SECTION 283111

FIRE ALARM SYSTEM AND VOICE EVACUATION SYSTEM

PART 1 GENERAL

To be read with Division 1 - General Requirements and Section 260500.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Smoke Detection Control Panel and Management Control Panel

B. Event Logging Printer

C. Colour Graphic Display Terminal

D. Initiating Devices

E. Signal Appliances

F. Auxiliary Devices

G. Fire Alarm Repeater Panel

H. System Mimic Display Panel

I. Fire Alarm Interface with Building Automation System.

J. Fire Alarm Cables

K. Voice Evacuation System

1.3 REFERENCES

A. The minimum standards for products specified in this section shall be relevant BSI/NFPA standards including but not limited to the following. Except as otherwise specified herein, perform work in accordance with specification codes and standards cited therein and to latest applicable addenda and supplements.

1. Kuwait Fire Department - Relevant Publications
2. Fire Alarm Committee - Relevant Publications

3. NFPA 72 - Installation, Maintenance, and Use of Protective Signalling Systems.
4. NFPA 72E - Automatic Fire Detectors.
5. NFPA 72G - Notification Appliances for Protective Signalling Systems.
6. NFPA 72H - Guide for Test Procedures for Protective Signalling Systems.
7. NFPA 101 - Life Safety Code.
8. BS 5839-1:2002+A2:2008 - Fire detection and alarm systems in buildings.

1.4 SUBMITTALS

A. Submit according to section 01 33 00 – Submittal procedures.

B. Shop Drawings: Provide annunciator layout and system wiring diagram showing each device and wiring connection required. Provide complete floor plans with layout of devices and wiring. Provide mimic panel layout as stated in the specifications. Shop drawings shall include complete installation details for each item.

C. Product Data: Provide electrical characteristics, connection requirements, dimensions, construction, system description and operation data. Include list of materials and Nationally Recognized Testing Laboratory (NRTL)-listing data.

D. Wiring diagrams from manufacturer differentiating clearly between factory- and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Make all diagrams specific to this Project and distinguish between field and factory wiring.

E. Floor Plans: Indicate final outlet locations and routings of raceway connections.

F. System operation description covering this specific Project, including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are unacceptable.

G. Maintenance data for fire alarm systems to include in the operation and maintenance manual specified in Division 1. Include data for each type of product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.

H. Submission to local Fire Authorities: In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Resubmit if required to make clarifications or revisions to obtain approval.

I. Record of field tests of system

J. Test Reports: Indicate satisfactory completion of required tests and inspections.

K. Sample: Provide one of each detector, manual call points, alarm sounder, control elements, master elements, etc., including accessories.

L. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

M. Kuwait Fire Department approval for the proposed system and components is must.

N. Compliance Clause: The contractor must submit a complete specification compliance statement for the proposed System.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 77 00.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 78 23.

B. Operation Data: Operating instructions.

C. Maintenance Data: Maintenance and repair procedures.

1.7 QUALIFICATIONS

A. Manufacturer: Company specialising in manufacturing the products specified in this section with minimum ten years documented experience, and with service facilities within the State of Kuwait.

B. Installer: Company specialising in installing the products specified in this section with minimum ten years documented experience, and certified first grade by Kuwait Fire Department as fire alarm installer. The installer shall be the approved service agent of the approved manufacturer.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of Kuwait Fire Department.

B. Furnish products listed and classified by UL or BSI as suitable for purpose specified and indicated.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.

B. Accept material on site in original packing. Inspect for damage.

C. Protect from moisture by using appropriate coverings. Store in dry interior locations.

1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance of fire alarm system for two years from Date of Substantial Completion.

1.11 EXTRA MATERIALS

A. Furnish under provisions of Section 01 77 00.

B. Deliver, store, protect and handle products to site under provision of Section 01 60 00 – Basic Product Requirements.

C. Provide ten manual station break-glass.

D. Provide five keys of each type.

E. Provide two of each type of automatic optical/ionisation smoke detectors without base and one of heat detector, duct detector, control element and master element.

F. Provide five each Fire telephone jacks, Fireman microphones and speakers, etc.

1.12 WARRANTY

A. Submit written guarantee signed by the contractor or the manufacturer for the period of 2 years from the date of substantial completion. The guarantee shall cover the repair and replacement of defective materials and workmanship as directed by the engineer except where any specific warranty from a supplier or manufacturer extends for a longer time.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. GENT, UK

B. Simplex, USA

C. EDWARD, Canada

D. Others : Under provisions of section 01 25 00 and requirements of this section.

2.2 FIRE ALARM, SMOKE DETECTION CONTROL PANEL AND MANAGEMENT CONTROL PANEL

A. Modular construction surface wall-mounted enclosure. Addressable with analogue detection technique suitable for number of devices with 15% spare as shown on drawings.

Provide with minimum 80 character visual display, printer and keyboard. Programme shall include proven technology to reduce false alarm together with automatic compensation and monitoring of alarm threshold levels to maintain sensitivity and to provide maintenance warning. Addressing shall be automatic without use of switch settings on devices. Provide with loop communication, open circuit and short circuit monitoring.

B. Power supply: Adequate to serve control panel modules, remote detectors, remote annunciators, door holders, smoke dampers, relays, and alarm signalling devices. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours followed by alarm mode for 60 minutes.

C. System Supervision: Component or power supply failure places system in trouble mode.

D. Initiating Device Circuits: Supervised zone module with alarm and trouble indication; occurrence of single ground or open condition places circuit in trouble mode [but do not disable that circuit from initiating an alarm].

E. Indicating Appliance Circuits: Supervised signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode but does not disable that circuit from signalling an alarm.

F. Indicating Appliance Circuits: Supervised signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode but does not disable that circuit from signalling an alarm.

