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## 2. FIRE ALARM AND DETECTION SYSTEMS

### 2.1 GENERAL

#### 2.1.1 Scope

1 This part specifies the requirements for the material, installation, testing and commissioning of fire alarm and detection systems for use within buildings. It covers all the system components for efficient operation.

#### 2.1.2 References

1 The following standards and references are referred to in this Part:

BS 5445	Components of automatic fire detection systems
BS 5839	Fire detection and alarm systems for building
BS 5306	Fire extinguishing installations and equipment on premises
BS 6360	Conductors in insulated cables and cords

#### 2.1.3 Contractor's Responsibility

1 The Contractor shall arrange for an approved sub-contractor, to supply, install, wire and commission the complete manual/automatic fire alarm system comprising manual fire alarm call points, alarm bells and sounders, smoke and heat detectors optical smoke detectors, combined smoke and heat detectors, duct mounted smoke detectors, flame detectors, alarm heights (xenon beacon), remote indicating lights' and control panels as indicated on the drawings. The system shall be designed, installed and maintained in accordance with the recommendations of BS 5839.

#### 2.1.4 System Description

1 The Contractor shall provide and install the system in accordance with the Project Documentation, applicable codes and manufacturer's recommendations.

2 Fire alarm panels, repeater panels, detection components, alarm components, cables, other materials and their installation shall be approved by Civil Defence Department, Ministry of Interior, State of Qatar.

3 The fire alarm system sub-contractor shall be registered with, and on the approved contractors list of the Civil Defence Department.

4 The fire alarm and automatic detection systems shall meet the requirements and comply with the relevant British Standards and shall meet the requirements of National Fire Protection Association.

5 The system shall be suitable for 240 V, 1 phase, 50 Hz power supply and be complete with standby sealed lead acid gas-recombination type long life batteries and charger to provide a 24 V DC for detection and alarm system.

6 Where the installation extends beyond more than one building the system in each building shall be self-contained with visual and audible alarms. A common fire alarm and common fault signal from each system shall be displayed on the control room repeater panel.

## **2.1.5 Quality Assurance**

- 1 Items and equipment specified in this part shall be provided by experienced and approved manufacturers and contractors as designated in the Project Documentation or to the written approval of the Engineer. All equipment shall be UL listed and shall be supplied from the same manufacturer who has a minimum of 10 years experience in the active manufacturing of fire alarm systems.

## **2.2 CABLING**

### **2.2.1 General**

- 1 The wiring size shall be not less than 1.5 mm<sup>2</sup> for call/detector circuits and 2.5 mm<sup>2</sup> for bell and battery circuits. The system shall be of the two wire type.
- 2 Cabling in fire alarm detection systems shall comply with the relevant provisions of BS 6883 and BS 5839.
- 3 In enclosed work areas and accommodation areas, zero halogen type cables shall be used.
- 4 Cables shall be able to withstand the IEC 331 gas flame test, enhanced to 3 hours at 950 °C.
- 5 Conductors shall be circular tinned wires complying with the relevant provisions of BS 6360, Class 2.
- 6 The Contractor shall provide and install the system in accordance with Project Documentation, applicable standards and manufacturer's recommendations. All wiring shall be in a conduit system which is separate from other building wiring. Junction boxes shall be sprayed red and levelled "Fire Alarm".

### **2.2.2 Cables**

- 1 Fire alarm cables shall be rated for 600/1000 V grade unless otherwise stated in the Project Documentation.

### **2.2.3 Insulation**

- 1 Fire alarm system cables shall have the following type of insulation as specified in the Project Documentation:
  - (a) pressure packed magnesium oxide insulation
  - (b) a composite insulation of mica impregnated glass tape beneath an extruded layer of ethylene propylene rubber (EPR)
  - (c) silicone rubber insulation.

## **2.3 CONTROL PANEL**

### **2.3.1 General**

- 1 The main fire alarm control panel shall be located in the main control room and shall be wall mounted. The fire alarm system shall protect all risk areas within the premises by giving warning of a fire condition when detected by an automatic detector or by the manual operation of a break glass call point. The risk area shall be divided into zones and each zone shall have its own fire indicator on the control unit. The control and indicating equipment, power supply unit and repeater panels shall comply with the electro-magnetic compatibility (EMC) test requirements described in BS 5839 and the Electronic Engineers Commission (EEC) requirements for the EMC directive 89/336/EU and the subsequent amendment 92/31/EU.

