheets used in the construction of control panels shall be minimum 2mm. thick or as specified and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all slag grounded off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into

an adequate thickness of metal provided with hank nuts. Self threading screws shall not be used in the construction of control panels. Base channel shall be of 75mm x 40mm x 5mm thick shall be provided at the bottom. Minimum clear space of 250 mm between top of channel of control panel and bottom most unit shall be provided.

The control panels shall be of adequate size with a provision of 10% spare space to accommodate possible future additional switchgear. Knockout holes of appropriate size and number of cables shall be provided in the control panels in conformity with the location of incoming and outgoing conduits/cables. All equipment such as meters and indicating lamps, etc shall be located adjacent to the unit with which it is associated and care shall be taken to achieve a neat and symmetrical arrangement. Facility shall be provided for termination of cables from both above and below the control panel. Where cables enter below, cables boxes shall be fitted at the rear and arranged in tiers to facilitate making connections to the upper and lower units. Clamps shall be provided to support the weight of the cables. All incoming and outgoing feeders shall be brought out to a terminal block of adequate size at suitable location inside the control panel. All wiring inside the control panel shall be colour coded and labeled with approved plastic beads for identification. Circuit diagrams showing the arrangement of circuits shall be pasted on the inside of the panel door and covered with transparent plastic sheet and all labeling shall be provided on the front face of the panel board.

### **5.3 Circuit Compartments**

Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker in the 'ON' position. Safety interlocks shall be provided to prevent the breaker or Contactor from being drawn out when the breaker is in the draw out position of the panel. Instruments and indicating lamps shall not be mounted on the panel compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.

#### **5.4 Instrument Accommodation**

Separate and adequate compartments shall be provided to accommodate instruments, indicating lamps, control contactors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accident contact with live parts of the circuit breaker and bus bar.

#### **5.5 Bus Bars and Bus bar Connection**

The bus bar and interconnections shall be of aluminum and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bars and shall be extensible on either side. The bars and interconnections shall be insulated with PVC heat shrinkable sleeve and colour coded. All bus bars shall be supported on unbreakable, non-hygroscopic insulated SMC/DMC type supports at regular intervals not more than 400 mm, to withstand the forces arising in case of short circuit in the system. Bus bars shall be provided in separate chamber of main control panels shall be connected by clamping, no holes shall be drilled in bus bars. If holes have to be drilled for making connections, extra cross section of bus bars shall be provided.

All bus bar connections in smaller control panels shall be done by drilling hole and connecting by brass bolts and nuts. Additional cross section of bus bars shall be provided in small control panels to cover up the holes drilled in the bus bars.

All connections between the bus bar and breaker and between breaker and contactor shall be through copper strips of proper size to carry full rated current and shall be insulated with coloured PVC heat shrinkable sleeve.

#### **5.6 Terminals**

The outgoing terminals and neutral links shall be brought out to a terminal block suitably located in the control panels. The current transformer for instruments,

metering and for protection shall be mounted on the terminal blocks. Separate cable compartment shall be provided for incoming and outgoing cables.

## **5.7 Wire ways**

A horizontal wire way screwed covers shall be provided at the top to take in the connecting control wiring of different vertical sections.

## **5.8 Cable Compartments**

Cable compartments/alley of adequate size shall be provided in the control panels for easy termination of all incoming and outgoing cables entering from bottom or top using detachable gland plates with proper knockouts. Adequate and proper DMC supports shall be provided in cable compartments to support cables. All incoming and outgoing terminals shall be brought out on terminal blocks in the cable compartment.

## **5.9 Materials**

### **5.9.1 Rotary Switches**

Switches up to 60 amps shall be rotary type with compact and robust construction, built up from one or more stacks with contacts and a positioning mechanism, with stop as required. The terminals shall be shrouded with insulation to prevent accidental contact with live parts. Rotary switches shall be backed up with moulded type HRC fuse fittings of appropriate rating.

### **5.9.2 Selector Switch**

When called for, selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

### **5.9.3 Moulded Case Circuit Breakers (MCCB)**

MCCBs shall be quick make, quick break, and preferably double break contact system, arc extinguishing device, independent manual type with trip free feature with mechanical ON, OFF, and TRIP indications as called for in BOQ. A trip button shall be provided for tripping the breaker.

MCCB shall be a compact high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload adjustment

### **5.9.4 Switches**

Switches beyond 60 amps shall be panel mounted double break type and suitable for load break duty, quick make and break action. Switch contacts shall be silver plated and shall be back-up with HRC fuses of appropriate rating. The switch handles shall be located at the front.

### **5.9.5 HRC Fuses**

Fuses shall be high Rupturing capacity of not less than 20 MVA at 415 volts. The back up fuse rating of each motor/heater/equipment shall be so chosen that the fuse does not operate on starting of motor/heater/equipment. Fuses shall be of the same make as the switches.

### **5.9.6 Starters**

Each motor shall be provided with a starter of suitable rating. Direct on line starters shall be provided for motors up to 10 HP.

Operating coils of contactors shall be suit able for 220/415 +/- 10% volts AC, 50 cycles supply system. The contactor shall drip out when voltage drops to 90% of the rated voltage.



### **5.9.7 Over Load Relays**

Contactors shall be provided with a three element, positive acting ambient temperature compensated time lagged hand-reset type thermal over load relay with adjustable setting.

### **5.9.8 Current Transformers**

Current Transformer shall be of accuracy class - I and suitable VA burden for operation for the connected meters and relays.

### **5.9.10 Single Phase Preventor**

Single phase preventor shall be provided for all the starters. Single phase preventor shall act when the supply voltage drops down to 90% of the rated voltage or on failure of one or more phases.

### **5.9.11 Indicating Lamp and Metering**

The meters shall be flush mounted and draw-out type. The indicating lamp shall be neon type and of low burden. Each phase indicating lamp shall be backed up with 2 amps fuse.

### **5.9.12 Push Button Stations**

Push button station shall be for manual starting and stopping of motors/equipment as called for. Red and Green colour push buttons shall be provided for starting and stopping operations. Push buttons shall be suitable for panel mounting and accessible from front without opening door.

### **5.9.13 Cables**

M.V. cables shall be PVC insulated aluminium conductor armoured cables suitable for laying in trenches, duct, and on cable trays as required.

### **5.9.14 Wires**

650/1100 volts grade PVC insulated copper conductor wires in conduit shall be used.

### **5.10 Cable Laying**

Easy access to all cables shall be provided to allow cable withdrawal/replacement in the future. Where more than one cable is running, proper spacing shall be provided to minimize the loss in current carrying capacity with necessary saddling/clamps.

### **5.11 Earthing**

The earthing of MCC and equipment shall be as per BIS Specification and considered in the main electrical panel. The loop earthing shall be carried out with G.I/Copper Strips/wires.

### **5.12 Painting for Panel**

All sheet steel work shall under go a process of seven tank treatment and painting with powder coating paint of approved shade.

### **5.13 CABLE WORK**

This section covers detailed requirements for supply, laying, testing and commissioning of cables.

#### **5.14 GENERAL**

MV cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

#### **5.15 MATERIAL**

The MV power cable of 660/1100 V. grade shall be PVC insulated Aluminium conductor armored cable conforming to IS : 1554 ( part - I ). MV cable shall be 3.5/4 core of size and type as specified.

The MV control cables shall be PVC insulated copper conductor armoured cable.

#### **5.16 STORAGE AND HANDLING**

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

Cable drums shall be stored on a well drained, hard surface, preferably of concrete, so that the drums do not sink in the ground causing rot and damage to the cable drums.

During storage periodical rolling of drums once in 3 months through 90° shall be done. Rolling shall be done in the direction of the arrow marked on the drum.

It should be ensured that both ends of the cable are properly sealed to prevent ingress/absorption of moisture by the insulation.

Protection from rain and sun shall be ensured. Sufficient ventilation between cable drums, should be ensured during storage.

The drums shall always be rested on the flanges and not on the flat sides.

Damaged battens of drums etc. should be replaced, if necessary.

When cable drums have to be moved over short distances, they should be rolled in the direction of the arrow, marked on the drum.