G. Fire department Trip Circuit: Provide output connections for future use.

H. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.

I. Provide TROUBLE ACKNOWLEDGE, DRILL, and ALARM SILENCE switch.

J. Trouble Sequence of Operation: System or circuit trouble places system in trouble mode, which causes the following system operations:

1. Visual and audible trouble alarm indicated by device at fire alarm control panel.

2. Visual and audible trouble alarm indicated at remote annunciator panel.

3. Manual acknowledge function at fire alarm control panel silences audible trouble alarm; visual alarm is displayed until initiating failure or circuit trouble is cleared.

K. Alarm Sequence of Operation: Actuation of initiating device places circuit in alarm mode, which causes the following system operations:

1. Sound and display local fire alarm signalling devices.

2. Transmit zone-coded signal to central station.

3. Indicate location of alarm on fire alarm control panel and on remote annunciator panel.

4. Transmit signal by zone to building smoke removal system.

5. Transmit signals to building elevator control panel to initiate return to main floor or alternate floor.

6. Transmit signal to building mechanical systems to initiate shutdown of fans and damper operation.

7. Transmit signal to release door hold-open devices by zone.

8. Alarm Silence: Silences the alarm signalling devices, however, the audio-visual alarm on panel continues till reset.

L. Smoke Control Mode Operation of HVAC Equipment.

1. Provide and install all required wiring, controllers, control elements, installation, sensors, making good, co-ordination with Mechanical and HVAC works as shown on the drawings and specifications and other trade to allow for the complete execution of fire control mode as approved by the Engineer and KFD. In response to signal from fire control panel start smoke control fans and open door automatically for air make-up.

2. Stop AHUs. Open entrance doors automatically and start smoke exhaust fans.

3. Operate SEF's.

M. Fire Alarm for Fire Fighting Equipment: Furnish and install complete with all required wiring, conduits, master/control elements/interface units and all necessary equipment and connection to provide visual and audible fire alarm signals in the fire alarm panel, irrespective of whether shown on drawing or not.

The interface of the fire alarm and detection system to fire fighting equipment shall be fully connected, tested, commissioned, functional in all respects and fully co-ordinated with mechanical works and as approved by the Engineer and KFD for fire pumps, jockey pumps, isolating valve, foam control panels, chiller panels, sprinkler system, FM200, etc.

N. Alarm Reset: System remains in alarm mode until manually reset with key-accessible reset function; system resets only if initiating circuits are out of alarm mode.

O. Lamp Test: Manual lamp test function causes alarm indication at each zone at fire alarm control panel and at annunciator panel.

P. Drill Sequence of Operation: Manual drill function causes alarm mode operation as described above.

Q. Zoning: As indicated.

2.3 EVENT LOGGING PRINTER

A. Event logging printer is to automatically record each event/alarm occurring in the system. Event recording is to be recorded with time, date, category (alarm, trouble, etc.) and field-programme description of event location and respective response if any. Event logging printer shall be provided at Fire Station Building or at CUP2 Office, security and BMS building

B. Printer is to be 240V, 50 Hz AC-power operated, 9-pin, impact dot-matrix, bi-directional printer with a minimum of 200 cps printer speed, RS 232 communication with fault conditions reporting to the FAC for paper out and disconnected or broken cable. Printers parameters are to be set up with a menu-driven program using front panel switches for selecting.

2.4 COLOUR GRAPHIC DISPLAY TERMINAL

A. Graphic display station is to be completely autonomous, comprising graphics processor unit, high resolution colour display screen and editing terminal/digitizer tablet.

B. The colour graphic terminal shall allow a real time display of all alarms, fault conditions and specific status events in the entire fire alarm system, allowing identification of their origin by :

1. Location of fire panel
2. Zone and/or device location
3. Originating source
4. Priority of alarm/fault condition

C. Graphics presentation shall have a minimum of three hierarchical levels.

1. Area overview
2. Building overview
3. Flow overview
4. Room overview

D. Graphics are to be stored in a resident RAM memory and backed-up by a hard disk memory with the possibility to compose, modify or edit the graphic schematics, text, symbols and zone allocations on site without jeopardising the fire alarm system operation.

E. Selection and activation of a certain graphic display is to be either automatic (event driven) or by manual request via the terminal.

F. The terminal shall assign a number of different graphic pages to each fire event – from a site overview of building layout, through a floor layout, breaking the site down into increasing levels of detail. Number of graphic pages required shall be finally determined by the site engineer. However assume 4 pages per layout, based on the drawings produced on AutoCAD.

G. The system shall operate on the Windows environment. The platform specification required is an IBM PC compatible with the following minimum specifications.

1. Intel Core 2 Duo Processor
2. 1.33 GHz Speed
3. 2 GB RAM
4. 120 GB Hard Disk
5. 17” LCD Colour monitor
6. 2 Serial Ports and 2 Parallele Ports

7. Real Time Clock

8. DVD+/R-DL, RAM Drive

9. Mouse + Keyboard and all other accessories.

2.5 VOICE COMMAND CENTER AND NETWORK DISPLAY UNIT

A. Voice command center (VCC) with Network Display unit (NDU) shall be provided at the Fire Station Building and / or at CUP2 Office, security and BMS building for centralized monitoring and control entire premises. VCC shall enable public announcement to any of the zones in addition to automatically generated alarm messages.

2.6 INITIATING DEVICES

A. Manual Alarm Call Points

1. The manual call point shall be electrically compatible with the standard range of automatic detectors so that it can be connected directly into a supervised two wire zone of the control units for feed back loop circuit (Class A wiring).

2. The manual call point shall be of streamlined and flat appearance permitting its use as flush mounted unit as approved by the Engineer.

3. The unit cover must be secured against unauthorised removal. Every removal of the cover must release an alarm.

4. All inscriptions, texts and marks must be on the manual call point front plate, not on the glass, so that the glass can easily be replaced anywhere. The glass must be secured in the cover against falling out.