- 2 A diagram shall be provided adjacent to the control panel showing the general layout of the building and the fire zones. The diagram shall be engraved with black paint filling on a white ebonite sheet of thickness not less than 2 mm. The letter height shall be 5 mm. The diagram shall be coloured to show the extent of the area covered by each fire zone. A different colour shall be used for each zone.
- 3 Upon receipt of an alarm, the control units shall perform the following actions:
  - (a) illuminate fire zone detector
  - (b) activate alarm warning devices within the building
  - (c) operate internal fire sounder
  - (d) operate ancillary devices as appropriate
- 4 Alarm warning devices shall be de-activated by operation of the 'Silence Alarms' switch. The internal sounder will continue to operate and the fire indicators remain lit until the key switch controlled push switch is operated. This should only be achieved if the alarm initiating device is no longer in alarm.
- 5 Reset of the controller, after the fire incident has been investigated, will be achieved by operation of the 'Reset' switch.
- 6 The fire alarm panel shall comply with BS 5839 Part 4 and requirements herein and be suitable for installation of fire detection and alarm systems to BS 5839 Part 1.

### 2.3.2 Fabrication

- 1 The panel shall be of the multi-zone, modular type and capable of extension. The number of zones shall be related to the requirements of the individual buildings and shall be agreed with the Engineer. As a minimum, the fire alarm panel is to be wall mounted and suitable for 6 zones with all modules installed.
- 2 A lockable smoked glass door shall protect the face of the panel from access by unauthorised personnel.
- 3 The enclosures of panels shall be fabricated from sheet steel, minimum thickness 1.5 mm and shall be provided with a hinged lockable door. Protection to at least IP54 shall be provided.
- 4 Control panels shall as a minimum requirement be equipped with the following:
  - (a) mains supply on indicator
  - (b) DC supply faulty indicator
  - (c) alarm indicator for each zone
  - (d) alarm accept push-button to acknowledge fire alarm signals, silence external audible alarms and energise an internal beeper unit or sounder
  - (e) reset push-button to restore monitoring systems to the inactive condition
  - (f) integral sealed battery and trickle battery charger where appropriate
  - (g) alarm transmission facilities via the telephone alarm system (this facility shall be provided for future use if not utilised under this Contract)
  - (h) termination for incoming and outgoing wiring systems
  - (i) voltage free normally closed circuits which shall open in the event of an alarm to shutdown ventilation and air conditioning equipment in the immediate vicinity of the alarm
  - (j) suitable fault indication (both visual and audible)
  - (k) interfacing facility to connect to Civil Defence Department system
  - (l) interfacing facility to control elevator system
  - (m) interfacing facility to control air handling units (AHU) of the HVAC systems
  - (n) interfacing facility to control fire doors/dampers.
- 5 Alarm indicators shall be of the light emitting diode type. Indicators shall be provided in pairs for each function.

6 Control panels shall continuously monitor all alarm circuits, including wiring and control devices. When a fault monitoring circuit has been energised it shall not rest until the fault condition is cleared.

7 The control panel shall include the following:

- (i) power supply normal light (green LED)
- (ii) power supply fault light (amber LED)
- (iii) battery charger fault light (amber LED)
- (iv) general evacuate push button
- (v) silence alarm push button
- (vi) reset push button
- (vii) common fire light (twin red LED)

8 Repeat facilities shall be available for common fire and fault conditions. In addition, two normally open/normally closed (NO/NC) volt free auxiliary contacts each rated at 2.5 amps (inductive) for 24 V DC and 240 V AC shall be available

9 Cable entries are to be made from knock-outs located on top and bottom of the fire alarm panel.

10 The removal of any detector(s) shall not effect the performance of other detectors in the system.

11 The sensitivity of any of the sensors shall be adjustable from the control panel.

## **2.4 BATTERIES AND CHARGING EQUIPMENT**

### **2.4.1 General**

1 The system shall be of the 24 V DC, monitored, open circuit type utilising transformed and rectified mains voltage supply under all normal circumstances but with stand-by provision in the form of rechargeable sealed lead-acid batteries.