For transportation over long distances, the drum should be mounted on cable drum wheels strong enough to carry the weight of the drum and pulled by means of ropes. Alternatively, they may be mounted on a trailer or on a suitable mechanical transport.

When unloading cable drums from vehicles, a crane shall preferably be used. Otherwise the drum shall be rolled down carefully on a suitable ramp or rails, where necessary.

While transferring cable from one drum to another, the barrel of the new drum shall have a diameter not less than that of the original drum.

The cables shall not be bent sharp to a small radius. The minimum safe bending radius for all types of PVC cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable, larger radius should be adopted. At joints and terminations, the bending radius of individual cores of a multi core cable shall not be less than 15 times its overall diameter.

Cable with kinks and straightened kinks or with similar apparent defects like defective armouring etc. shall be rejected.

Cables from the stores shall be supplied by the contractor as per the site requirement in pieces cut in the stores.

## **5.17 INSTALLATION**

### **5.18 GENERAL**

The cable installation including necessary joints shall be carried out in accordance with the specifications given herein. For details not covered in these specifications, I.S.:1255 shall be followed. No straight through joint shall be permitted in the system. The cables shall be supplied as per cable schedule submitted by the contractor & approved by Engineer-in-Charge.

### **5.19 ROUTE**

Before the cable laying work is undertaken, the route of the cable shall be decided by the Architect in consultation with Owner representative.

While shortest practicable route shall be preferred, cable runs shall generally follow fixed developments such as roads, foot-paths etc. with proper offsets so that future maintenance, identification etc. are rendered easy. Cross country run to shorten the route length is not desirable as it would lead to route identification and maintenance problems, besides posing difficulties during later development of open areas etc.

While selecting cable routes, corrosive soils, ground surrounding sewage and effluent etc. shall be avoided. Where this is not feasible, special precautions as approved by the Architect shall be taken.

As far as possible, the alignment of the cable route shall be decided taking into consideration the present and future requirements of other agencies and utility services affected by it, the existence of any cable in the vicinity as may be indicated by cable markers or cable schedules or drawing maintained for that area, possibilities of widening of roads/lanes, storm water drains etc. Cable routes shall be planned away from the drains and should be within the property.

Whenever cables are laid along well demarcated or established roads, the MV cables shall be laid further from the kerb line than HV cables.

Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted, MV cables shall be laid above HV cables.

Where cables cross one another the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

## **5.20 WAY LEAVE**

It may be necessary to obtain way leave for the cable route from the appropriate authorities some of whom are listed below :

Drainage, Public Health and Water Works.

Telephones and Telegraphs.

Gas works.

Other Undertakings.

Owners of properties.

Where necessary, joint inspection with representatives of other authorities may be arranged so that mutual interests are safeguarded. In case of private property, Section 12/51 of the Indian Electricity Act shall be complied with.

## **5.21 PROXIMITY TO COMMUNICATION CABLES**

Power and communication cables shall as far possible cross at right angles. Where power cables are laid in proximity communication cables the horizontal and vertical clearances shall not normally be less than 60 cms.

## **5.22 LAYING METHODS**

Cables shall be laid direct in ground or in pipes/closed ducts, in open ducts or on cable trays suspended from slab depending on site conditions.

### **5.23 Laying in Pipes/Closed ducts :**

In location such as road crossing, entry to building, on poles, in paved areas etc. cables shall be laid in pipes or closed ducts.

GI or Hume Pipes (spun reinforced concrete pipes) shall be used for such purposes. In the case of new construction, pipes as required shall be laid along with the Civil works and jointed according to the instructions of the Engineer-in-Charge as the case may be. The size of pipe shall be as indicated in the electrical drawings. GI pipe shall be laid directly in ground without any special bed. Hume pipe (Spun reinforced concrete pipe ) shall be laid over 10 cm. thick cement concrete 1:5:10 (1 cement :5 coarse sand : 10 graded stone aggregate of 40mm nominal size) bed, after which it shall be completely embedded in concrete. No sand cushioning or tiles need be used in such situations. Unless otherwise specified, the top surface of pipes shall be at a minimum depth of 1mtr. from the ground level when laid under roads, pavement etc.

Where steel pipes are employed for protection of single core cables feeding AC load, the pipe should be large enough to contain both cables in the case of single phase system and all cables in the case of polyphase system.

The pipes on road crossing shall preferably be on the skew to reduce the angle of bends as the cable enters and leaves the crossings. This is particularly important for high voltage cables.

Manholes of adequate size as decided by the Engineer-in-Charge shall be provided to facilitate feeding/drawing in of cables and to provide working space for persons. They shall be covered by suitable manhole covers with frame of proper design. The construction of manholes and providing the cover is not in the scope of this Contract and shall be got executed and paid for by the Engineer-in-Charge through another agency.

Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothed to prevent injury to cable insulation or sheathing.

Pipes for cable entries to the building shall slope downwards from the building and suitably sealed to prevent entry of water inside the building. Further the mouth of the pipes at the building end shall be suitably sealed to avoid entry of water. This seal in addition to being waterproof shall also be fireproof.

All chases and passages necessary for laying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Engineer-in-Charge.

Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes/closed ducts etc.

## **5.24 Laying on Cable Trays**

Cables, where indicated in approved shop drawings, shall be laid on overhead cable trays which are suspended from ceiling or supported from wall, by anchor fasteners as required.



The Contractor shall provided for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, trifoil clamps and structural steel members (comprising of channels, angles, flats, rods) to be fabricated at site for structural supports for cable trays racks etc.

### **5.25 Termination**

Brass single compression glands shall be provided for MV cables termination

### **5.26 Testing**

All 650/1100 Volt grade cables before laying shall be tested with a 500 V megger or with a 2,500/5,000 V megger for cables of higher voltages. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armour and insulation resistance between conductors.

All cables shall be subject to above mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.

### **5.27 Cable Trays**

Prefabricated Cable trays of ladder type and associated accessories, tees, bends, elbows & reducers shall be fabricated from 12 gauge (2.6 mm thick) mild steel. Perforated cable trays and associated accessories tees, elbows, and reducers shall be fabricated from 14 guage (2 mm thick) MS steel.

Cable trays and accessories and covers shall be painted with one shop coat of red oxide zinc chromate primer and two coats of Aluminium alkyd paint.

The Contractor shall provide for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, trifoil clamps and structural steel

members (comprising of channels, angles, flats, rods) to be fabricated at site for structural supports for cable trays racks etc.

## **5.28 EARTHING**

This section covers detailed requirements for earthing.

## **5.29 GENERAL**

The non-current carrying metal parts of electrical installation shall be earthed properly. All metallic structure, enclosures, junction boxes, outlet boxes, cabinets, machine frame, portable equipments, metal conduits, trunking, cable armour, switchgear, distribution boards, lighting fittings and all other parts made of metal in close proximity with electrical circuits shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing will be in conformity with the relevant Indian Electricity Rules 1956 and Indian Standard Specification IS : 3043. Every item of equipment served by the electrical system shall be bonded to earthing system.

Every switch, lighting fixture and 5 Amp outlets shall be provided with insulated copper conductor of 1.5 sq. mm for earthing. The computer workstations shall be earthed with 2.5 sq.mm.insulated copper conductor wire.

Separate copper earth pits shall be provided for UPS, EPABX & Networking equipment.

The raceways shall not be used as a grounding conductor.

## **5.30 Connection Of Earthing Conductors**

Main earthing conductor shall be taken from the earth connections at the PDB to the earthing pit. 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 armouring shall be earthed at the ends adjacent to switch boards 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 equipment shall be earthed with 2 no. G.I. strips/wires and non current carrying metallic parts with, 1 no. G.I. strips/wires.

Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, metallic enclosures 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 earthing system. The Electrical resistance of metallic enclosures for cables and conductors measured between earth connections at the main switch boards and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate circuit breakers and shall not exceed 1 OHM.

### **5.31 Earth Connections**

All metal clad switches and other equipment carrying single phase circuit, shall be connected to earth by a single connection. All metal clad switches carrying 3 phase shall be connected with earth by two separate and distinct connections. The earthing conductor inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size. The earthing conductor shall be painted to protect it against corrosion. Earthing conductor outside the building shall be laid 600 mm below finished ground level. The over lapping in **G.I.** strips in joints shall be welded. Lugs of adequate capacity and size shall be used for all termination of conductor wires. Lugs shall be bolted to the equipment body to be earthed after the metal is cleaned of paint and other oily substance and properly tinned.