5. The manual call point shall be designed for fail-safe operation. The alarm contracts shall be of self-cleaning design to prevent failure after a prolonged period of inactivity.

6. The call point shall have a local indicator confirming its actuation, and it shall be possible to test the call point without destroying the seal or removing the cover.

7. The call point alarm actuating mechanism shall be equipped with strain limits, preventing permanent deformation of P.C.B and contacts.

8. The manual call point shall be equipped with a self-holding device to maintain the alarm condition until reset by an authorised person.

9. The manual call point housing shall accommodate the sealed electronic circuit for an individual address system.

10. The manual call point must be designed to permanently withstand corrosion, as defined by international standards.

B. Automatic Fire Detectors

1. Includes ionization smoke detectors, photoelectric smoke detector, and temperature rate-of-rise with maximum limit heat detectors and linear smoke beam detector. Any of the detectors shall fit in the same detector base so that only the detector head could be changed at any time without changing the base or disconnecting any wiring.

2. The base or the detector head shall be equipped with integrated hermetically sealed solid state pulse coding module for individual addressing and more intelligent signal processing with built-in alarm indicator.

   The base shall be supplied with a removable dust cover to protect the contact area during installation and construction phase of the building.

3. Provision for connecting a remote alarm indicator shall be available in every detector base.

4. The detectors provided shall be characterised by the following features as a minimum:

   a) The detector shall be of plug-in design for installation in pre-wired bases, with a built-in mechanism which allows mechanical locking of an installed detector head.

   b) The detectors shall be of impact proof material and vibration proof when fitted to the bases, with corrosion proof contacts.

   c) The detectors shall be protected against transient interference and its response behaviours must not be affected by the changes in operating voltage.

   d) Reversed polarity or faulty zone wiring shall not damage the detector.

   e) The response sensitivity of each detector shall be field-adjustable to one of at least seven levels. It shall be possible to test the sensitivity of a detector in the field. Sensitivity of a detector can be tested and adjusted through the software of the system.

   f) The response (activation) of a detector shall be clearly visible from outside by a flashing light of sufficient brightness.

   g) A built-in integration circuit shall allow the suppression of brief deceptive phenomena.

h) The detector shall be designed for fast and simple cleaning and with a built-in barrier to prevent entry of insects into the sensors.

i) The detector shall be inserted into or removed from the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance.

j) The detector shall connect to the local control unit via a fully supervised two-wire feed back loop circuit (Class A wiring).

5. In addition to the previous features the different types of detectors shall be specifically specified according to the following:

   a. Addressable Ionization Smoke Detectors:

      i. Smoke detectors shall be semi-recessed or surface mounted solid state, dual chamber ionization type capable of detecting visible and invisible products of combustion. Detector sensitivity shall be adjustable and shall be unaffected by changes in temperature, humidity and barometric pressure.

      ii. All radio active parts of the detectors shall be safeguarded against tampering. The radio-active source shall be fully gold plated.

      iii. The smoke entry windows of the detector shall be suitable for local air current patterns, and shall be installed within safe location as recommended by the manufacturer.

      iv. Detector operation shall incorporate a time delay, response integration circuit to minimise false alarms of smoking with built-in facility to isolate or connect this circuit according to the need of the protected room.

      v. Detectors shall be of plug-in design for installation on pre-wired bases.

      vi. A built-in indicator in the detector base shall indicate detector operation in alarm conditions.

      vii. The detectors shall be designed to provide satisfactory service without any harmful effects for prolonged and continuous periods with the following conditions:

         Ambient temperature: 0°C to 60°C

         Relative humidity: 95% RH continuous without condensation.

      viii. Smoke detectors and accessories in the explosion-proof areas shall be intrinsically safe type.

b. Addressable Photoelectric (Light Scattering) Smoke Detectors.

i. Photoelectric smoke detector shall be semi-recessed or surface mounted and shall respond predominantly to light white smoke.

ii. The detectors must exhibit uniform response behaviour in course of time.

iii. The light source intensity shall automatically adjust to compensate for possible effects of dirt and dust accumulation in the sensor.

iv. Smoke density in the chamber shall be measured by a symmetrical optical system.

v. The detection principle shall employ a multiple light pulse coincidence circuit, preventing false alarms.

vi. All electronic circuits must be solid state devices and virtually hermetically sealed to prevent their operation from being impaired by dust, dirt or humidity.

vii. All circuitry must be protected against usual electrical transients and electro-magnetic interference.

viii. Reversed polarity or faulty zone wiring shall not damage the detector.

ix. The response sensitivity of each smoke detector shall be field-adjustable to a minimum of seven levels. It shall be possible to test the sensitivity of a detector in the field.

x. The response (activation) of a detector shall be clearly visible from the outside by a flashing light of sufficient brightness.

xi. The smoke entry windows of the detector shall be field adjustable to match local air current patterns.

c. Heat Detectors: Heat Detectors shall be semi recessed or surface mounted, solid state with combination fixed temperature and rate of rise detection operating in temperatures above 50°C or rate of rise of 10°C/minute. They shall have removable protective cover to enable thorough cleaning and have the sensors protected against mechanical damage. A built-in indicator in the detector base shall indicate detector operation in alarm conditions.

d. Duct Mounted Smoke Detector: NFPA 72E, ionization type with auxiliary SPDT relay contact, key-operated NORMAL-RESET-TEST switch, duct sampling tubes extending width of duct, and visual indication of detector actuation, in duct-mounted housing. Addressable analogue type.

2.7 SIGNALLING APPLIANCES

A. Local alarm horns shall be flush, suitable for wall or ceiling, mountings, or suitable construction to match the interior design and as approved by the Engineer. Fully electronic, low voltage, low power consumption, matching the system and of rated sound level within 96 dB at 1 meter and 800 Hz continuous tone.