### **2.4.2 Batteries**

1 Batteries shall have a capacity capable of maintaining the system in normal working condition for at least 24 hours and in the alarm state for at least 30 minutes without recharging unless otherwise stated in the Project Documentation.

### **2.4.3 Battery Chargers**

1 Battery chargers are to be of sufficient capacity to power the system whilst recharging a fully discharged battery. The battery shall be fully charged within 8 hours.

## **2.5 DETECTORS**

### **2.5.1 General**

1 Detectors shall conform to the relevant provisions of BS 5445 and be fully compatible with the system offered and shall comprise a fixed base which can be used with other types of detector head.

2 The base shall have fixed non-corroding terminals and contain no electronic components.

3 The head shall comprise the sensing elements which shall be housed in a corrosion proof enclosure which can be fixed to the base by a bayonet or plug-in twist-lock mechanism.

- 4 The sensing elements shall be exposed to the atmosphere through a protective cover which will allow free movement of air but provide a high degree a resistance to dust and insects. A small drain hole shall be included to allow any condensation to drain.
- 5 Integral LED's shall be provided which will confirm operation and also permit detector testing.
- 6 The removal of a detector from its base shall cause a fault signal to be indicated.
- 7 It shall be clearly stated on the head of the detector the type of element it contains or the principle on which the detector operates.
- 8 All detectors shall operate at a nominal voltage of 24 V DC and shall exhibit long-term stability and reliability under the prevailing conditions at the installation location.

#### **2.5.2 Optical Smoke Detectors**

- 1 The sensors shall utilise the light scattering principle. They shall employ a photoelectric cell and light source so arranged that only light scattered by smoke particles falls on the photoelectric cell.
- 2 The Optical smoke detector shall respond to the visible smoke produced by smouldering or burning materials.
- 3 The detector shall be fully operational after initiation of an alarm without any maintenance.

#### **2.5.3 Combined Smoke and Heat Detectors**

- 1 Combine smoke and heat detector shall comprise of two chambers. One chamber containing the photoelectric smoke detector and the other chamber shall contain the heat detector.
- 2 The smoke detector shall utilise a horizontal optical bench construction which houses the detector and the optical sensor. The detector shall be arranged for radial detection of forward scattered light.
- 3 The heat detector shall operate at fixed temperatures set at 57 °C, 71 °C or 99 °C to trigger the alarm. The setting shall depend on the application and as specified in the Project Documentation.
- 4 The detector shall be fully operational after initiation of an alarm without any maintenance.

#### **2.5.4 Heat Detectors**

- 1 The detector shall be a combined unit including both fixed temperature element and rate of rise temperature element.
- 2 Each heat detector shall incorporate a dual thermal element which responds to either an excessively high temperature or a rate of rise of temperature which is unacceptable.
- 3 The heat detector shall operate on the principle that one element is exposed to the atmosphere whilst the other is contained in such a way that it is not so readily affected by increasing temperature. At a certain rate of rise of temperature or at a pre-set fixed temperature, the imbalance between the two elements shall cause the detector to trigger.
- 4 The fixed element of the heat detector shall be the type that can be reset for renewed detection. The detector shall be fully operational after initiation of an alarm without any maintenance

### **2.5.5 Duct Mounted Smoke Detectors**

- 1 Duct smoke detectors shall be provided in the main return air duct adjacent to each air handling unit (AHU).
- 2 They shall be of the duct mounted type and initiate alarm in case of a developing fire. These shall be provided with two sampling tubes. The first, an inlet tube for intake of air from the duct to the sensor assembly. The second, an exhaust tube to allow air to leave the assembly.
- 3 Duct smoke detectors shall be interlocked with the air handling unit motor and volt free contact shall also be provided to raise an alarm on the main fire alarm panel. Installation of duct mounted detectors shall be approved by the Air Conditioning Section of MEW.

