ANNEXURE C.2
TECHNICAL SPECIFICATION – SMOKE DETECTION

INDEX

1 OBJECTIVE

This specification covers the general technical specifications and components for **analogue addressable fire detection and alarm system,** as well as installation requirements**.**

2 DETECTION SYSTEM

2.1 GENERAL

The fire detection system shall consist of a central control unit connected to field devices such as fire detection devices, monitoring and control devices and annunciation devices located throughout the protected area.

The control unit shall continuously monitor the analogue status of all sensing devices and initiate action when a fire or smoke condition is present. The control panel should make all decisions regarding the state of the system from the information received from each field device. All interfacing such as the monitoring of the sprinkler flow switch, gas release pressure switches, signals to open detection zones etc. shall form part of this contract as indicated on the drawings.

The operation of the system shall be field configurable from the control panel via a keypad or Windows based software to suit the specific application and to permit future changes. This configuration shall be maintained under power failure conditions.

The control unit shall have a front panel compromising of indicating LED's, control keyboard and backlit LCD display, as described in detail later. The LCD display will give details of any event which occurs in the system.

Data ports are to be provided for communicating with remote LCD repeaters, intelligent mimic panels and graphics computers.

The fire panel shall be modular in design and have facilities for operating as stand-alone units, or as part of a network.

In terms of SANS 10139 Code of Practice, the systems to be installed shall be L1, and M as indicated in the scope of work document.

2.2 TECHNICAL STANDARDS

The design of the fire detection system shall be approved to:

- SANS 10139.
- BS EN 54
- The panel shall also be manufactured according to ISO9001 Standards.
- Notwithstanding the above also where specifically required other relevant codes or standards as indicated in this specification

2.3 POWER SUPPLY

1.1.1 General

The largest alarm load is the maximum load imposed by the fire alarm system on a power supply under fire conditions. It will include the power required to operate the sounders,

detectors, fault warning devices, the illumination and any ancillary services powered by the fire alarm system etc.
Any power required for a display should be derived from the fire alarm system power supply and should be taken into account when assessing the capacity of the power supply.

The load imposed on the power supply by the simultaneous operation of detectors or manual call point (or both) shall not cause an existing fire alarm to cease. In systems using microprocessors or stored programs, the imposition of the maximum alarm load should not cause incorrect operation.

2.3.1 Normal Power Supply

The normal supply for the fire detection and alarm reporting systems shall be derived from the nearest electrical distribution panel and shall form part of this contract. Is all cases the tenderer shall allow for the installation of a mini distribution board, 20A DP isolator and 5A SP circuit breaker at the nearest electrical distribution panel. It shall also include conduit to the fire panel. This installation shall be done by a qualified electrician and a certificate of compliance shall be provided.

2.3.2 Standby Power Supply (Secondary Batteries)

Where secondary batteries with an automatic charger are used they should be of a type that has a life of at least 5 years under the conditions of use likely to be experienced in the fire alarm system. Automotive lead-acid batteries (e.g. the type normally used for starting cars) are not acceptable.

Because the life of the battery frequently depends on its charging conditions, care should be taken that the battery charger satisfies any requirement specified by the battery supplier. Where replacement batteries or battery chargers are used, similar care should be taken to ensure charging compatibility. Replacement cells shall be compatible with the existing cells in both charge and discharge characteristics. The supplier of the system shall specify a method of test that is likely to predict failure of the battery in the interval between routine tests.

The charging rate of the battery shall be such that, having been discharged to its final voltage, the battery can be charged sufficiently to comply with the recommendations after a charging period of 24 hours.

2.4 ANALOGUE ADDRESSABLE FIRE PANEL

2.4.1 Panel Description

The fire alarm panel shall be a 24-volt analogue addressable unit, designed to communicate with the sensors and field devices. It shall be a microprocessor based unit, and shall incorporate all hardware and software to enable it to make decisions based upon information received from sensors, and operate appropriate outputs to initiate required alarms and signals.

The panel shall comply fully with standard EN54-2

The control unit shall continuously monitor the analogue status of all sensing devices, and initiate action when a fire or smoke condition is present. The alarm management shall be field configurable from the control panel via a key pad to enable the system to be tailored

to suite the protected building, and to permit future changes. This configuration shall be maintained under power failure conditions.

The control unit shall have a front panel comprising of indicating LED's, control keyboard, and LCD display, as described in detail later.

The panel shall have the amount of zones as indicated in the bill of quantities. The zones must be fully field programmable to permit sensors to be allocated to any zone. It shall be a multi loop panel, as indicated on the design drawings. The fire panel electronics shall be completely modular offering easy expansion from 2 to 8 loops in 2 loop increments with zone fire and fault indications expandable from 16 to 64 zones in 16 zone increments. Expanding or adding options shall be by means of plug-in modules that are automatically configured by the system. The fire panel shall be able to operate up to eight loops. Each loop shall be capable of handling a maximum of 126 addressable devices. These devices may be either detectors or controllers, monitors and input/output units as described below.

The zoning must be manually configured on system start-up or on request by an authorised operator. The panel must provide facilities for the operator to inspect the zoning configuration, and inhibit, or activate devices. Facilities must be provided for identifying all active and inhibited addressed, and all connected device types. The panel shall support at least the following types of sensors and monitors:

Fire Sensors

- Ionisation smoke detectors
- Optical smoke detectors
- Heat detectors
- Manual call point (indoor and waterproof)
- Multi-sensing detectors
- CO sensors
- HSSD devices
- Beam detectors

Monitoring Controllers

- Zone monitoring unit; used to interface a conventional zone of detectors to the analogue addressable system
- Isolator; for short circuit protection
- Sounder circuit controller; used to operate sounders in a zone

Input/Output Devices

- Input/Output Unit; one monitored, and one unmonitored opto-coupled
- Input and one loop powered relay
- Output; one loop powered relay
- Switch monitor unit; for monitoring normally open or normally closed contacts
- Switch monitor plus; a standard switch monitor incorporating circuitry to monitor flow switches
- Mini switch monitor; a switch monitor in a moulding
- Mini switch monitor (interrupt); a manual call point monitor incorporating an interrupt facility for fast response

Gas control unit

Gas status unit

2.4.2 Panel Operation

Four levels of access into the system menu via the keypad are to be provided:

- Level 1 : Operating (no access code required)
- Level 2 : Maintenance Technician (access code required)
- Level 3 : Commissioning (access code plus key)
- Level 4 : Access Code Changes (access code plus key)

Facilities for “locking-off” controls are to be provided.