### **5.32 Protection From Corrosion**

Connection between copper and galvanised equipment shall be made on vertical face and protected with paint and grease. Galvanised fixing clamps shall not be used for fixing earth conductors. Only copper fixing clamp 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.

### **5.33 EARTHING STATION**

#### **5.34 PLATE ELECTRODE EARTHING**

Earthing electrode shall consist of a Copper plate of 600 mm X 600 mm X 3 mm or G.I. plate of 600mm x 600mm x 6.3 mm as called for in the Schedule of Quantity. 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 electrode shall be located as near the water tap, water drain or a down take pipe as possible. Earth electrode shall be kept clear of the building foundations and in no case shall it be nearer than 2 meters from the outer surface of the wall.

The earth plate shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. A 20 mm dia 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 funnel and a mesh for watering the earth through the pipe. The funnel over the GI pipe shall be housed in a masonry chamber approximately 300 mm x 300 mm x 300 mm deep. The masonry chamber shall be provided with a cast iron cover resting over a CI frame. Test facility shall be provided with test links for the earthing station.

### **5.35 Pipe Electrode Earthing**

Earthing Electrode shall consist of G.I. medium class. 40 mm dia 4.5 m long pipe (without any joint) G.I. pipe Electrode shall be cut, tapered at the bottom and provided with holes of 12 mm dia drilled not, less than 7.5 cm from each other upto 2 M of length from the bottom. Pipe electrode shall be buried in the ground vertically with its top at not less than 200 mm below the ground level. When more than one pipe is to be installed a separation of not less than 2 M shall be maintained between two adjacent electrodes as called for in the drawings. Wherever possible, earth electrode shall be located as near the water tap, water drain or a down take pipe as possible. Earth electrode shall be kept clear of the building foundations and in no case shall it be nearer than 2 meters from the outer surface of the walls. The pipe electrode shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. A 40 mm x 20 mm reducer shall be used for fixing of funnel with mesh. The funnel and mesh have been provided for watering the earth through the pipe. The funnel over the G.I. Pipe shall be housed in a masonry chamber 300mm x 300mm x 300mm. deep. The masonry chamber shall be provided with a cast iron cover resting over a CI frame. The breaked earth pit will be provided with test links in suitable enclosures.

### **5.36 Resistance To Earth**

The resistance to each earthing system shall not exceed 1.0 ohm.

## **SPECIFICATIONS FOR BUILDING MANAGEMENT SYSTEM**

### **GENERAL**

#### **SUMMARY**

Furnish all labor, materials, equipment, and service necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.

All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Client MCD.

Client MCD shall be the named license holder of all software associated with any and all incremental work on the project(s).

#### **SYSTEM DESCRIPTION**

The entire Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark/LonTalk communication protocols to a Network Area Controller (NAC) / Router. Building Management System products shall be manufactured as per LonWorks products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal.

The Building Management System (BMS) shall be comprised of Network Area Controller or Controllers (NAC) / Routers. The NAC / Router shall connect to the local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to LonMark/LonTalk and/or BACnet Direct Digital Controllers (DDC) and other open protocol systems/devices.

#### **SUBMITTAL**

Eight copies of shop drawings of the components and devices for the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package. BMS contractors supplying products and systems, as part of their packages shall provide

catalog data sheets, wiring diagrams and point lists to other contractors for proper coordination of work.

Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol. BMS contractors shall provide these diagrams for their portions of work; the Systems Integrator shall be responsible for integrating those diagrams into the overall trunk cable schematic diagrams for the entire Wide Area Network (WAN).

Submittal shall also include a complete point list of all points to be connected to the BMS..

Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ compatible files. Eight copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk. BMS contractors shall provide as-built for their portions of work. The BMS contractor shall be responsible for as-built pertaining to overall BMS architecture and network diagrams. All as-built drawings shall also be installed into the BMS server in a dedicated directory.

## **SPECIFICATION NOMENCLATURE**

Acronyms used in this specification are as follows:

FMCS	Facility Management and Control System
BMS	Building Management System
NAC	Network Area Controller
DDC	Direct Digital Controller
IBC	Interoperable BACnet Controller
GUI	Graphical User Interface
WBI	Web Browser Interface
PMI	Power Measurement Interface
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement

## **DIVISION OF WORK**

The BMS contractor shall be responsible for all controllers (DDC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.

The BMS contractor shall also be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web browser pages, setup of schedules, logs and alarms, LonWorks network management and connection of the NAC to the local or wide area network.

## **AGENCY AND CODE APPROVALS**

All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.

UL-916; Energy Management Systems

C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 “signal Equipment”

CE

FCC, Part 15, Subpart J, Class A Computing Devices

## **SOFTWARE LICENSE AGREEMENT**

The CLIENT MCD shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

The CLIENT MCD shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, CLIENT MCD shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, BMS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner. The owner shall determine which organizations to be named in the SI organization ID (“orgid”) of all software licenses. Owner shall be free to direct the modification of the “orgid” in any software license, regardless of supplier.

## **DELIVERY, STORAGE AND HANDLING**

Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

## **JOB CONDITIONS**

Cooperation with Other Contractors: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.



## **MATERIALS**

### **GENERAL**

The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein. All systems and software within BMS shall be Year 2000 compliant and shall be supported by compliance documentation from the manufacturer.

The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

### **OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES**

The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, LonWorks technology, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2001, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file and a resource file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.

All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

## **NETWORKS**

The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

Local area network minimum physical and media access requirements:

Ethernet; IEEE standard 802.3

Cable; 100 Base-T, UTP-8 wire, category 5

Minimum throughput; 100 Mbps.

## **NETWORK ACCESS**

Remote Access.

For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The CLIENT MCD shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

## **NETWORK AREA CONTROLLER (NAC) / ROUTER**

The BMS contractor shall supply one or more Network Area Controllers (NAC) / Router as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided in IO Summary.

The Network Area Controller (NAC) / Router shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC / Router. It shall be capable of executing application control programs to provide:

### **Calendar functions**

Scheduling

Trending

Alarm monitoring and routing

Time synchronization

Integration of LonWorks controller data and BACnet controller data

Network Management functions for all LonWorks based devices

The Network Area Controller must provide the following hardware features as a minimum:

One Ethernet Port – 10/100 Mbps

One RS-232 port

One LonWorks Interface Port – 78KB FTT-10A

One RS-485 ports

Battery Backup

Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)

The NAC / Router must be capable of operation over a temperature range of 32 to 122°F

The NAC / Router must be capable of withstanding storage temperatures of between 0 and 158°F

The NAC / Router must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

The NAC / Router shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC / Router shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

The NAC / Router shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

Event Alarm Notification and actions

The NAC / Router shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

The NAC / Router shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.

Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:

To alarm

Return to normal

To fault

Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: Electricals, HVAC, Fire, etc.

Provide timed (schedule) routing of alarms by class, object, group, or node.

Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

Control equipment and network failures shall be treated as alarms and annunciated.

Alarms shall be annunciated in any of the following manners as defined by the user:

Screen message text

Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:

Day of week

Time of day

Recipient

Pagers via paging services that initiate a page on receipt of email message

Graphic with flashing alarm object(s)

Printed message, routed directly to a dedicated alarm printer

The following shall be recorded by the NAC / Router for each alarm (at a minimum):

Time and date

Location (building, floor, zone, office number, etc.)

Equipment (air handler #, accessway, etc.)

Acknowledge time, date, and user who issued acknowledgement.

Number of occurrences since last acknowledgement.

Alarm actions may be initiated by user defined programmable objects created for that purpose.

Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

A log of all alarms shall be maintained by the NAC / Router and/or a server (if configured in the system) and shall be available for review by the user.

Provide a “query” feature to allow review of specific alarms by user defined parameters.

A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

Data Collection and Storage

The NAC / Router shall have the ability to collect data for any property of any object and store this data for future use.

The data collection shall be performed by log objects, resident in the NAC / Router that shall have, at a minimum, the following configurable properties:

Designating the log as interval or deviation.