### **2.5.6 Infra-Red Flame Detectors**

- 1 The infra-red flame detectors shall be capable of detecting infra-red radiation produced by flaming fires involving carbonaceous materials.
- 2 The infra-red flame detectors shall be approved and listed by the Loss Prevention Council Board (LPCB) and manufactured under the appropriate category by the Underwriters Laboratories, Inc. (UL), and shall bear the "UL" mark.
- 3 The infra-red flame shall be able to detect a fuel fire of 0.1 m<sup>2</sup> area from a distance of 30 m for the following fuels:
  - (a) petrol
  - (b) N-heptane
  - (c) kerosene
  - (d) diesel oil
  - (e) alcohol
  - (f) ethylene glycol
- 4 The infra-red flame detectors shall employ narrow band optical filters that block unwanted radiation such as that emanating from the sun or tungsten filament lamps.
- 5 The infra-red flame detectors shall be designed to be sensitive to modulation of the received radiation in a small range of frequencies corresponding to the flicker of flames.
- 6 The infra-red flame detectors shall be designed to have high resistance to contamination and corrosion.
- 7 The electronic assembly of the infra-red flame detectors shall be encapsulated in high resistivity epoxy resin.
- 8 The infra-red flame smoke detectors shall include radio frequency interference (RFI) screening and feed through connecting components to minimise the effect of radiated and conducted electrical interference.
- 9 The infra-red flame detector shall incorporate an LED, clearly visible from the outside, to provide indication of alarm actuation.

### **2.5.7 Remote Indicating Lights**

- 1 All fire detectors shall be provided with remote indicator facility. The remote indicator output shall diode gated for protection against electrical interference generated along the remote indicator wiring and to enable one remote indicator to be connected to a number of detectors. The remote indicator shall be polarity independent and operate at constant brightness over the range of 8-28 V.

## 2.6 ALARMS

### 2.6.1 Manual Fire Alarm Call Points

- 1 Manual fire alarm call points shall consist of a die cast plastic enclosure with a die cast plastic cover locked in position with screws. The enclosure shall house a micro switch. The micro switch plunger shall bear onto an inset break glass panel fixed into the cover. The call point shall be arranged for surface or flush mounting as appropriate. The cover and the enclosure shall be self coloured red. The words 'BREAK GLASS FOR ALARM' shall be printed on the frangible glass. A testing facility using a special key shall be provided to enable the call point to be tested without breaking the glass and the frangible glass shall be covered with plastic film to prevent injury when the glass is broken. The mounting height shall be 1400 mm above finished floor level.
- 2 The switching unit contacts shall be gold or silver plated or on alloyed metal which will not corrode when left unattended in a highly polluted environment. Contact blades and other metal parts of the switching unit shall also be constructed from plated or alloyed metal which will not corrode when left unattended. Contacts shall be normally open or normally closed to suit the alarm monitoring system. The voltage and current rating of the contacts shall be marked within the enclosure. The items shall have approval and listing by the LPCB (Loss Prevention Council Board).
- 3 The call point shall be suitable for direct connection into the wiring system, and shall comply with the relevant provisions of BS 5839: Part 2.
- 4 The call point shall be resistant to the ingress of dust and water to IP55.

### 2.6.2 Alarm Bell

- 1 Red underdome indoor fire alarm bells shall be installed in locations complying with the relevant provisions of BS 5839 and in locations as indicated in the Project Documentation. Each bell shall be suitable for 24 V DC operation and shall be polarised. The output shall not be less than 90 dBA at 1 m distance. 150 mm diameter underdome bells shall be used indoors and 225 mm diameter underdome bells shall be used outdoors. Outdoor underdome bell shall be to IP44.
- 2 Alarm bells shall be of the gong type. They shall be continuously rated and mounted 2200 mm above finished floor level.
- 3 Bells shall be painted red and marked with the words "FIRE ALARM".
- 4 Each bell or sounder circuit shall have a separate fuse at the fire alarm control unit.

### 2.6.3 Electronic Sounders

- 1 Electronic Sounders shall comply with the relevant provisions of BS 5389 and BS 5306 and shall be suitable for 24 V DC use. These sounders shall be coloured red and be polarised, suppressed and suitable for line monitoring. Electronic sounders are to have a low current consumption of approximately 30 mA but have a minimum output of 100 dBA at 1 m.
- 2 The electronic sounder shall be capable of providing at least two distinct and different sounds and be suitable for "on site" adjustments.

### 2.6.4 Alarm Lights

- 1 Visual flashing alarm lights shall be located above doors and openings as indicated in the Project Documentation. They shall be of the xenon flashing type and suitable for 24 V DC. The wording "Fire" shall be prominently displayed when this alarm is activated.

END OF PART