The panel is to incorporate a keyboard and push-button with the following functions:

- Numeric keyboard
- System reset button
- Alarm accept button/silence alarm button
- Alarm sound button
- Panel buzzer “mute” button
- Lamp test function
- Control buttons as required for system operation
- Menu functions for maintenance and commissioning

2.4.3 Device Identification Device Status and Polling

The panel must automatically identify every device on the address line during initial start-up, and record this information in memory. Thereafter the panel should check the device types on every scan, and indicate a "wrong device" fault should a device be changed to an incorrect type.

The control panel shall poll all devices attached to the system within 5 (five) seconds. The analogue value must be read and stored in memory on every scan.

The status of a device, once polled, must be assessed by the control panel which should indicate the following conditions:

- Fire
- Pre-condition
- Fault (Communication, wrong device type and device removed)
- Maintenance
- Device statistics as detailed elsewhere

The system shall incorporate a polling system which polls each sensor individually and reads information at regular intervals to the control unit. The idle value shall be continuously updated in order to compensate for ageing and atmospheric conditions. The panel shall make decisions based upon the number of devices attached to the loop.

All communication shall be under the control of the panel, which shall sequentially poll each device in turn and authorise communication. No device shall communicate with the control panel without authority. The control panel must be able to read information from a device or send instructions to a device.

The panel shall monitor each device on every scan, and give a fault signal for any of the following conditions, within 30 seconds:

- Detector removed
- Address unit removed
- Incorrect device type

2.4.4 Calibration

The system must check the calibration of each analogue line device and record changes caused by environmental contamination. When maximum calibration adjustment is reached the panel must indicate a “maintenance” signal. This must be a dedicated signal, and must be separate from the pre-alarm” signal.

The build-up of dirt or similar contamination on the optical surface will cause the output signal from the detector to gradually change. The control panel shall be capable of monitoring this slow change in signal and at a predetermined level indicate that the detector is in need of servicing.

2.4.5 Panel Display

All display and indicators shall be LCD for text, and LED for lamp indication. The type, calibration, sensitivity and status of each device must be able to be displayed at the control panel. The control panel shall be able to physically identify the zone in which each sensor or device address resides, and shall give a “configuration-fault” signal if a sensor or device address is located in the incorrect zone. Fire indication shall be by zone, displayed on LED indicators, and on the LCD text display.

Fault, maintenance, pre-alarm, and device/zone disabled signals shall be indicated visually by LCD text display, and audibly, in the control unit. The top portion of the LCD text display shall always show the first alarm received. The lower portion of the LCD text display shall show the last alarm received. It must be possible to manually scroll through all alarms on the lower portion of the screen, using “up” and “down” scroll buttons.

The display must show the total number of alarm events currently in the system. Fire alarm shall take priority when displaying. However, it must be possible to view all events currently in the system, displayed devices, and other events. It shall be possible to view the devices, by address, that initiated the alarm on the LCD text display, on manual request. When viewing the device, a 40 character location message specific to each device shall be displayed.

The visual indications must be arranged so that the different warnings are clearly distinguished. (i.e. amber for fault, red for alarm). The internal audible signal device may be the same for all alarms, but either tone variation or time switching shall be used to differentiate the signals. Outputs shall be provided for audible alarms, control functions, remote mimics and connection for computers and printers.

The LDC text display must be able to simultaneously display a minimum of the following information in each display mode.

One Display Mode:

- Type of alarm
- 2 Zones (first and last)
- Alarm count
- Total number of alarms
- 40 Character zone location message for each zone
- Time and date

Device Display Mode:

- Type of alarm
- 2 Zones (first and last)
- Alarm count
- Total number of alarms
- 40 Character zone location message for each zone
- Time and date

Device Display Mode:

- Loop number, zone number, detector address
- Alarm count
- Detector in alarm
- Alarm type
- Active or accepted
- Time and Date

The LCD must be at least a 160 character display.

2.4.6 Software Algorithms

The data from which sensor must be evaluated by intelligent software algorithms to identify the presence of fire or smoke, and any possible faults present. The system must support a number of software different algorithms, each tailored to suit the profile of a different hazard or protected area. These algorithms must be specifically matched to provide the optimum protection for each type of area. It must be possible to allocate selected algorithms independently to each sensor in the system. In addition, different algorithms must be to be automatically allocated to the same sensor at different times.

It must be possible to customise algorithms to take into account special conditions that may exist in certain specific hazards. This customisation should incorporate the features below.
Alarm sensitivity relative to each analogue detector is to be individually adjustable, device by device, by the control panel.

Not less than four levels of sensitivity adjustment are required for each device, as follows:

- Smoke sensors (1) 1.5%/m obs
  (2) 2.5%/m obs
  (3) 3.5%/m obs
  (4) 5.0%/m obs

- Heat Sensors (1) 42°C
  (2) 58°C

(3) 70°C
(4) 82°C

2.4.7 Line Monitoring

The control panel shall monitor the loops for short-circuit, open circuit and physical removal of devices from the system. Faults of this nature shall be indicated visibly and audibly within the time period specified in EN54 Part 2.

2.4.8 Memory Allocation

The control panel shall allow for the allocation of system memory to suit individual site applications.