B. General alarm horns shall be fully electronic of combined visual/audible alarm horn and alarm flash light in a weather proof protective housing for out-door areas. The horn shall be of multi-tone switchable facility where different tones could be selected within the device provide continuous, intermittent or siren tones at a rate sound level within 105/115 dB at 1 meter and 1000 Hz.

C. ELECTRONIC SOUNDER WITH STROBE

A combined electronic sounder and strobe shall be capable of providing a minimum sound level of100dBA ± 2dBA @ 1 metre.

The sounder shall be capable of providing 3 different sound signals which are selected/ configured via the main control panel. Configuration of sounder patterns shall not be carried out locally at individual sounders.

In order to meet with the requirements of BS5839 Part 1, the frequency of sound signals emitted will be as follows:

- 800Hz Low tone
- 970Hz High tone

The unit shall have its own microprocessor to handle loop communications and monitoring of the internal strobe element for faults in both the quiescent and alarm conditions. The microprocessor shall also monitor the sound producing element during an alarm condition to ensure that faulty devices can be automatically identified during the weekly test procedure.

All associated electronic components shall be hermetically sealed to provide protection from hostile operating environments.

The electronic strobe element of the unit shall form part of the sounder horn of the device and shall have a matrix of high brightness LED's providing a light output equivalent to a 3W xenon strobe.

The frequency of the electronic strobe light output shall be 0.5Hz (Alert) and 1Hz (Evacuate).

- The unit shall be manufactured from ABS plastic with a polycarbonate lens. These devices shall be available in a 2 way configuration allowing for direct connection to the detection loop. It shall be possible to connect up to 60 low profiles combined electronic sounder/strobes to each detection loop of the fire alarm control panel.

2.8 AUXILIARY DEVICES

A. Control Module (Control Element)

1. The addressable control module shall be designed to convert specific signals on an addressable detection line from the control unit into control functions to actuate other modes as specified elsewhere.

2. The output contact of the addressable control module shall be rated for 0.5A and 240VAC.

3. The addressable control module shall have an input for a connection of an external contact to provide a confirmation signal to be sent back to the control unit via a detection line after the control function has been carried out.

4. The addressable control element shall be connected to be the control unit via a fully supervised two-wire circuit.

5. The control function to be assigned to the addressable control element shall be programmable at the control unit.

6. The addressable control module shall have a built-in response indicator lamp to flash during activation.

7. The addressable control module shall have terminals with built-in strain limits to prevent permanent deformation of the terminal and weakening of contact pressure.

8. The addressable control module shall operate reliably between 0°C and 60°C and up to 95% relative humidity.

B. Master Element: Provide addressable digital module to relay status of devices such as flow switch, temper switch, foam protection system.

C. Transformer/Rectifier/Battery Units for Door Closer and Door Opener Devices.

1. Fire door closers will be provided and installed for the doors specifically identified on the drawings. These fire door closers will each incorporate a 24 volt dc electro magnet which, when energised, shall hold the door open. Power for all door closers within a specific

fire alarm zone group shall be derived from a common transformer/rectifier/battery unit.

2. The transformer/rectifier/battery assembly shall be housed in a common enclosure with hinged lockable cover and fixed shrouded terminal blocks for all outgoing wiring. The batteries shall be enclosed in a separate compartment. An earthed electrostatic shield shall be provided between transformer primary and secondary windings.

3. In the event of an alarm, the appropriate fire alarm relay shall interrupt the supply to the associated electro-mechanical door closer, hence allowing the doors to close automatically.

4. The power unit battery bank shall be of the sealed lead-acid recombination type, and maintenance free, to provide a minimum of 1 hour standby at the output rating specified. The charger shall be constant voltage type with self protecting current limit and output voltage controlled within =2% of nominal voltage irrespective of =6% input voltage variation, and rated for 24 hour recharge. A “charge healthy” LED and floating load terminals shall be provided.

5. Provide at each electro-magnetic door closer location, a flush pattern, momentary action push button station for manual release of adjacent door closer (or pair of door closers in double door locations) in the positions shown on the architectural drawings. Stations shall be designed to break contact when pressed and re-establish contact when released. The push button shall be within flush brass or satin stainless steel front plate type to suit area, labelled “DOOR RELEASE” in both English and Arabic lettering.

6. The final connection to each electro-mechanical door closer, shall be via a flush mounted single gang junction box with overlapping cover plate located directly above the door transom mounted device, with circular flexible insulated and sheathed cable making back entry into device. All electro-magnetic devices and associated controls shall be earthed.

7. Door openers: Doors provided with door openers shall open the doors in case of a fire signal received from fire alarm panel. Necessary power supply shall be provided to each device. Co-ordinate with architectural specification for the details of the door opener device.

2.9 FIRE ALARM REPEATER PANEL (FARP)

A. Provide recess mounting fire alarm repeater panel at the location indicated in the drawings.

B. Programmable panel shall provide remote annunciation and control using an 80 character, back-lit, alphanumeric, LCD readout. Information is presented in clear, descriptive English language and includes: point status (alarm, trouble, etc.), alarm type (smoke detector, manual station, etc.), number of system alarms, supervisory conditions, and troubles, and a custom location label.

C. Alarm, supervisory and trouble conditions are also indicated by dedicated LEDs and a tone-alert. Each condition has a dedicated acknowledge push-button switch that silences the tone-alert but leaves the LED on until all conditions in that category are restored to normal. Switch operation is either globally or individually acknowledgeable, determined by the control panel operation. Repeated operation of the appropriate acknowledge switch will scroll the LCD display showing activity in the sequence of occurrence. The tone-alert also sounds to indicate the operation of any of the push-button switches.