For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

All log data shall be stored in a relational database in the NAC / Router and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.

All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

All log data shall be available to the user in the following data formats:

HTML

XML

Plain Text

Comma or tab separated values

Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

The NAC / Router shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC / Router on the network. Provide the ability to configure the following archiving properties, at a minimum:

Archive on time of day

Archive on user-defined number of data stores in the log (buffer size)

Archive when log has reached it's user-defined capacity of data stores

Provide ability to clear logs once archived

## **AUDIT LOG**

Provide and maintain an Audit Log that tracks all activities performed on the NAC / Router. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC / Router), to another NAC / Router on the network, or to a server. For each log entry, provide the following data:

Time and date

User ID

Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

## **DATABASE BACKUP AND STORAGE**

The NAC / Router shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

Copies of the current database and, at the most recently saved database shall be stored in the NAC / Router. The age of the most recently saved database is dependent on the user-defined database save interval.

The NAC / Router database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

## **DIRECT DIGITAL CONTROLLERS (DDC)**

Direct Digital Controllers shall be 16 bit microprocessor based Interoperable LonWorks Controllers.

The Network Area Controller (NAC) / Router will provide all scheduling, alarming, trending, and network management for the LonMark / LonWorks based devices.

The DDCs shall communicate with the NAC / Router at a baud rate of not less than 78.8K baud. The DDC shall provide LED indication of communication and controller performance to the technician, without cover removal.

All DDCs shall be fully application programmable. Controllers offering application selection only (non programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the DDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

The BMS contractor supplying the DDC's shall provide documentation for each device, with the following information at a minimum:

Network Variable Inputs (nvi's); name and type

Network Variable Outputs (nvo's); name and type

Network configuration parameters (nci, nco); name and type

It is the responsibility of the BMS contractor to ensure that the proper Network Variable Inputs and Outputs (nvi and nvo) are provided in each DDC, as required by the point charts.

The supplier of any programmable DDC shall provide one copy of the manufacturer's programming tool, with documentation, to the CLIENT MCD.

The controller shall be capable of either integrating with other LonMark™ devices or stand-alone operation.

The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for LonWorks™ network communications.

FLASH Memory Capacity: 60 Kilobytes with 8 Kilobytes for application program.

FLASH Memory settings retained for ten years.

RAM: 2 Kilobytes

The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.

The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.

Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.

Accuracy:  $\pm 1$  minute per month at 77° F (25° C).

Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).

- The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
- Rated voltage: 20-30 VAC, 50/60 Hz
- The controller shall have an internal DC power supply to power external sensors.
  - a. Power Output: 20 VDC  $\pm 10\%$  at 75 mA.
- The controller shall have a visual indication (LED) of the status of the device:
  - b. Controller operating normally.
  - c. Controller in process of download.
  - d. Controller in manual mode under control of software tool.
  - e. Controller lost its configuration.
  - f. No power to controller, low voltage, or controller damage.
  - g. Processor and/or controller is not operating.
- The minimum controller Environmental ratings:
  - h. Operating Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
  - i. Storage Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
  - j. Relative Humidity: 5% to 95% non-condensing.
- The controller shall have the additional approval requirements, listings, and approvals:
  - k. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
  - l. CSA (LR95329-3) Listed
  - m. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.

- n. Meets Canadian standard C108.8 (radiated emissions).
- o. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity)
- p. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission)
- o The controller shall have three analog outputs (AO).
  - q. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
  - r. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring.
  - s. Input and Output wiring terminals shall be designated with color coded labels.
- o The controller shall provide for “**user defined**” Network Variables (NV) for customized configurations.

## GRAPHICAL USER INTERFACE SOFTWARE

### Operating System:

The GUI shall run on Microsoft Windows XP Professional.

The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.

Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.

Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.



Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.

Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

Create, delete or modify control strategies.

Add/delete objects to the system.

Tune control loops through the adjustment of control loop parameters.

Enable or disable control strategies.

Generate hard copy records or control strategies on a printer.

Select points to be alarmable and define the alarm state.

Select points to be trended over a period of time and initiate the recording of values automatically.

On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

Programming software shall be same as GUI. The Same GUI can be used to configure the DDCs & NAC.

## Alarm Console

The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

## WEB BROWSER CLIENTS

The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.

The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

The Web browser client shall support at a minimum, the following functions:

User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.

HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.

Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

Modify common application objects, such as schedules, calendars, and set points in a graphical manner.

Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

View logs and charts

View and acknowledge alarms

Setup and execute SQL queries on log and archive information

The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

## **SERVER FUNCTIONS AND HARDWARE**

A central server shall be provided. The server shall support all Network Area Controllers (NAC) / Router connected to the customer’s network whether local or remote.

Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.

It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

The server shall provide the following functions, at a minimum:

**Global Data Access:** The server shall provide complete access to distributed data defined anywhere in the system.

**Distributed Control:** The server shall provide the ability to execute global control strategies based on control and data objects in any NAC / Router in the network, local or remote.

The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC) / Routers.

The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.

The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.

The server shall provide demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.

The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers / Routers. Systems not employing this prioritization shall not be accepted.

Each Network Area Controller / Router supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.

The server shall provide central alarm management for all Network Area Controllers / Routers supported by the server. Alarm management shall include:

Routing of alarms to display, printer, email and pagers

View and acknowledge alarms

Query alarm logs based on user-defined parameters

The server shall provide central management of log data for all Network Area Controllers / Routers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:

Viewing and printing log data

Exporting log data to other software applications

Query log data based on user-defined parameters

Server Hardware Requirements: The server hardware platform shall have the following requirements:

The computer shall be an Intel Pentium M based computer (minimum processing speed of 2.4 GHz with 1 GB RAM and a 100-gigabyte minimum hard drive). It shall include a DVD-ROM/CD-RW Combination Drive, 2-parallel ports, 2-asynchronous serial ports and 2-USB ports. A minimum 17" flat panel color monitor, 1280 x 1024 optimal preset resolution, 25 ms response time shall also be included.

The server operating system shall be Microsoft Windows XP Professional. Include Microsoft Internet Explorer 6.0 or later.

Connection to the BMS network shall be via an Ethernet network interface card, 100 Mbps.

A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 60-PPM print speed minimum.

For dedicated alarm printing, provide a dot matrix printer, either 80 or 132 column width. The printer shall have a parallel port interface.

## **SYSTEM PROGRAMMING**

The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

### **Programming Methods**

Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other

objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.

Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.

The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.

The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

### **LonWorks NETWORK MANAGEMENT**

The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks network management tools for working with LonWorks networks. These tools shall manage a database for all LonWorks devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between LonWorks devices, known as "binding". Systems requiring the use of third party LonWorks network management tools shall not be accepted.

Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

The network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.

These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.

The network management database shall be resident in the Network Area Controller (NAC) / Router, ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system, shall not be accepted.

## **OBJECT LIBRARIES**

A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

All control objects shall conform to the control objects specified in the BACnet specification.

The library shall include applications or objects for the following functions, at a minimum:

**Scheduling Object.** The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.

**Calendar Object.** . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.

**Duty Cycling Object.** Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals

**Temperature Override Object.** Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.

**Start-Stop Time Optimization Object.** Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.

**Demand Limiting Object.** Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheClient MCDble equipment is not enough to reduce the demand to

below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheClient MCDble object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.

Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an “on” condition. The user must be able to specify either input condition as the “on” condition.

Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.

PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.

Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.



Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.

Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.

Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.

The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC) / Router. At a minimum, provide the following as part of the standard library included with the programming software:

LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer.

For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device

manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.

For BACnet devices, provide the following objects at a minimum:

- Analog In
- Analog Out
- Analog Value
- Binary
- Binary In
- Binary Out
- Binary Value
- Multi-State In
- Multi-State Out
- Multi-State Value
- Schedule Export
- Calendar Export
- Trend Export
- Device

For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.