For this purpose system memory shall be able to be allocated to the following functions:

- Input/output programming, including Boolean logic
- Text
- Event buffer

2.4.9 Panel Controls

The control panel shall have the following control keys as minimum:

Alpha/numeric keypad with scroll and arrow keys

- Silence Buzzer
- Disable Function
- Test Function
- Reset
- Test 3rd Source

Sounder

- Sound Alarms
- Delay ON/OFF Toggle
- Fault/Disable
- Silence

Fire Brigade

- Call Fire Brigade
- Delay ON/OFF Toggle
- Fault/Disable
- Stop Fire Brigade

2.4.10 General Outputs

The control panel shall provide, as a minimum, the following general outputs:

- Common Fire Relay

- Common Fault Relay
- Supervised Alarm Bell Relay
- Supervised Fire Brigade/Evacuation Relay

All relay ratings shall be 2A @ 24V DC

2.4.11 Programmable Outputs

A minimum of 4 programmable output relays shall be provided internally to the panel. It shall be possible to expand this via a current loop connecting to remote fireman's panels which will provide either 8, 16, 32 or 64 open collector outputs. These outputs may be programmed as zone fire/fault outputs or normal freely programmable outputs.

Programmable outputs shall also be able to be added at any point in the loop taking up one address.

2.4.12 Data Outputs

The following data outputs shall be provided by the control panel:

- Two RS232 ports which can be assigned to text, graphics, external printer or modem
- Single or Dual RS485 ports available for networking of up to 31 control panels
- Current loop to drive up to a combination of 15 fireman's panels and repeaters

2.4.13 Programmable Inputs

It shall be possible to program inputs and outputs from any of the following sources:

- Panel Inputs
- Panel Relays
- Field I/O devices
- System I/O devices
- Inter-panel I/O by means of networking
- Programming facilities shall include the use of Boolean algebra.

2.4.14 Panel Printers

- Internal Printer

The panel shall provide as an option an internal 40 column impact printer.

External Printers

It shall be possible to connect external printers to the panel by means of a RS232 port. These printers shall be assigned as being either event printers or report printers.

2.4.15 Networking

The networking capabilities of the system shall be such that up to 32 control panels may be connected via RS485 medium or optical medium. The system shall ensure rugged, reliable and peerless operation in that no master panel shall be required for the system to operate. It shall be possible to remove and add to the network to allow for easy expansion

of the system.

The network shall use an industry standard protocol such as ARCNET or ETHERNET to ensure that no data is corrupted.

The network shall be able to provide:

- Inter-panel Input / Output Programming
- Remote Uploading/Downloading of System Configurations to individual panels
- Remote Maintenance Features
- RS232 Nodes for connection to Graphics Packages, Building Management Systems and modems
- Global Repeater Panel
- LCD Repeaters

2.4.16 Software Control

In order to ensure the reliability of the system, the following requirements for software design shall apply:

The software shall have a modular structure.

Measures shall be included in the program to prevent the occurrence of a deadlock in the system. The execution of the program shall be monitored. The memory contents containing program and configuration data shall be checked automatically at intervals not exceeding 1 hour.

2.4.17 Programming

Programming will be possible from the keypad at the front of the panel or by downloading data from a PC. All programming will be menu-driven and protected by access codes and memory lock.

The programming will allow for at least the following functions:

- Programming Output Relays
- Programming Detectors
- Programming Inputs/Outputs
- Uploading/Downloading of configuration data

It will be possible to programme all the above also from a PC by downloading the information to the panel. This will allow the installer/user to have a copy of the complete system's programme in magnetic medium. One way of programming will not exclude the other.

It will be possible at all times to upload the stored programme to a PC in order to maintain updates.

All executable code and data shall be held in memory, which is capable of continuous, reliable, maintenance free operation, for a period of at least 10 years. The program shall be held in non-volatile memory, which can only be written to at access level 4.

The site-specific data shall be protected against power loss by a back-up energy source, which can only be separated from the memory at access level 4. The back-up battery shall be capable of maintaining the memory contents for at least 5 years.

2.4.18 Processor Monitoring

The panel must be provided with fault tolerance enabling monitoring and resetting of the microprocessor in the event of microprocessor failure. For diagnostic purposes, a counter must allow the viewing of the incidents that the processor has been reset by the system. This information must be stored in non-volatile memory, enabling it to be viewed even if the panel has been turned off. The counter must only be able to be reset by an authorised engineer, under a level 3 access code.

The microprocessor must perform full diagnostic tests on all memory devices on start-up, as follows:

- RAM Test (Running Data)
- EPROM checksum verification (Programme storage)
- EEPROM checksum verification (Site Configuration Storage)

Should any test fail an audible and visual fault indication must be given, and the LCD display must indicate the nature of the fault.

The control unit shall perform periodic checksum tests, at intervals not exceeding 60 minutes, on the RAM, EPROM, EEPROM memories, and give and audible, visual, and LCD text fault indication in the event of a discrepancy.

It must be possible to view the original and current checksums for all memories on the pane LCD display, as a maintenance (level 2) function.

In the event of a fault condition where the processor will not restart within 20 seconds, the panel must give an audible and visual alarm indication.

2.4.19 Fire Panel Cabinets

Where fire panels are located outside a building, the fire panel (analogue addressable or conventional) shall be mounted inside a lockable IP65 cabinet.

The cabinet shall be constructed from minimum 0.8mm sheet metal and shall be powder coated. The colour shall be red. It shall allow for conduit entry from the top, bottom, sides or from the back. The cabinet shall be large enough to house the fire panel, power supply unit, backup batteries as well equipment as specified.

The cabinet shall have a safety glass door to enable viewing of the fire panel without having to open the cabinet. The door shall also be lockable with a master key system allowing one key to fit all cabinets. Five sets of keys shall be provided with the cabinet.

2.5 ALARMS

The alarm threshold level of each analogue device shall be individually adjustable from the control panel. Four levels shall be available each having a fixed pre- and fire alarm threshold.

The system shall automatically raise the alarm threshold of all devices as their quiescent analogue value increases as a result of environmental contamination. When the maximum level of compensation is reached for a sensor the panel must indicate a "Maintenance" condition for that specific sensor. There shall be no limit to the number of devices which may be in alarm simultaneously.

Every analogue detector must have the facility for verifying the validity of an alarm signal over a 20 second period, before initiating an alarm. This alarm verification function must be able to be enable or disable, on a device by device basis, from the control panel.

2.5.1 Alarm Outputs

The panel must incorporate two monitored audible alarm outputs for the switching-on of bells or electronic sounders. These outputs must be continuously monitored for open and short circuit. Each output must be rated at 0.75 A at 24V DC.