D. Notification appliances can be deactivated by pressing the “ALARM SILENCE” switch. Pressing the “SYSTEM RESET” switch restores the system to normal operation. When system activity is normal, the LCD displays the time, and “SYSTEM IS NORMAL”.

E. Four programmable “CONTROL” switches and associated LEDs are included. Typical applications include: manual evacuation, door holder release bypass, elevator capture bypass, etc. All switches on the annunciator are controlled by the “ENABLE” key switch with a key is removable only in the disabled position.

2.10 SYSTEM MIMIC DISPLAY PANEL

A. Provide graphic annunciator panels and secure semi flush wall-mounted at the entrance of the CUP buildings, brush stainless steel mimic engraved display panel of all floors of the building incorporating as a minimum, the following fire alarm, fire fighting, smoke control and evacuation facilities:

1. Basic outline floor plan - per floor at 1:200 scale in black engraving showing escape staircases and primary corridor routes (where applicable), to staircase. Identify also the elevator locations, together with associated machine rooms where emergency evacuation procedures are to be performed.

2. Identify in red engraving where elevators are designated for fire fighting use, and locations of fireman’s switches.

3. Identify in red engraving the locations of Reception at Ground Floor.

4. Identify fire alarm bell zones in red engraving, with zone indicated by number.

5. Identify key plant room areas e.g. pump room, HT panel room, LT panel room, transformer vault, generator room, paralleling switchgear room etc., by black engraving.

6. Identify wet riser connection points by engraved blue circle and lettering.

7. Identify smoke control plant locations in engraved red circle and letter together with plant reference code used in DDC system control.

B. Provide graphic annunciator panels and secure semi flush wall-mounted at the entrance of the Utility Tunnel, brush stainless steel mimic engraved display panel of all floors of the building incorporating as a minimum, the following fire alarm, fire fighting, smoke control and evacuation facilities:

1. Basic outline floor plan at 1:200 scale or at the scale to be proposed based on the space available at the entrance of the Utility Tunnel ramp in black engraving showing escape staircases and primary corridor routes (where applicable), to staircase where emergency evacuation procedures are to be performed.

2. Identify fire alarm bell zones in red engraving, with zone indicated by number.

3. Identify wet riser connection points by engraved blue circle and lettering.

Identify smoke control plant locations in engraved red circle and letter together with plant reference code used in DDC system control.

C. LEDs are to be present in all areas within the complex. LED indications are to be provided indicating fire conditions in all areas.

D. The exact positions for wall mounting the mimic panels shall be agreed with the Engineer.

2.11 FIRE ALARM INTERFACE WITH BAS, PUBLIC ADDRESS SYSTEM, LIFT, ACCESS CONTROL AND VIDEO SURVEILLANCE SYSTEM ETC.

A. Provide and connect gateway to interconnect fire alarm system to Building Automation System, so that all the fire alarm data is available at the Building Automation System for control.

B. Provide and connect fire alarm system to public address system located in Management Control Centre for emergency paging override.

C. Identify clearly the CE provided for lift for interface with lift controllers.

D. Provision shall be made in the panels for future connection to the fire brigade.

E. Provide interface requirements with access control system and video surveillance system.

2.12 FIRE ALARM WIRE AND CABLE

A. Fire Alarm Power Branch Circuits: Building wire as specified in Section 260519/2.6 A-F.

B. Wires in galvanised steel conduit.

2.13 NETWORKING OF CONTROL PANELS

It shall be possible to network connect up to 31 controls as a secure network connection. The network shall be configurable so that single panels, groups of panels or all panels on the network operate the same site configured cause and effect fire plan.

The network shall also be configured to allow master control from any one of the control panels on the network, configuration operating across the network shall include master sectors co-incidence detection, non fire and supervisory actions.

It shall be possible to connect individual networks together via the use of domain bridges. Network to Network connection may be hard wired, modem or fibre optic link, the maximum number of panels within a linked secure network shall be 50.

2.14 ALARM CONTROLS

The following alarm controls shall be provided and shall operate on all control panels on the network:

- Sound Alarms
- Silence Alarms
- Reset
- Cancel Buzzer

USER ACTIONS BUTTONS

Up to 62 user action buttons shall be provided. The function of these shall be programmable and each shall be capable of displaying a label describing its function.

SYSTEM VIEW

It shall be possible to view all of the control panels and devices connected to the system on a “tree” representation (an expandable hierarchy of icons). It shall be possible to select devices in the tree by pressing on their icon. Once a device is selected it shall be possible to perform the following functions:

- Disable or enable the device
- Modify the device's label

Modify the auxiliary text associated with the device

2.15 FIREMAN'S TELEPHONE SYSTEM

A. The contractor shall design, supply, install, test and commission a complete fire telephone system. The contractors shall submit the system from the approved fire and voice alarm specialist who shall then design and provide the system Dedicated, two-way, supervised, telephone voice communication links between the FACP and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module.

B. Provide the following:

1. Common-talk type for firefighter use only.
2. Selective-talk type for use by firefighters and fire wardens.
3. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously.
4. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes audible signal to sound and high-intensity lamp to flash.
5. Selector panel controls simultaneous operation of telephones in selected zones and permits up to six phones to be operated simultaneously. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
6. Provide display to indicate location of caller.
7. Remote Telephone Cabinet: Flush-mounted cabinet, factory-standard red finish, with handset.
   a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating Fire Emergency Phone, with "break-glass" type door access lock.

C. Fire telephone jack points shall be provided at the locations and with the zone configuration shown on the drawings.

D. The building structure shall have a dedicated fireman's telephone system. The system shall enable a discreet 2-way voice link between the remote telephone outstations and the master station shall be installed within the control room at Ground Floor.