For BACnet devices, provide the following support at a minimum

- Segmentation
- Segmented Request
- Segmented Response
- Application Services
- Read Property
- Read Property Multiple
- Write Property
- Write Property Multiple
- Confirmed Event Notification
- Unconfirmed Event Notification
- Acknowledge Alarm
- Get Alarm Summary
- Who-has

I-have  
Who-is  
I-am  
Subscribe COV  
Confirmed COV notification  
Unconfirmed COV notification  
Media Types  
Ethernet  
BACnet IP Annex J  
MSTP  
BACnet Broadcast Management Device (BBMD) function  
Routing

### **DDE DEVICE INTEGRATION**

The Network Area Controller /Router shall support the integration of device data via Dynamic Data Exchange (DDE), over the Ethernet Network. The Network Area Controller shall act as a DDE client to another software application that functions as a DDE server.

Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the BMS. Objects provided shall include at a minimum:

DDE Generic AI Object  
DDE Generic AO Object  
DDE Generic BO Object  
DDE Generic BI Object

### **MODBUS SYSTEM INTEGRATION**

The Network Area Controller / Router shall support the integration of device data from Modbus RTU, Ascii, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.

Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the BMS. Objects provided shall include at a minimum:

Read/Write Modbus AI Registers  
Read/Write Modbus AO Registers  
Read/Write Modbus BI Registers  
Read/Write Modbus BO Registers

All scheduling, alarming, logging and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.

The BMS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning

### **OPC SYSTEM INTEGRATION**

The Network Area Controller / Router shall act as an OPC client and shall support the integration of device data from OPC servers. The connection to the OPC server shall be Ethernet IP as required by the device. The OPC client shall support third party OPC servers compatible with the Data Access 1.0 and 2.0 specifications.

Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the OPC system data into the BMS. Objects provided shall include at a minimum:

- Read/Write OPC AI Object
- Read/Write OPC AO Object
- Read/Write OPC BI Object
- Read/Write OPC BO Object
- Read/Write OPC Date/Time Input Object
- Read/Write OPC Date/Time Output Object
- Read/Write OPC String Input Object
- Read/Write OPC String Output Object

All scheduling, alarming, logging and global supervisory control functions, of the OPC system devices, shall be performed by the Network Area Controller / Router.

The BMS supplier shall provide an OPC client communications driver. The equipment system vendor that provided the equipment utilizing OPC shall provide documentation of the system's OPC server interface and shall provide factory support at no charge during system commissioning.

### **GRAPHICAL USER INTERFACE COMPUTER HARDWARE (DESKTOP)**

The browser workstation shall be an Intel Pentium based computer (minimum processing speed of 2.4 Ghz with 1.0 GB RAM and a 100-gigabyte minimum hard drive). It shall include a DVD-ROM/CD-RW Combination Drive, 2-parallel ports, 2-asynchronous serial ports and 2-USB ports. A minimum 17" flat panel color monitor, 1280 x 1024 optimal preset resolution, 25 ms response time, shall also be included.

Connection to the BMS network shall be via an Ethernet network interface card, 10 Mbps.

A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 8 PPM print speed minimum.

## OTHER CONTROL SYSTEM HARDWARE

Space Temperature Wall Module..

Wall module shall have a 20K Ohm NTC thermistor temperature sensor with operating range of 45 to 99 F under a locking cover/enclosure with UL 916 listing designed for mounting on a standard electrical switch box.

Space temperature sensors shall be accurate to plus or minus one F degree.

Where specified, space temperature sensors shall have a setpoint knob calibrated for warmer-cooler adjustments (*option: calibrated to allow plus or minus adjustments to a software setpoint*).

Where specified, wall module shall also have an after-hours override pushbutton and LED override indicator.

Where specified, the wall module shall have a fan coil unit fan control switch for (*auto-off-on*)(*auto-off-low-med-hi*) fan control. The wall module function is further specified in SECTION III Sequence of Operation.

Standard Automatic Control Dampers. Provide all automatic control dampers not specified to be integral with other equipment.

Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.

Blades shall not be over 8 inches wide nor less than 16-gauge galvanized steel triple V type for rigidity.

Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.

Dampers shall be suitable for temperature ranges of -40 to 180F.

All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.

Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. w.c. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. wc. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized.

Maximum leakage for dampers in excess of sixteen inches square shall be 30 CFM per square foot at static pressure of 1 inch of WC. Testing and ratings to be in accordance with AMCA Standard 500.

Low Leakage Automatic Control Dampers. Provide all automatic control dampers not specified to be integral with other equipment.

Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.

Blades shall not be over 8 inches wide nor less than 16-gauge galvanized steel triple V type for rigidity.

Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.

Dampers shall be suitable for temperature ranges of -40 to 180F.

All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.

Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. wc. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. w.c.

Side seals shall be stainless steel of the tight-seal spring type.

Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all low leakage control dampers with the temperature control submittal.

Maximum leakage for low leakage dampers in excess of sixteen inches square shall be 8 CFM per square foot at static pressure of 1 inch of WC.

Low leakage damper blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage.

Testing and ratings shall be in accordance with AMCA Standard 500.

Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized. Testing and ratings to be in accordance with AMCA Standard 500.

Round Motorized Dampers. Round dampers shall be provided where specified and shall be factory mounted in a section of round duct a minimum of 12 inches long, but no less than one inch longer than the duct diameter.

Duct shall be sleeve type spiral duct crimped on the downstream end, 24 gage galvanized minimum except duct over 12 inches in diameter shall be 22 gage.

Duct shall have an integral galvanized steel actuator mounting plate and a ½ inch zinc-coated steel blade shaft extending a minimum of 2 inches beyond the actuator mounting plate.

Shaft bearings shall be flanged bronze oilite pressed into the frame.

The blade shall be a minimum 16 gage galvanized steel, and damper frame shall be provided with closed-cell neoprene seals with silicone rubber bead. Damper shall be designed for a 2500 ft/min approach velocity and a 4 inch minimum static pressure.

Damper shall be suitable for operation from 32 to 130F temperatures.

Damper and actuator combination shall be designed for leakage rates less than 13 cfm per square foot at one inch w.c differential and 25 cfm at four inches w.c. Actuator shall have an external declutch lever to allow manual blade positioning during equipment and power malfunctions.

Control Valves: (*Globe Type*) Control valves shall be 2-way or 3-way pattern as shown constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.

Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings).

Two-way water valves shall have equal percentage flow characteristics and three-way valves shall have equal percentage flow characteristics straight through and linear through the bypass.

Provide valve position indicator on all valves. Leakage rate shall be no more than 0.05% of Cv.

Valves 1/2 inch through 1 1/2 inch shall be screwed pattern except where solder connections are specified for valves 1/2 or 3/4 inches.

Three-way valves bypass port shall be of one size reduced Cv to preclude the need for a bypass port balancing valve.

Valve and cartridge replacement tool shall be configured for maintenance or replacement without draining the coil to prevent water spill; however, an integral isolation valve on the control valve outlet will also be acceptable.

Valves shall close off against 58 psi minimum.

Two inch valves shall be "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration and ANSI-rated to withstand the pressures and temperatures encountered.

Valves shall have stainless-steel stems and spring loaded Teflon packaging with replaceable discs.

Control Valves: (*Characterized Ball Valves*) Control valves 1/2 to 2 inches shall be 2-way or 3-way forged brass screwed pattern as shown constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.

Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings).

Two-way water valves shall have equal percentage flow characteristics and three-way valves shall have equal percentage flow characteristics straight through and linear flow through the bypass.

Leakage rate shall be ANSI Class IV (no more than 0.01% of Cv).

Valves shall be rated for no less than 350 psig at no less than 250 degrees F.

Provide a removable handle to operate valves manually during actuator power loss or failure.

Two-way valves shall close off against 100 psi minimum, and three-way valves shall close off against 40 psi minimum.

Valves shall have stainless-steel or chemically nickel-plated brass stem and throttling port.

Valves shall be tagged with Cv rating and model number.

Butterfly Control Valves: Where specified butterfly control valves over 2" in size shall be cast iron body type for 2-way or 3-way applications specified constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.

Valves shall have tapped lugs for standard flange connection, and designed for isolation and removal of downstream piping at full rated pressure.

Two-position valves shall be 'line' size.

Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings).

Valves shall be rated for bubble tight shutoff at no less than 150 psi.

Valve disc shall be aluminum bronze.

Valve stems shall be stainless steel, with inboard top and bottom bronze bearings, and an external corrosion resistant top bearing to absorb actuator side thrust.