A test facility shall be provided in order to test each of the alarm bell outputs. When the test is initiated the selected alarm bell will operate intermittently. Alarm bells will have a delay facility, which is selected by controls on the front panel. Manual call points will override this delay.

2.5.2 Alarm Contacts

One voltage free change-over contact must be provided. This must operate on a “fire” condition, and is to remain “on” until the system is reset. The contacts are to be rated 2 A at
24 V DC.

2.5.3 Double-Knock (Coincidence) Operation

It shall be possible to programme any of the control outputs or addressable relays to operate upon an alarm from any two sensors in the programmed group.

2.5.4 Alarm Verification

The control panel shall employ methods to eliminate false alarms from occurring. Alarm verification of automatic devices must be programmable on a zone by zone basis. Alarm verification shall be selectable as normal, one detector confirmed, or two devices simultaneously in alarm.

Fire alarm response times shall be within the parameters of EN54 Part 2. The reporting of manual call points to the control panel shall be done on an interrupt basis. Once devices are in a pre-condition state, the scan rate shall be increased in order to decrease the reaction time.

2.5.5 Silencing Operation

It shall be possible to programme any of the control outputs or addressable relays to operate in either “silencing” mode or “non-silencing” mode.

- In “silencing” mode the relay or outputs shall de-activate when the “alarm accept” button is pressed, or when the “reset” button is pressed, or when the “reset” button is pressed.

- In “non-silencing” mode, the relay or output shall be de-activated only when the “reset” button is pressed.

2.5.6 Activation Delay

It shall be possible to programme any of the control outputs or addressable relays to activate after a delay period from receipt of the control signal.

This delay shall be 0-16 minutes, in one second increments.

2.5.7 Software Control

All the above functions, shall be under software control, and programmed through the panels keyboards or by means of a computer. It must be possible, as an option, to programme the panel off-line on a computer, and download the programme into the panel. It must be possible to save the programme to disk for future reference.

2.5.8 Level of Sound

A minimum sound level of either 65 dB(A), or 5dB(A) above any other noise likely to persist for a period longer than 30s, whichever is the greater, shall be produced by the sounders. Where required, high volume fire sirens shall be supplied and installed. These sirens shall have a sound level of not less than 110dB(A) at 1 metre, and have a 1000 m range and be suitable for continuous operation.

2.5.9 Discrimination

The alarm sound shall be distinct from the background noise or any other sounders likely to be heard, and in particular should be distinct from the audible fault warning signal given in the control equipment. All fire alarm sounders within a building should have similar sound characteristics.

2.5.10 Frequency

The fire alarm sounder frequencies shall lie in the range of 500 Hz to 1000 Hz. If a two-tone alarm is used, at least one of the major frequencies should lie within this range.

2.5.11 Sound Continuity

The sound of the fire alarm should be continuous although the frequency and amplitude may vary for example as in a warbling note, provided that the distinction from the alert signal is clear.

2.5.12 Audible Alarms in Noisy Areas

In part of buildings where there are noisy machines, the power requirements of the high power sounders that are needed may place excessively high demands on the capacities of standby supplies. In such cases, the sounders of the fire alarm system (the primary sounders) may be reinforced by secondary sounders operated directly from the mains supply and without standby supplies, provide that:

- when the machine noise ceases and the secondary sounders are out of service, the

primary sounders meet the sound levels recommended.

- the primary sounders in all other parts of the premises are distinctly audible at all times when operated, and

- failure of the supply to the secondary sounders will either result in the silencing of the noisy machines or in the giving of an audible and visible fault warning at the control and indicating equipment.

2.5.13 Intelligibility

Any speech message that carries information or instructions relevant to fire action should be intelligible above the background noise in any part of the building to which the message is addressed.

Where the sound level of this message falls below that recommended, the message should be preceded for at least 6 second by an attention – drawing signal, that has at least the loudness recommended and that is used only as a fire warning signal. Where the fire action in the building depends on the reception of verbal messages, the attention drawing signal should not normally last for more than 10 seconds.

2.5.14 Interfacing to Detection System

Fire sirens shall normally be loop powered and comply with the abovementioned specifications. Where specified high volume fire sirens shall be used. These sirens shall be supplied complete with power supply, relay unit for activating the siren and shall be red in colour.

2.6 REMOTE PANEL OUTPUTS

An optional serial port shall be provided for connecting to remote panels and computers. The remote units must have the following display and controls:

Remote 160 character LCD text display which repeats all events being displayed on the panel display.

-
- Numeric keyboard
- System reset button
- Alarm accept button/silence alarm button
- Alarm sound button
- Panel buzzer “mute” button
- Lamp test function
- “Help” button
- Control buttons as required for system operation
- Menu functions for maintenance and commissioning

Peripheral Panels : A full range of compatible repeater panels and devices shall be available for connection to the main system.

2.6.1 Global Repeater Panel

A global repeater panel shall be provided or available to display all data, and to provide control of all the control panels on the network at a central point. From the global repeater

panel it shall be possible to upload/download and configure any control panel connected to the network.

2.6.2 Local Repeater Panels

Two types of local repeater panels shall be available:

- Full Repeater Panel
- LCD Repeater Panel

The full repeater panel shall look identical in appearance to the control panel and shall provide all LCD display data and zone fire and fault indications. All the controls of the associated control panel shall also be available. The repeater shall connect directly to the RS485 or optical network.

The LCD repeater shall be used only to repeat the LCD data of the main control panel. No zone indication LED to fire and fault will be available, however, all the controls of the associated control panels will be available. The repeater shall connect directly to the RS485 or optical network.

2.6.3 Conventional Repeaters

A complete line of conventional repeater panels shall also be available. The repeaters shall be available as 8, 24 or 32 zone repeaters each having the following outputs:

- Alarm and Fault LED indication per zone
- Common Fire
- Common Fault
- In Service / Processor Running
- Communications Failure

The following inputs shall also be available:

- Sound Alarms
- Silence Bells
- Silence Buzzer
- LED Test

The conventional repeaters shall connect directly to the current loop of the control panel.

2.6.4 Firemans Panel

The fireman's panel PC board is provided as an open collector repeater in order to accommodate mimic panels and to provide remote zone fire and fault outputs or remote freely programmable outputs. Each output will drive at least 10mA.