E. Communication with the Fire Telephones Control panel shall be achieved by plugging the portable handset into any of the jack outlet points located throughout the building (as shown on the drawings). The Fire Telephones Control panel shall acknowledge any communication request, activating visual and audible annunciation on the panel. The operator shall accept the call by depressing the relevant zone selector switch enabling two-way private communications to proceed.

F. The Fire Telephones Control panel shall be completely non-blocking and shall be capable of supporting simultaneous communication requests from all telephone outlet points. The operator shall have ultimate control and shall be able to select zones at his discretion. Once communication is attempted (by plugging the portable handset into the jack) the call request remains logged on the master station display until answered.

G. The system shall incorporate a phone-to-audio interface, whereby it enables any remote telephone jack point to patch through the system and become a microphone. In addition, the facility to enable communication between two telephone outstations of different zones (of the same building) shall be provided.

H. The contractor shall supply 5 nos. of portable handsets. These shall be stored in a metal enclosure marked with comprehensive instructions.

2.16 FIRETELEPHONE OUTSTATIONS (JACK OUTLET POINTS)

A. The telephone outstation jack outlets shall be wall-mounting type, located at the positions shown on the drawings. Jack outlet points shall be flush mounted unless otherwise noted.

B. Plate finishes shall match those of the lighting and small power wiring accessories.

2.17 FIREMAN'S MICROPHONES

A. The fireman's microphones shall be rugged, handheld dynamic units. The microphone shall have an integral push to talk button, a mounting bracket and a non-detachable, heavy-duty coiled cable, overall extended length between 1500mm and 2000mm. A volume control shall not be fitted to the microphone

2.18 OPERATOR PANEL

A. The integral operator panel comprises of a telephone handset / cradle and a push button / LED array that allows the operator to indicate 'outstation call in' and 'outstation circuit trouble'.

B. Momentary push buttons also facilitate
   1. Imitation of audible alert to a selected Fire phone outstation
   2. Initiation of audible alert to all Fire phone outstation
   3. Testing of lights and sounders
   4. Acknowledge fault sounder push button.

C. Provide as minimum twin LED indicators identifying:
   1. System healthy
   2. System trouble
   3. A.C supply healthy
   4. D.C charger healthy

D. All LED colors shall comply with BS 5839-1:2002+A2:2008.

2.19 FIREPHONE OUTSTATIONS

A. The Fire phone outstation shall be made available to suit the needs of the building design. These outstations shall comprise of the following:

B. Recessed wall box pattern, flush fit, complete with telephone handset and hinged door. Enclosure and telephone identified in fire red.

C. Surface mount pattern also in mild steel with 220-degree opening door and magnetic catch. All in fire red.

D. Desk version, conventional style telephone-red. Handset only, with jack plug for local socket point.

2.20 FIREPHONE SYSTEM OPERATION AND DIAGNOSTICS

A. Operator to outstation
   1. Operator lifts handset-“assurance” tone is heard from the earpiece.
   2. Operator depresses relevant push button –associated channel LED lights and assurance tone is cancelled.
   3. Operator depresses ‘call’ outstation button called outstation is imitated –ring tone returned to operator handset earpiece –outstation lifts Firethorn handset, ring tone cancelled at outstation and operator handset earpiece –two way duplex speech proceeds. Upon call competition both operator and outstation return handsets to respective cradles-Operator panel automatically resets.

B. Outstation to operator panel
   1. Outstation lifts telephone –respective Fire phone outstation push button/call in LED flashes and sounder initiated –ring tone issued to outstation handset earpiece.
   2. Operator lifts handset, sounder cancelled –operator selects pulsating LED outstation selector, LED goes ‘steady’ and two way full duplex speech path established.
   3. Further call in requests made whilst the operator is engaged
   4. Flashing outstation lights, short bleep remainder tone, operator can take calls in any order of preference.
   5. In event of a handset outstation left off the hook, operator can depress “call” key and howler “attention getting” sound issued by handset earpiece.
   6. The operator can also initiate ringers all outstations by depressing one “ALL CALL” key.

C. Diagnostics
   1. Each outstation line circuit is supervised. Trouble indication from open or short circuit line is indicated by LED displays on the operator panel.
   2. Both AC and DC supply circuits are monitored and fault indication raised should these occur.

3. A sealed lead acid battery integral with the system to meet BS 5839-1:2002+A2:2008 is provided for service in the event of AC mains failure. Damage against deep discharge is provided to protect the battery.

2.21 VOICE EVACUATION SYSTEM

A. Voice Evacuation System shall have facility to broadcast the background music. The system shall be seamlessly integrated with the fire detection system. The integrated public address and voice alarm system shall comprise of voice command centers (units with facility to control the audio) as shown in the contract schematics and distributed amplifiers, adopting NFPA Class a Style 7 wiring. All loop cabling and any other components and accessories deemed necessary for a safe, reliable and satisfactory system shall conform to the relevant and applicable requirements and recommendations of NFPA 72/ BS 5839-1:2002+A2:2008.

B. Prior to placing order for any equipment, the contractor shall submit comprehensive document comprising working drawings, catalogues and descriptive literature of components, maintenance manuals etc for engineer's study and approval. The contractor shall be required to train and instruct client's personnel in the correct use, operation and supervision of the system, preferably prior to the handing over of the project.

C. The contractor shall ensure that all system components offered shall be manufactured by one manufacturer who shall also be on the Kuwait fire brigade list of approved manufacturers and be established in KUWAIT for a minimum of 5 years. The Contractor shall be responsible for all submittals of complete design information to KFB for obtaining all necessary approval certificates prior to the commencement of the installation and upon completion.

D. In order to ensure whole site integration capability, the voice alarm system will be awarded to a single specialist manufacturer of both fire and voice and the awarded contractor shall be responsible for the design, global operation, management and interfacing of these systems.