Duct Mount, Pipe Mount and Outside Air Temperature Sensors: Temperature sensors with an accuracy of  $\pm 0.3^{\circ}$  F.

Outside air sensors shall include an integral sun shield.

Duct sensors shall have sensor approximately in center of the duct, and shall have selectable lengths of 6, 12, and 18 inches.

Multipoint averaging element sensors shall be provided where specified and shall have a minimum of one foot of sensor length for each square foot of duct area (provide multiple sensors if necessary).

Pipe mount sensors shall have copper, or stainless steel separable wells.

Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point shall be provided where specified. Current switches shall include an integral LED for indication of trip condition and a current level below trip set point.

Water Flow Meters: Water flow meters shall be axial turbine style flow meters which translate liquid motion into electronic output signals proportional to the flow sensed.

Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.

Flow meters shall be 'insertion' type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown.

Accuracy shall be  $\pm 2\%$  of actual reading from 0.4 to 20 feet per second flow velocities.

Low Temperature Limit Switches. Safety low limit shall be manual reset twenty foot limited fill type responsive to the coolest section of its length.

High Temperature Limit Switches. Safety high limit (firestats) shall be manual reset type.

CO2 Sensors.

Carbon Dioxide sensors shall be 0-10 Vdc analog output type, with corrosion free gold-plated non-dispersive infrared sensing, designed for duct mounting.

Sensor shall incorporate internal diagnostics for power, sensor, analog and output checking, and automatic background calibration algorithm for reduced maintenance. Sensor range shall be 0-2000 PPM with  $\pm 50$  PPM accuracy.

Humidity Sensors.

Duct and room sensors shall have a sensing range of 5% to 95%.



Duct sensors shall be provided with a sampling chamber.

Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH. They shall have a compensated ambient temperature range of -40°F to 170° F.

Enthalpy Sensors. Duct mounted enthalpy sensor shall include a temperature sensor and a humidity sensor constructed to close an electrical contact upon a drop in enthalpy (total heat) to enable economizer modes of operation where specified.

Variable Frequency Drives.

Variable frequency drives shall be UL listed and sized for the power and loads applied.

Drives shall include built-in radio frequency interference (RFI) filters and be constructed to operate in equipment rooms and shall not be susceptible to electromagnetic disturbances typically encountered in such environments. Similarly, the drives must not excessively disturb the environment within which it is used.

All VFDs over 3 horsepower shall be provided with an AC choke.

VFDs shall be installed in strict conformance to the manufacturer's installation instructions, and shall be rated to operate over a temperature range of 14 to 104 F.

VFD automatic operation shall be suitable for an analog input signal compatible with the digital controller output.

Each VFD shall be fan cooled and have an integral keypad and alphanumeric display unit for user interface. The display shall indicate VFD status (RUN motor rotation, READY, STOP, ALARM, and FAULT), and shall indicate the VFD current control source (DDC input signal, keypad, or field bus control). In addition to the alphanumeric display, the display unit shall have three pilot lights to annunciate when the power is on (green), when the drive is running (green, blinks when stopping and ramping down), and when the drive was shut down due to a detected fault (red, fault condition presented on the alphanumeric display).

Three types of faults shall be monitored, "FAULT" shall shut the motor down, "FAULT Auto-reset" shall shut the motor down and try to restart it for a programmable number of tries, and "FAULT Trip" shall shut the motor down after a FAULT Auto-reset fails to restart the motor. Coded faults shall be automatically displayed for the following faults:

- Over current
- Over voltage
- Earth ground
- Emergency stop
- System (component failure)
- Under voltage
- Phase missing
- Heat sink under temperature
- Heat sink over temperature
- Motor stalled
- Motor over temperature
- Motor underload
- Cooling fan failure
- Inverter bridge over temperature
- Analog input control under current
- Keypad failure

### Other product unique monitored conditions

In addition to annunciating faults, at the time of fault occurrence the VFD shall capture and make available to the user certain system data for subsequent analysis during fault trouble shooting, including duration of operation (days, hours, minutes, seconds), output frequency, motor current, motor voltage, motor power, motor torque, DC voltage, unit temperature, run status, rotation direction, and any warnings. The last 30 fault occurrences shall be retained as well as the fault data listed in the previous sentence of each fault. New faults beyond 30 shall overwrite the oldest faults.

The display unit keypad shall allow setting operational parameters including minimum and maximum frequency, and acceleration and deceleration times. The display shall offer user monitoring of frequency, unit temperature, motor speed, current, torque, power, voltage, and temperature.

**Actuators, General.** All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. Valves shall be provided with actuators suitable for floating or analog signal control as required to match the controller output. Actuators shall be power failure return type where valves or dampers are required to fail to a safe position and where specified.

Non-Spring Return Low Torque Direct Coupled 35 & 70 lb-in Actuators. Actuators shall be 35 (ML 6161 or ML 7161) or 70 lb-in. (ML6174 or ML 7174) with strokes adjustable for 45, 60, or 90 degree rotation applications and designed for operation between 20 and 125 F.

Each actuator shall also have a minimum position adjustable rotation of 0 to 30 degrees.

Actuators shall be for floating or two position (ML 6161 or ML6174) control, or for 4-20 mA or 2-10Vdc (ML7161 or ML7174) input signals.

Analog control actuators shall have a cover mounted direct/reverse acting switch.

Actuator motor shall be magnetically coupled or shall have limit switch stops to disengage power at the ends of the stroke.

Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning.

Actuators shall have NEMA 1 environmental protection rating and be 24 volt and UL listed with UL94-5V plenum requirement compliance.

Minimum design life of actuators shall be for 1,500,000 repositions and 35 lb-in. models shall be designed for 50,000 open-close cycles and 70 lb-in. models shall be designed for 40,000 open-close cycles.

Actuator options shall include 1) Auxiliary feedback potentiometers, 2) open-closed indicator switches, 3) actuator timings of 90 seconds, 3 minutes, or 7 minutes, one or two auxiliary switches, and 4) torque of 35 or 70 lb-in.

Non-Spring Return High Torque 177 and 300 lb-in Actuators. MN6120A, MN6134A, MN7234A Series Actuators shall be UL listed 24 Vac in NEMA 2 enclosures designed for operation between -5 and 140 F.

Rotation direction shall be switch selectable.

Minimum design life of actuators shall be for 1,500,000 repositions and for 60,000 open-close cycles.

Actuators shall be suitable for the controller output signals encountered, floating or analog, and shall have full cycle timing of 95 seconds.

Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning.

*(Select one or more of the following descriptions required)*

- Actuators shall have 300 lb-in. torque.
- Actuators shall have 177 lb-in. torque with adjustable stroke, 30 to 90 degrees.
- Actuators shall have 177 lb-in. torque with adjustable stroke, 30 to 90 degrees, and shall auxiliary end switches to annunciate full open and full closed positions.

Spring Return Direct Coupled Actuators. Actuators shall have torque ratings of 44lb-in. (MS4105, MS7505, MS8105), 88 lb-in. (MS4110, MS7510, MS 8110), or 175 lb-in (MS4120, MS7520, MS8120). Actuators shall be modulating 90 seconds nominal timing or two-position 45 seconds nominal timing types with strokes for 90 degree rotation applications and designed for operation between -40 and 140 F.

Each torque rating group shall have optionally selected control types, floating control, 2-position 24 Vac, 2-position line voltage, or analog input which is switch selectable as 0-10Vdc, 10-0 Vdc, 2-10 Vdc, or 10-2 Vdc.

Actuator spring return direction (open or closed) shall be easily reversed in the field, and actuators shall spring return in no greater than 20 seconds.

Actuators shall be direct connected (no linkages), and shall have integral position indication.

Actuators shall have NEMA 2 environmental protection rating, and UL approved and plenum rated per UL873.

Minimum design life of modulating actuators shall be for 1,500,000 repositions and 60,000 spring returns, except 2-position actuators shall be for 50,000 spring returns.

Each actuator shall be provided with a manual power-off positioning lever for manual positioning during power loss or system malfunctions, including a gear-train lock to prevent spring action.

Upon power restoration after gear lock, normal operation shall automatically recur.