The repeater will have the following outputs:

- Either 8, 16, 32, or 64 freely programmable open collector outputs
- General alarm
- General fault
- In service/Processor running
- Communication failure

This board will have inputs for local silence buzzer and LED test. The fireman's PCB will connect directly to the current loop of the control panel.

2.6.5 Graphics Terminals

The system shall be capable of operating with colour graphic packages residing on personal computers. The personal computer shall connect directly to the control panel via a RS232 port or to the network via a RS232 node.

2.7 DEVICES and LOOP DEVICES

2.7.1 General

Sensors shall have complete electromagnetic and electrostatic protection against externally generated noise and the effects of devices such as fluorescent light fixtures, variable frequency motor controllers, cellular telephones, and electrical surges from other sources. Protection must meet the European Directive CE336/89, and must comply with the following standards:

- IEC801-1: General surge protection requirements
- IEC801-2: Electrostatic discharge
- IEC801-3: Radiated Electro magnetic interference
- IEC801-4: Voltage transients – Fast transient bursts
- IEC801-5: Process equipment : surge immunity requirements

In addition, sensors must be fully resistant to RFI interference to a signal strength of 10v/m over a frequency range of 1MHz to 1000 MHz, and a signal strength of 50v/m over 50v/m over cellular telephone signal ranges 450-466 MHz, and 890 – 960 MHz.

An indicator LED shall be provided on the detector, which illuminates when the detector is in an alarm condition. The indicator shall be operated independently of the detector from the central point panel. Provision shall be made fro an output from the detector suitable for operation of a remote indicator LED. The output shall be operated independently of the smoke detector from the central point panel.

The installer, using high integrity sealed dipswitches shall set the unique address of the detector. Each device on line must be uniquely identifiable by the control unit. This must be achieved by pre-setting the address of each device. Removal of a detector head from its base must extend a fault condition to the control unit.

The identification of each type of address unit and each type of sensor (i.e. multi-sensor, ionisation detector, heat detector, sprinkler switch, etc.) must be transmitted to the panel on each polling scan.

The condition of each line device, including circuit, calibration and contamination, must be transmitted to the panel on each polling scan.

2.7.2 Line Isolators

It shall be possible to fit loop isolators at a spacing defined on the drawings. The isolators shall protect against short circuits, and partial short circuits, on the loop by isolating that section of the loop where the short circuit occurred, thus maintaining the integrity of the remainder of the system. All line and loop insulators shall be installed below ceiling level,

on ceiling boards and labelled as a line isolator.

2.7.3 Manual Call Points

Manual call points shall be clearly identifiable and simple to use without the need for instructions regarding their method of operation. The method of operation of all manual call points in an installation shall be identical. If necessary, a striker shall be provided adjacent to the call point to facilitate breaking the cover. The delay between operation of a call point and the giving of the general alarm shall therefore not exceed 3 seconds. All call points shall be of the type with the flap installed. Flap has to be lifted before glass can be broken

Call points shall be fixed at a height of 1.4 metres above the floor, at points as indicated on the drawings. Manual call points shall be sited against a contrasting background to assist in easy recognition. They may be flush mounted in locations where they will be seen readily, but where they will be viewed from the side (e.g. in corridors) they should be surface mounted or semi-recessed in order to present a side-profile area of not less than 750mm^2.

Where external (Outdoor) manual call points are shown these shall be installed in IP65 rated boxes at the positions indicated. These boxes shall be red with the words “FIRE ALARM CALL POINT” written on them. The box shall not be lockable but shall be kept closed by means of a magnetic lock. At the external call point a siren and strobe light shall be positioned directly above the call point approximately 3.0 meters above floor level. Above the strobe light a 450 x 450 double face FB5 fire alarm sign shall be mounted triangularly from the wall. All strobe lights and sirens shall be weather proof, suitable for mounting on outsides of buildings. Operation of the siren and strobe shall be dedicated to the manual call point

2.7.4 Detector Bases

Sensors must plug into separate mounting bases with a twit-lock action. The bases shall be fitted with corrosion resistant connector springs and terminal screws with captive clamping plates. All bases shall incorporate a concealed security lock to prevent unauthorised removal of tampering with sensors. It shall be possible to activate the security lock in areas where required. With the security lock activated, it must only be possible to remove a sensor from its base using a special tool.

There shall be a facility on the base for attaching a label indicating the address of that detector. A similar facility shall be available on the detector, enabling the fitting of a label indicating its address. When the detector is fitted to its base, both the detector and base address labels shall be visible, and aligned adjacent to each other.

2.7.5 Analogue Addressable Heat Detectors

Heat sensors shall comply with standard EN54-5 (1996)

The heat detector shall be electronic in operation, and shall monitor ambient temperature by means of a NTC thermistor. The detector shall be capable of operating within the following environmental limits:

Description	Value
Temperature	–20°C to +60°C.

operating range	
Humidity operating range	0% to 95% RH (excluding condensation)
Wind	Not affected

Each detector shall be suitable for protecting an area up to 50m² at a height of up to 7.5m. The installation and siting of the sensors shall be carried out on accordance with SABS 0139 : 2000 Edition.

2.7.6 Analogue Addressable Optical Detectors (Photoelectrical)

Photoelectric optical smoke sensors shall comply with standard EN 54-7.

The photoelectric optical smoke sensors shall be suitable for detecting visible smoke such as is produced by slow smouldering fires. They shall be of the light scattering type using a pulsed internal LED light source and a photocell sensors.

The detector shall be capable of operating within the following environmental limits.

Description	Value
Temperature operating range	–20°C to +60°C.
Humidity operating range	0% to 95% RH (excluding condensation)
Wind	Not affected

The detector shall be capable of protecting an area up to 100m² at a height of up to 12m. The installation and siting of the sensors must conform to SANS 10139.

2.7.7 Analogue Addressable Ionisation Detectors

Ionisation smoke sensors must comply with Standard EN 54.7

Ionisation smoke sensors will be suitable for detecting invisible products of combustion as well as visible smoke and be of the dual chamber source type to provide good stability in changing environmental conditions.