E. The system shall be fully programmed to accommodate fire alarm and voice communication zones as indicated on the drawings and schematics. The system shall be configured to allow on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to the buildings.

F. All distributed amplifier unit components and devices shall be connected to two-wire loop circuits with each component adhering to NFPA Class A Style 7 standards of wiring. Removal or disconnection of any component from the loop or short circuits on the loop, shall not affect the functioning and performance of other components on the same loop and on the system. Speaker circuits may be wired in NFPA Class B style.

G. The system components shall be allocated addresses automatically from the fire alarm panel at the time of system power up, as is the case with fire alarm devices. However the speakers need not have a specific address.

H. Facility to introduce/change delay periods in operating speaker circuits, shall be possible to program from FACP without the need to change any hardware. All the programming related to voice alarm speaker circuits should be restricted to the FACP. Introduction of separate programming for operation of speaker circuits, into the voice command units shall not be acceptable.

I. The distributed amplifier rack units shall house the amplifiers and the speaker circuits shall be wired as shown in the schematics. The distributed amplifier racks shall be mounted close to the broadcast zone they are to serve so that the loudspeaker wiring is minimized. Each of these units shall house the power supply, battery backup and full monitoring facilities. These units shall be modular in construction allowing for a high degree of flexibility so that the performance can be closely matched to the requirements. This unit shall meet the Voice Alarm Standards as hitherto mentioned in NFPA 72 and BS 5839-1:2002+A2:2008 Part 8. These units shall have the facility to accept background music from the Entertainment Rack with an override facility in case of fire.

J. The Voice Command Unit for audio controls shall be designed to complement the fire alarm control panel. It shall provide manual access to the voice alarm section of the system. The voice command centre shall be an integral part of the fire alarm control panel unit. If in case this unit has to be independent of the FACP then the interlinking between the FACP and the Voice Alarm Command Unit shall adhere to NFPA Class A Style 7 standard. Silencing and sounding and the programming of the phased evacuation of the speaker circuits shall all be done from the fire alarm control panel only. Controls on the voice command unit shall be available for broadcast zones of the voice alarm as per the contract drawings. Standard configurations shall allow for recorded Alert and Evacuate messages as well as an emergency microphone to be operated in each area. In addition up to four other recorded messages shall be stored in this unit.

K. The distributed amplifier rack units shall also be wired to the detection loops of the fire alarm control panels only. This shall be in addition to the audio cable interlinking the voice command centre for audio controls the distributed amplifier racks.

L. The integrated Public address and Voice alarm system shall cover all normally accessible areas as shown on the contract drawings. In addition loop powered loop signaled electronic sounders connected to the fire alarm system shall be provided.

M. The Distributed Amplifier Rack Units shall include amplifiers for local areas. These units shall be capable of complete standalone operation for the areas it is assigned to, should the network/interface connections fail

N. In the event of a catastrophic failure occurring on any individual component within the Distributed Amplifier Rack Unit, pre-recorded emergency alarm message shall still be available at the voice command audio control unit.

O. Loudspeakers installed throughout the corridors and public areas of the premises shall normally be used for background music but in case of the fire alarm, the voice alarm system shall take priority.

P. Initiation of voice alarm shall take immediate priority and shall cancel all other PA operations.

Q. The voice alarm system shall be capable of broadcasting pre-recorded emergency alarm messages and live speech in the event of fire detection system activating.

R. The systems shall be capable of broadcasting up to four different pre-recorded messages to different zones or group of zones simultaneously.

S. Evacuate signal relates to a general evacuation message and alert message corresponds to standby instructions.

T. In addition a FIRE DRILL and an ALL CLEAR message shall be incorporated into the operation.

U. A fire alarm broadcast signal shall cancel any public address operation and shall override it.

V. A fireman's microphone shall be fitted to the Voice Command Centre units. These shall allow direct voice instructions to be transmitted to a single zone, selected zones or all zones.

W. When a fireman's microphone is operated, this shall override any automatic voice alarm signal being transmitted to the zone selected. The Alert and Evacuate pre-recorded messages will be maintained in other zones while live voice fire announcements are being broadcast to selected loudspeaker zones.

X. Speakers serving a particular area shall be fed from two different circuits so that emergency messages can be broadcasted in the event of a failure of one circuit.

2.22 VOICE COMMAND CENTRE WITH AUDIO CONTROLS

A. The Voice Command Unit with the audio controls shall be a mains and battery backed unit and shall be an integral part of the main fire alarm control panel. However, standalone voice alarm panels installed next to the Fire Alarm Control Panel shall also be acceptable provided the interlink between these two panels conforming to NFPA Class A Style 7 wiring. These units shall initiate the broadcast of live speech in the designated public areas using manual controls. The use of these units

shall be primarily for broadcast of fire messages and other optional auxiliary messages, which are site and application specific.

B. There shall be an audible indication by an integral buzzer to announce a local Voice Command Unit fault.

C. The user controls on the unit shall be key switch enabled to allow authorized use of system controls.

D. The Audio loop shall connect the Voice Command Units to all the Distributed Amplifier Units. The audio loop shall carry the messages and data from the master Voice Command Unit to the distributed amplifier units in the system. The messages it carries shall be from the microphone or from the auxiliary message stores.

E. The integral microphone with Press to talk button shall be located behind the enable controls door. It shall be possible to loop connect 10 external all call microphones for fire announcements.

F. The Voice Command Unit shall be capable of storing 4 auxiliary messages (as mentioned below) that can be initiated at this unit for broadcast on the secure fire alarm network with each message of 45-seconds duration.

1. Test
2. All Clear
3. Alert
4. Evacuate

2.23 DISTRIBUTED AMPLIFIER RACK UNITS

A. The Distributed Amplifier Rack Unit shall be mains powered and battery backed and shall be normally installed near its loudspeaker circuit area. They shall amplify audio signal for broadcast to its zones of loudspeakers. The audio signal shall be either live or pre-recorded messages. The live speech shall be from the microphone and the prerecorded messages from the digital stores, which shall be local on the Alert and Evacuate Store Modules in this unit.