Fast Acting Two Position Fire & Smoke Actuators (ML4115, ML8115 Fire/smoke damper actuators shall be direct connected (no linkages) two-position spring return types with stroke for 90 degree nominal rotation applications and designed for 60,000 full stroke cycles and normal operation between 0 and 130 F.

Actuators control shall be compatible with SPST control switch and with torque ratings of 30 lb-in.

Actuator timing shall be 25 seconds maximum in powered instances and shall spring-return in 15 seconds.

Actuators shall be UL listed with UL873 plenum rating with die-cast aluminum housing with integral junction box and conduit knockouts, and designed to operate reliably in smoke control systems requiring UL555S ratings up to 350F.

The actuator shall be designed to operate for 30 minutes during a one-time excursion to 350F.

Actuator shall require no special cycling during long-term holding, and shall “hold” with no audible noise at a power consumption of approximately half of the driving power.

Actuators shall be 24 volt (ML8115) or 120 volt (ML4115) with models for clockwise (add a B suffix) and counter-clockwise (add an A suffix) spring return.

Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting Fall devices as shown. Control panels shall meet all requirements of Title 24, California Administrative Code. All electrical devices within a control panel shall be factory wired. All external wiring shall be connected to terminal strips mounted within the panel. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels. A complete set of ‘as-built’ control drawings (relating to the controls within that panel) shall be furnished within each control panel.

BTU Meters: BTU meters shall be electromagnetic type, communicating on Modbus Protocol

## **EXECUTION**

### **INSTALLATION**

All work described in this section shall be performed by system integrators or contractors that have a successful history in the design and installation of integrated control systems.

Install system and materials in accordance with manufacturer’s instructions, and as detailed on the project drawing set.

Drawings of the BMS network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.

Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by this contractor in accordance with these specifications.

Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by this contractor.

### **WIRING**

All electrical control wiring and power wiring to the control panels, NAC, computers and network components shall be the responsibility of the this contractor.

The electrical contractor shall furnish all power wiring to electrical starters and motors.

All wiring shall be in accordance with the Project Electrical Specifications, the National Electrical Code and any applicable local codes. All BMS wiring shall be installed in the conduit types specified in the Electrical Specifications unless otherwise allowed by the National Electrical Code or applicable local codes. Where BMS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

### **WARRANTY**

Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

Within this period, upon notice by the CLIENT MCD, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this contractor at no expense to the CLIENT MCD.

### **WARRANTY ACCESS**

The CLIENT MCD shall grant to this contractor, reasonable access to the BMS during the warranty period.

The CLIENT MCD shall allow the contractor to access the BMS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

### **SOFTWARE LICENSE**

CLIENT MCD shall be the named license holder of all software associated with any and all incremental work on the project(s). The owner, or his appointed agent, shall determine which organizations to be named in the “**orgid**” of all software licenses.

CLIENT MCD, or his appointed agent, shall be free to direct the modification of the “**orgid**” in any software license, regardless of supplier.

The owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for

use within based controllers and/or servers and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required Ids and passwords for access to any component or software program shall be provided to the owner.

### **ACCEPTANCE TESTING**

Upon completion of the installation, this contractor shall load all system software and start-up the system. This contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

This contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of CLIENT MCD's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the CLIENT MCD's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

System Acceptance: Satisfactory completion is when BMS contractor have performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of CLIENT MCD Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

### **OPERATOR INSTRUCTION, TRAINING**

During system commissioning and at such time acceptable performance of the BMS hardware and software has been established this contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

This contractor shall provide 40 hours of instruction to the CLIENT MCD's designated personnel on the operation of the BMS and describe its intended use with respect to the programmed functions specified. Operator orientation of the systems shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

The training shall be in three sessions as follows:

**Initial Training:** One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.

**First Follow-Up Training:** Two days (16 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.

## **SPECIFICATION FOR INTELLIGENT VEHICLE ACCESS SYSTEM**

### **CONTENTS**

#### **SPECIFICATIONS for**

- Ticket Dispenser(DTD540)
- Electric Barrier(DEB90)
- Manual Pay Station(DMP540S)
- Fee Display
- RF Reader
- Zone Computer (DZC500)

### **TICKET DISPENSER**

***Model : DTD540 (Bar-code Paper Ticket)***

#### **General Function**

- 1) The ticket dispenser (DTD540) is installed at entrance of parking lot. A loop coil is placed just in front of TD to start the TD process.
- 2) Tickets are issued automatically when driver pushes the button and gate opens. If vehicle has a RF card, the gate opens immediately.
- 3) When the card is issued by TD, the data is recorded on ticket two ways: First it is recorded on a magnetic strip twice to insure readability, and second it is printed on the ticket so that the driver is aware of time/date. No. of equipment, No. of parking lot and other information is recorded on the ticket.
- 4) When inserting a season card, congress card and one-time use ticket into the slot of TD, it reads the ticket automatically and EB will open.
- 5) When the parking lot is full, all ticket function stops.
- 6) With RF Tag Reader interfaced, a car with RF tag issued goes through and the system acquires RF TAG number at ICC (Intelligent Communication Controller) to control the EB automatically according to the result from the RF TAG.

#### **User Guidance**

- 1) When a car approaches, it displays voice guidance message for convenient use.
- 2) When the parking lot is full, TD stops issuing tickets and transmits signal which can control display.
- 3) Voice guidance is provided according to the situation.

#### **Card Writing and Printing Device**

- 1) Card writing device issues bar-code tickets.
- 2) Card writing device reads parking ticket and so on.
- 3) Entering time and serial No. is printed on ticket by the thermal print method. There is no need for ink or ink ribbon.

- 4) If there aren't enough tickets, the warning message indicating ticket insufficiency is transmitted to ICC. (Intelligent Communication Controller)
- 5) Parking ticket is issued within 2 seconds.

### **Monitor/Control Device**

- 1) The control device using Micro Processor monitors/controls all the units that connect to it. If there is any error in the unit or EB, a warning signal is transmitted to the ICC.
- 2) The ICC receives operational information and if something goes wrong with high rank device, it is O.K. The ICC memory allows for normal function until the high rank device is back online.
- 3) Control device has self-diagnosis and EB control functions.
- 4) LCD display and button is arranged to set operational configuration and check to operation.

### **Housing**

- 1) Housing Material : Self standing, Water proof
- 2) Housing Material : Galvanized Steel 1.6t
- 3) Painting : Basic Painting
- 4) Front Panel : special ABS (Highly intensified material preventing unwanted transformation  
1) caused by external environment)
- 5) Housing Size : 340mm(W) x 1220mm(H) x 560mm(D)
- 6) Weight : Approx 55kg

### **Power Supply**

- 1) Main Power Supply : AC220V±10%, 50/60HZ
- 2) Power Consumption : Approx 70W (Heater: 600W)
- 3) Operating Temps : -25°C ~ +55°C
- 4) Temperature Compensation: Driven Fan or Heater by sensing the temperature sensor
- 5) LON Port : RS-422 (Multi-drop)
- 6) Vehicle Detection : Loop Detector

## **ELECTRIC BARRIER**

**Model : DEB90**

### **General Function**

- 1) The Electric Barrier controls in/out of the vehicles.
- 2) When the vehicle which has RF TAG approaches to RF TAG READER, bar opens, after it receives "Open" signal..
- 3) The arm will open promptly after it receives "Open" signal. After the vehicle drives in/out completely, the arm will close automatically via the loop detector sensor.

### **MOTOR Driving Gear**

- 1) Arm is operated through several links connected to the gear box and motor.



- 2) The motor drives without friction clutch and there is almost no error.
- 3) Arm does not cause any unstable vibration in order to provide smooth operation from start to finish. This will also provide higher durability.

### **Control Device**

- 1) Control device that loads Micro Processor controls and checks the status of Electric Barrier to prevent error.
- 2) When the Arm is impacted, it drops to prevent it from being damaged.
- 3) The status of electric barrier in the up, down, drop and vehicle detection mode is checked and transferred to the local unit that is connected to Electric Barrier.