The radioactive source shall be Americium 241 mounted in such a way that it is mechanically secure. The device shall have been certified by the National Radiological Protection Board or a similar body. The detector shall be capable of operating within the following environmental limits:

Description	Value
Temperature operating range	–20°C to +60°C.
Humidity operating range	0% to 95% RH (excluding condensation)

Wind	Up to 10 m/s

The detector shall be capable of protecting an area up to 100m² at a height of up to 12m. The installation and sitting of the sensors must conform to SABS 0139: 2000 Edition.

2.7.8 Analogue Addressable Multisensors

Multisensors shall comply with standard ISO 72401-15.

The multisensor sensors shall incorporate photelectronic optical smoke sensors, and high sensitivity thermal sensors, software interlocked to provide early warning from all types of smouldering and thermal fires. Multisensors shall be able to be operated by the control software as combination multisensing devices, or as smoke sensors only, thermal sensors only.

- The smoke element shall be of the light scattering type using a pulsed internal LED light source and a photocell sensor.

- The thermal element shall utilise high sensitivity, high speed thermistors optimised to measure small changes in temperature, and rate of change.

The elements shall measure both absolute smoke and thermal levels, but also rate of smoke and thermal change.The smoke and thermal elements must report independently to the control panel, and must be software interlinked to enable intelligent high-level decision-making.

The detector shall be capable of operating within the following environmental limits:

Description	Value
Temperature operating range	–20°C to +60°C.
Humidity operating range	0% to 95% RH (excluding condensation)
Wind	Not affected

The detector shall be capable of protecting an area up to 100m² at a height of up to 12m. The siting of the sensors must conform to SABS 0139 : 2000 Edition.

2.7.9 Optical Beam Detectors - Analogue Addressable Through Input Units

Optical beam smoke detectors shall be supplied complete with transmit and receiver units, power supplies, mounting bracket and addressable input units.

The beam detector shall thus be fully addressable and it shall be possible to connect the beam detector to the fire detection loop to receive and view alarm inputs on the fire panels and graphics.

The detector offered shall function reliable with the transmitter and receiver 100m apart, shall incorporate self-checking and automatic compensation software.

The beam detectors shall be installed at a distance below the roof structure that is permissible by the manufacturer. If additional mounting brackets are required, these will be included in the cost for the detector.

Where beam detectors are required to be protected against false alarms by motion detection, suitable passive infrared motion detectors and control panel shall be provided. Activation of the motion detector shall disarm the beams. The re-activation of the beam and control thereof shall incorporate a timing device. On disarming, an adjustable timer (adjustable between 0 to 30 minutes) shall keep the beam disarmed and only if no movement is sensed over the set time period shall the beams be re-armed.

Motion detection requirements are indicated on the drawings and in the Bills of quantities

2.7.10 Infra-red and UV Flame Detector

Infra-red Flame detector

The flame detector must be of the dual infra-red type, solar blind. Both alarm and fault relays must be incorporated with the option for use on 4-20mA systems. The spectral response must be between 1.00 and 2.8 μm. The detector must be suitable for 2 or 4 wire operation. The detector must be capable of detecting hydrogen flame.

UV Flame detector

The UV flame detector must have a spectral response of 185 to 260 nm. Both alarm and fault relays must be incorporated. The detector must be of the non-flameproof type. The facility must exist to switch out the fault relay for 2 wire operation. The minimum field of view must not be less that 100^{o}. The detector must be capable of operating from 12 or 24V DC.

2.7.11 Zone Monitor Unit

The zone monitor unit will interface a zone of conventional, non-addressable detectors and call points to the analogue addressable system. This unit will connect to the 2-wire loop. The device shall power the conventional zone from the analogue addressable loop and supervise the zone for short circuit and open circuit by means of an end-of-line resistor.

The device shall report fire alarms and faults to the panel under a single address common for all the conventional detectors. The alarm LED on the detectors will light up in alarm condition. The unit shall have an output to drive a remote LED.The zone monitor unit shall be available in a flush mount and surface mount versions.

2.7.12 Input/Output Unit

The input/output unit shall provide a programmable voltage-free, single pole, change-over relay output; a single, monitored switch input and an unmonitored, non-polarised opto-coupled input. The unit shall be loop-powered and operate at between 14-28 VDC.

The output relay rating shall be 1 A at 30 VAC or DC maximum. A flush mount and surface mount version shall be available.

2.7.13 Output Unit

The output unit shall provide a voltage-free, single pole, change-over relay output rated at 30 VAC or DC maximum. The unit shall be loop powered and operate between 14-28 VDC. A flush mount and surface mount version shall be available with maximum dimensions 150x90x48 mm.

2.7.14 Switch Monitor Unit

The switch monitor unit shall be designed to monitor the state of one or more single pole, volt free contacts connected on a single pair of cables and to report the status to the analogue addressable control panel. The unit shall provide four input states to the control panel: 'Normal', 'Fault', 'Pre-alarm' and 'Alarm'. The switch monitor unit shall be loop powered and operate between 14-28 VDC.

A flush mount and surface mount version shall be available.

2.7.15 Switch Monitor Plus Unit

The switch monitor plus unit shall be identical in appearance to the standard switch monitor unit but shall incorporate additional circuitry to monitor flow switches and provide a time delay in so doing. It shall also contain circuitry which can be used to reset a beam detector.

2.7.16 Mini Switch Monitor Unit

The function of the mini switch monitor shall be identical to that of the standard switch monitor but it shall be housed in a moulding, allowing it to be easily incorporated into other equipment. The unit shall have 6 fly leads for connection to the analogue addressable loop, the switch circuit and a remote LED.

2.7.17 Mini Switch Monitor (Interrupt)

The mini switch monitor (interrupt) shall perform the same task as a manual call point and shall incorporate an interrupt facility. The unit shall be used to monitor contacts and report fire with fast response.

2.7.18 Sounder Control Unit

The sounder control unit shall be designed to control the operation of a group of externally powered sounders. The unit shall allow the sounders to be operated continuously or be pulsed, 1 second on; 1 second off. It shall be possible for sounder control units at different addresses, to be controlled individually or in selectable groups. A facility to synchronise the outputs when being pulsed, shall be available.