B. Each of this unit shall consist of a maximum of 7-8 loudspeaker circuits with each channel powered from separate amplifier module, to secure the broadcast of messages.

C. The amplification of audio shall be by means of amplifier modules installed in the Distributed racks. There shall be a number of modules available with various power ratings to meet the loudspeaker requirements. Their frequency bandwidth shall be in the range of 150Hz to 20Khz if used in conjunction with the BGM rack or upto 4KHz is sufficient if only voice is to be transmitted.

D. The Distributed racks shall meet the requirements of NFPA 72/ BS 5839-1:2002+A2:2008 Part 8. Each of the distributed racks shall be given a label by the Fire Alarm Control Panel to identify its location in the system. The label shall be automatically displayed along with any events related to the distributed racks.

E. The Distributed rack shall facilitate optional local live speech. The global speech shall be broadcasted from the Voice Command Unit microphones via the audio loop to all the Distributed racks and its loudspeaker circuits in the system.

F. The distributed racks shall be IP40 rated.

G. The Distributed racks shall be connected to the entertainment system to allow broadcasting of the background music as a low priority task. This shall be done via the background music card installed in these racks.

Tuning method: Electronic, onsite adjustable with LED on station.

2.24 SPEAKERS

A. The speaker shall be either suitable for flush mounting to a false ceiling of any configuration or for surface mounting if there is no false ceiling. It shall be equipped with a multiple tapping-matching transformer to provide easy control of speaker sound volume. Supporting brackets to mount the speaker onto false ceilings of different configurations shall be provided. The diameter of the speaker shall not be more than 180mm.

B. It shall satisfy the following performance characteristics;
1. on-axis frequency response not to vary by more than ± 10 dB over the frequency range 150Hz to 20KHz
2. Sensitivity not to be less than 90dB/W
3. Nominal input power to be at least 2W

2.25 WIRING

A. All cables associated with Fire Alarm installation shall be fire resistant 2 core 1.5 sq mm-screened type. Cables shall comply with BS 7629-1:2008 and BS 6387. The cable for use on the Audio loop and the loudspeaker circuit shall be of the following type and specification. (Typically 1 km per circuit. The audio loop may exceed 1 km)

- the cable is to BS 6387 having
- typically no more than 2 cores
- a maximum of 0.5 micro-farad intercore capacitance
- a maximum of 13 ohms per core

- each core having no less than 1.5 sq mm cross sectional area
- with an inherent or thorough metal conduit screen for earth continuity in order to produce electrical protection and screening
- having protection from heat an mechanical damage
- the cable screen must be capable of being earthed at each system device (outstation)

C. An extra 2-core cable shall connect the entertainment rack to the distributed amplifier units for the broadcast of background music.

D. Multi core cables having more than 2 cores shall not be allowed for loop wiring due to inadequate separation and possible interference problems.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install system according to relevant BS/ NFPA standards and local fire brigade requirement.

B. Fire Alarm Power Supply Disconnect: Paint red and label "FIRE ALARM." Provide with lockable handle or cover.

3.2 EQUIPMENT INSTALLATION

A. Manual Alarm Call Stations: Mount semi flush in recessed back boxes. Mounting height as indicated.

B. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised.

C. Smoke Detectors: Install ceiling-mounted detectors not less than 4 inches (100 mm) from a side wall to the near edge. Install detectors located on the wall at least 4 inches (100 mm), but not more than 12 inches (300 mm), below the ceiling. For exposed solid-joist construction, mount detectors on the bottom of the joists. On smooth ceilings, install detectors not over 30 feet (9 m) apart in any direction. Install detectors no closer than 60 inches (1520 mm) from air registers.

D. Audible Alarm-Indicating Devices: Install not less than 90 inches (2280 mm) above the finished floor nor less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes. Combine audible and visual alarms at the same location into a single unit.

E. Visual Alarm-Indicating Devices: Install adjacent to each alarm horn and not more than 80 inches (2030 mm) above the finished floor and at least 6 inches (150 mm) below the ceiling.

F. Device Location-Indicating Lights: Locate in public space near the device they monitor.

G. FACP: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

3.3 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceway according to Section 260533 "Raceways and Boxes for Electrical systems." Conceal raceway except in unfinished spaces and as indicated.

B. Wiring within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

C. Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

D. Colour Coding: Code-code fire alarm conductors differently from the normal building power wiring. Use one colour code for alarm circuit wiring and a different colour code for supervisory circuits. Code-code audible alarm indicating circuits differently from alarm-initiating circuits. Use different colours for visual alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling and terminals according to Section 260553 "Identification for Electrical systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorised service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

C. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.

D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

E. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72. Minimum required tests are as follows:
   1. Verify the absence of unwanted voltages between circuit conductors and ground.
   2. Test all conductors for short circuits using an insulation-testing device.
   3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
   4. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
   5. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
   6. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
   7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications.
   8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards. Obtain local authority approval for the installation.

G. Report of Tests and Inspections: Provide a written record of inspections, tests and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.

H. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

3.6 CLEANING AND ADJUSTING

1. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.7 DEMONSTRATION

A. Startup Services: Engage a factory-authorised service representative to provide start-up service and to demonstrate and train Owner's maintenance personnel as specified below.
   1. Train Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of 8 hours' training.
   2. Training Aid: Use the approved final version of the operation and maintenance manual as a training aid.
   3. Schedule training with Owner with at least 7 days' advance notice.

3.8 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls and sensitivities to suit actual occupied conditions. Provide up to 3 requested adjustment visits to the site for this purpose.

END OF SECTION