### **Housing**

- 1) Housing Configuration : Self Standing, Water Proof
- 2) Housing Material : Galvanized Steel 2.0t
- 3) Painting : After basic paints, paints partially
- 4) Housing Size : 350mm(W) x 1110mm(H) x 350mm(D)
- 5) Weight : Approx 60kg
- 6) Arm Material : Rectangular Aluminum straight arm(2.5M)
- 7) Arm Structural : Arm drop type and rubber under the arm

### **Power Specification**

- 1) Main Power Supply : AC230V±10%, 50/60HZ
- 2) Power Consumption : Approx 95W
- 3) Operating Temps : -30°C ~ +55°C
- 4) Motor Capacity : 90W
- 5) Operating Speed : within 1.5 seconds ( 90 degree moving )

### **MANUAL PAY STATION**

***Model : DMP540S (Bar-code Paper Ticket)***

#### **General Function**

- 1) The manual pay station is installed at exit to control Electric Barrier.
- 2) Parking fee is calculated and displayed when an hourly ticket, park value card with insufficient balance or season card with exceeded period is inserted.
- 3) If the calculation of parking fee is processed at exit manual pay station, ticket is withdrawn and EB opens.
- 4) Special fee, such as lost ticket, free ticket, unreadable ticket, pre-paid ticket can be generated at manual pay station.
- 5) It monitors the operation of local equipment remotely by step.
- 6) Parking fee discount applies to button discount, amount discount and coupon/ticket discount.
- 7) When an RF season card is used, it will interface with the RF Tag Reader. System will then acquire RF Tag No. from ICI and control EB automatically according to the programmed result.

### **Bar-code Scanner**

- 1) Scan Ratio : 110 Scan / second.
- 2) Resolution : 5mil (0.125mm).
- 3) Photo Sensor : 2160 Pixel Linear CCD
- 4) Illumination : 660nm Visible RED LEDs
- 5) Field Width : 80mm
- 6) Depth of field : 0~15mm
- 7) Capacity : 90mm x 55mm x 175mm
- 8) Weight : 140g
- 9) Electricity : 5V DC  $\pm$  5%
- 10) Operating Temperature : 0<sup>0</sup>C ~ +50<sup>0</sup>C

### **Keyboard and Operational Display**

- 1) Standard keyboard for PC is used to input and easily manage data.
- 2) It operates via Windows XP.

### **Monitor and Control Device**

- 1) Minimum control device is Pentium IV 2.4 GHz; RAM 256MB, HDD 80GB.
- 2) Various units are connected to ICI. If the communication with the ICI is blocked, the generated ticket information is stored in the units own memory.
- 3) It checks the system status by self-diagnosis function and if there's any error, it displays error message on the Monitor.

### **Receipt Printer**

- 1) Receipt and various settlements are printed by cutter inbuilt thermal printer.
- 2) The receipt is printed on the 58mm wide paper within 1 second.
- 3) The address and name of parking lot is printed on top of receipt.

### **Intelligent Communication Interface (ICI)**

- 1) IF anything goes wrong with manual pay station, the system manages normally with ICI memory.
- 2) ICI has the function as channel distribution and communication hook-up.
- 3) ICI controls EB and input/output signage.

### **Electric Specification**

- 1) Main Power Supply : AC220V $\pm$ 10%, 50/60HZ
- 2) Power Consumption : 380W (including monitor, control device, validator, receipt printer)
- 3) Operating Temps : 0<sup>0</sup>C ~ +50<sup>0</sup>C
- 4) Weight : Approx 35kg (including Validator, Fee Display)
- 5) Location of Installation : Indoor
- 6) LON Port : RS-422 (Multi-drop)

## **FEE DISPLAY**

**Model : DFD500.**

### **General Function**

Fee displayer shows the parking fee, which is received from manual pay station, in order that parking fee is paid promptly and correctly.

### **Display for Customer**

- 1) Display Method : LED
- 2) Display : 6 digits
- 3) Material : Plastic
- 4) Operating Temps : -10°C ~ +45°C
- 5) Weight : 1.5 KG
- 6) Cable : RS-232 with computer

## **RF CARD READER**

**Model : RF**

### **General Function**

- 1) RF Card Reader consists of short-range card reader and antenna and works by connecting to electric barrier.
- 2) It is used with season cards. The distance between RF card and RF reader is about 40~50CM(this range could be changed with the according to the circumstance).
- 3) RF Card is passive method (no-battery type) and the RF card is semi-permanent.
- 4) By approaching of RF season card user, it acquires information of RF card automatically to open barrier arm.
- 5) The management of the RF tag does not need extra management computer. It is processed by ICC with the same program with the magnetic card management. In order to provide convenience in management, RF card is registered at the same time as it is dispensed.

### **Technical Specification**

- 1) Frequency : RF (125KHZ)
- 2) Reading speed : within 1.5second
- 3) Operating temps : Antenna -30<sup>0</sup>C ~ +65<sup>0</sup>C
- 1) Rreader 0<sup>0</sup>C ~ +50<sup>0</sup>C
- 4) Display : LED
- 5) Card Type : NO BATTERY TYPE
- 6) Life Cycle of Tag : semi permanent
- 7) Antenna : POLE type (Pole is not included)

## **ZONE COMPUTER**

**Model : DZC500**

## **General Function**

- 1) It monitors and controls all the entrance and exit equipments and transmits basic Operating Information to Local Units.
- 2) Zone Computer collects Data from Local Equipment by Communication with them. It also manages and prints various settlements and statistics.
- 3) Zone Computer sends settled operating information to local units automatically so that local units can work automatically.
- 4) Zone Computer displays the status of selected local unit with remote monitoring function of Local units, so that operators can analyze the operating status.
- 5) Zone computer operates up to 4 parking lots with segregated operating information and parking fee tariffs.
- 6) Zone Computer functions with the software to manage RF TAG without the necessity of extra management computer for RF tags. This provides convenient operations by registering the RF Tags in the program upon issuance of RF cards.
- 7) Zone Computer records and manages in/out of RF TAG.

## **Main Function**

- 1) If there is any error in the Local Unit, error message and management related information will be displayed on Zone Computer.
- 2) All of the local units that are connected to Zone Computer are checked and controlled remotely.
- 3) Zone Computer counts the vehicle's in and out on each floor and confirms the occupied spaces according to the normal parker/season card parker.
- 4) The management of season card is managed by group/individually and the information of customer can be changed. It can also inputs information of card owner.

## **Monitor/Control Device**

- 1) Minimum control device is PentiumIV 2.8GHz Computer, 512MB, 40GB(Working), 40GB(Back Up), CDDriver 52X
- 2) It is connected to 17"LCD Monitor, PC Keyboard, Mouse.
- 3) O.S operates by Windows XP.

## **Intelligent Communication Controller (ICC)**

- 1) ICC which contains 16 Bit Micro processor and Memory saves operating information of parking lot and season card registration.
- 2) Even though Zone Computer fails, the system still operates normally by the ICC.

## **Electric Specification**

- 1) Main Power Supply : AC230V  $\pm$ 10%, 50/60HZ
- 2) Power Consumption : Approx 620W
- 3) Operating Temps : 0°C ~ +50°C
- 4) Installation : Indoor
- 5) Weight : Approx 35Kg

### **GCC(Guidance Communications Controller)**

- Channels : Max. 5ch x 90 Ultra Sonic Sensor
- Communication : RS-485 between DUS35 , Ethernet between DGMC
- Housing : Steel

### **Ultrasonic Sensor**

- Detection Ranges : 0.5 ~ 3.5meters (Adjustable ranges at local or remotley)
- Communication : RS-485
- Power : DC 24V
- Ports : a) Controls Bay Lamp
- b) Connects with Emergency Switch Button
- c) Interfaces with Display Board

### **Bay Lamp**

- Blue and Red High Brightness LED Indicator
- Power : DC 24V

### **Block Guide Display**

- Two sets LED Modules with each controller
- Arrow and Vacancy amounts will be dispalyed on the LED Module
- Contents of the signage will be designed by Dealers
- Size : 1800mm(W) x 220mm(H) x 180mm(D)
- Housing : Steel (Black)
- Power : Switching Power Supply

### **Repeater**

- after every 30 sensors will be required for the communication line
- Power : DC 24V

### **Power Supply**

- Input Power : AC 120V / 220V
- Output : DC 24V / 6A
- Housing : Steel Housing with door

### **Cabling in MS Conduit**