The rating of the sounder circuit output shall be 1 A at 30 VDC maximum.

2.7.19 Loop Powered Sounder

The loop sounder shall connect directly to the analogue addressable loop with its own unique address. The sounder shall be able to be operated in a continuous or pulsed mode. It shall be possible to connect a maximum of 32 sounders to an analogue addressable loop.

The loop sounder shall have an output of 85 dB (A) at 1 metre at a current consumption of only 3 mA. The unit shall be able to be supplied as a sounder base, or a sounder base with cap, for use as a standalone sounder.

2.7.20 Gas Discharge Control Units

The gas control unit shall be designed to interface a gas-protected area to the analogue addressable control panel. The unit shall provide evacuate facilities and shall control the safe discharge of gas. The self-contained unit shall have key switches for automatic or manual selection, as well as an isolate switch for maintenance and resetting the system after activation.

Indicating dual LED's are to be provided for Auto, Manual, Isolate, Gas Discharge and Fault/Reset. A buzzer shall be sounded for fault warning. A lamp test push button shall also be provided.
A dual-action (lift flap break glass) manual gas release device is to be provided on the gas control unit.

Supervised relay contacts are to be provided for the Bell, Siren, Evacuate Sign, strobe light and Gas Discharge. These contacts shall be monitored for short circuit, open circuit and fuse failure. The door interlock mode shall provide a warning buzzer when the door is locked and the gas control unit is in manual mode, or when the door is unlocked and the gas control unit is in the automatic mode.

Internal LED's shall be provided for the various fault conditions to allow for quick maintenance. Should the protected area have a second entrance, a remote gas status unit shall be provided.

The remote gas unit shall provide an indication of the status of the main gas control unit by means of dual LED's as well as a manual call point discharge facility. Dual LED's provide indication for Auto, Manual, Isolate, Gas Discharge and Fault.

2.7.21 Interface With Other Systems

The loop shall be capable of receiving information from third-party systems, e.g. operation of Sprinkler flow switch, by means of standard interface units. The source of this information shall be identified by its own unique address. In addition, the interface unit shall indicate to the panel the type of alarm, e.g. ”sprinkler activated”, etc.

The system must be able to support up to 512 optional relays. Each relay must be software programmable and must be able to be allocated to a loop device, a zone, fire alarm, fault or coincide operation.

The operation relays must be able to be allocated in a different grouping or the same grouping as the zones. Each optional relay shall have a change-over-free contact rated at 2A at 24V DC.

2.8 SYSTEM MAINTENANCE

The control panel shall keep statistics for each of the system sensors. These statistics shall be able to be displayed on demand by a level 2 operator.

The control panel shall provide extensive facilities to help with the general use and maintenance of the system. As a minimum the following maintenance facilities shall be

available:

2.8.1 Automatic Monitoring

Every addressable device shall be continuously monitored by the control panel for the following:

- Removal of Device
- Quiescent Value
- Contamination
- Circuit Failure
- Device Type
- Communication Quality
- Short Circuit
- Open Circuit

Should any of the above parameters be out of specification the panel shall give a fault indication visually and audibly.

A description of the nature of the fault as well as the location of the faulty device shall also be displayed.

The control panel shall also monitor all loops for earth faults which shall be reported as described above.

2.8.2 Visual Monitors

It shall be possible to visually monitor, on a real time basis, the status of each device connected to the system.

Furthermore graphics screens shall be available for zones and individual sensors where the following may be visually monitored:

- Actual Value
- Average Value
- Maximum and Minimum Values
- Contamination Levels
- Communication Quality

Each of the above screens shall be able to be printed on demand by means of a print screen facility.

2.8.3 Archive Facility

The control panel shall have an archive facility capable of storing the last 999 events. The events shall be stored on a first in, first out basis. It shall be possible to print these events selectively as follows:

All Events
Fire Events Only
Fault Events Only
Conditions/Maintenance Events Only
Soak Test Results

Actions (i.e. Reset/Sound Bells, etc.)
Last x Events From A Given Date/Time

2.8.4 Statistics

The system shall be able to supply the following statistics per device:

- Maximum and Minimum Value with Data
- Average Value
- Number of Alarms
- Communication Quality

2.8.5 System Maintenance Reports

The following system maintenance reports shall be available on demand:

- Event Buffer Data
- Soak Test Results
- Test Reports
- Exception Reports

2.8.6 Service/Commission Mode

A service/commission mode switch shall be available to assist the installer with the commissioning and servicing of the system. In the service/commission mode all panel outputs shall be disabled in order to prevent false alarms from being raised during the servicing/commissioning of the system.

2.8.7 Zone Test Mode

The control panel shall be able to enter a test mode which will allow a one person walk test for up to 4 zones simultaneously. When in this mode, the control panel shall not operate any relays or alarms based on the data received from the zones in test. However the panel will log all alarms occurring in these zones in order to generate a report at the end of the test period.

Should an alarm occur in any zone other than those being tested, then the panel is to respond to the alarm in the normal manner.

2.8.8 Sensor Test

A self-test feature shall be incorporated in all analogue sensors. The control panel shall initiate the self-test for each sensor and monitor the results obtained from each sensor. After the test is complete the control panel will evaluate the results and pass or fail each respective sensor. A printout of all sensors failing the test shall be provided.

2.8.9 Soak Test

Should problems be experienced with a particular sensor, it shall be possible to put that specific sensor into a soak test mode. The soak test feature shall provide the facility to monitor and log, at programmable intervals, all data received from the sensor under test for analysis at a later stage. In this mode the control panel shall not generate any alarms

or faults based on the data received from a sensor in soak test mode.

2.8.10 Remote Maintenance

Remote maintenance of the system shall be able to be performed via modem connection to the network. All control panels on the network shall be able to be accessed remotely via the modem. Entry into the system shall be password protected and it shall be impossible to change any site configurable data without operator intervention at the respective control panel.

It shall be possible, once connected to the site, to:
Emulate any panel as if the operator were standing at the panel;
Upload/Download the site configuration;
Selectively retrieve all or parts of the event buffer.

The system shall also operate in ‘central station’ mode whereby the panels may dial to a central station for fires, faults and conditions. The telephone numbers for the central stations must be configured in the panel. It shall be possible to dial different stations for fires and faults.

3 OPERATION

The system shall be designed to operate with the minimum of operator training. Basic fire alarm functions shall be completely self-explanatory. The occurrence of a fire or fault alarm shall indicate all relevant test and zone information without operator intervention.

In quiescent condition, the panel will have the "supply ON" indicator illuminated and the "Processor Running" indicator flashing. The LCD display will show time and date as well as the loop alarm status.

The occurrence of a fire or fault signal or a keyboard operation carried out by an operator, shall not inhibit or delay the receipt of additional alarms. Should any port at the system be isolated or placed in a test mode, a LED on the front of the panel must illuminate to indicate the systems abnormal status. This condition must also be indicated on the LCD display. The normal operation of all other devices shall not be affected in this state.

3.1 ACCESS LEVELS

Access to the system shall be protected as follows:

3.1.1 Control Key

The control key shall be used to enable or disable the keyboard and control keys of the panel.

3.1.2 Access Codes

Access codes shall be used to prevent unauthorised entry into the programming menus of the panel. Each menu shall be able to have 2 different levels of access.

3.1.3 Door Lock

The panel door lock shall be used to prevent unauthorised entry into the cabinet.

3.1.4 Non-Volatile Memory Switch

The non-volatile memory switch shall prevent any unauthorised or accidental changes being made to the system configuration data.

3.2 SELF-MONITORING

The control panel shall be designed and programmed to perform extensive automatic self-monitoring. If the control panel detects a fault, it shall result in a fault indication being given by means of a common fault amber LED. Control panel shall be continuously monitored:

- 24V power supply fault (external supply)
- Fire brigade/evacuation open circuit
- Alarm bell open circuit
- Fire Brigade short circuit
- Alarm bell short circuit
- Power failure
- Watchdog time-out
- Low battery
- No battery connected
- Tamper switch
- No printer
- Memory lock unlock
- Event buffer full
- No communication
- Earth fault
- Battery over-voltage
- RAM memory check
- EPROM memory check

3.3 FIRE OPERATION

- Any fire alarm will cause the following actions to occur immediately.

- The LCD to light up and display the following information:

  type of alarm
  loop number
  zone number
  sensor address
  type of sensor
  event number
  status
  number of alarms
  time and date
  2 lines x 40 characters of user programmable text

- The common fire indicator and appropriate zone fire indicator will illuminate
- The LED on the affected detector(s) will operate
- The event will be logged in memory
- Programmed relays will be triggered

- The fire alarm will override any fault condition that might be present on the display
- Bell & fire brigade/evacuation outputs will become active according to the immediate or delay parameters set
- Sounders and bells will continue to operate (continuous tone) until silenced by inserting the control key and pushing the silence alarm button
- If the bells and fire brigade have been silenced they will become active again for any new fire alarm
- Sounder circuit controllers will be sounded as programmed
- Messages will be sent to the configured data ports and/or printer
- Coincidence, area and adjacent area devices will be operated as programmed
- The programmed I/O's will be activated (including inter panel I/O)
- Messages will be sent to the configured repeater panels, mimic panels and graphic packages

3.4 FAULT OPERATION

- A fault warning will cause the following actions to occur immediately:

- The LCD to light up and display the following information:

  type of alarm
  loop number (if applicable)
  zone number (if applicable)
  sensor address (if applicable)
  type of sensor (if applicable)
  event number
  status
  number of alarms
  time and date
  40 characters of user programmable text

- The system fault and appropriate zone fault indicator (LED) will illuminate
- The "general fault" relay will activate
- The panel buzzer will sound intermittently
- Inputs/outputs configured for fault will be operated, if applicable, messages will be sent to the configured repeater panels, mimic drivers and graphics.

3.5 GAS CONTROL UNITS OPERATION

Gas control units shall provide the interface between the smoke detection – and gas extinguishing systems. The control signals required to trigger the gas system shall be provided as part of the smoke detection system and shall be wired to the gas release valves.

Two signals from separate alarm circuits inside the area shall be necessary to activate the gas release. Activation of the break glass unit located on the gas control unit shall directly start the extinguishing cycle. The gas control units shall have key switches for manual or automatic selection as well as an isolate switch for maintenance purposes. Dual LED's shall indicate automatic or manual mode, gas discharge, isolate, reset and fault statuses.

The control unit shall provide the necessary outputs for gas release valves, audible and visual alarms. Gas control units shall be equipped with break glass units in the same panel and will be installed outside the risk areas in the positions as indicated on the

drawings. Gas control units shall be fitted at the main entrance door to each gas protected area. Status units shall be fitted at each secondary entrance door to the gas protected area.

3.6 WARNING NOTICES

Warning notices shall be provided on the doors leading into the gas protected area(s) in accordance with the specifications of SABS ISO 14520. These notices shall flash and display the message to evacuate due to an eminent gas discharge. These displays shall be powered by the fire detection system.

3.7 CONTROL PROCEDURES

3.7.1 With The Gas Control Unit In The Automatic Mode

The extinguishing system shall use the double knock principle before activating the gas release valve. The HSSD system does not form part of this double-knock system as it only serves as advance smoke alarm and to switch units releasing smoke particles off. Two signals from separate detectors inside the area shall be necessary to activate the gas release.

- **HSSD Signal** : (Switch-off AC-System – automatic reset by timer)

- **First knock : (First smoke detector detects a fire)**

Step 1: Activate alarm bells (inside & outside room) - alert tone.
Step 2: Open pressure relief dampers
Step 3 Shut off HVAC (manual reset) unit and close fresh air damper
Step 4: Open motorised relief-dampers

- **Second knock: (Second smoke detector detects a fire)**

Step 5: Activate alarm bells (inside & outside room) - evacuation tone.
Activate evacuation signs - flashing mode.
Step 6: Activate pre-release timer adjustable from 20 to 120 sec set at 45sec
Step 7: Activate evacuation signs – steady-on mode
Step 8: Release gas

- **After pre-release period:**

Step 9: Close motorised relief dampers.
Step 10: Manual reset to restart the system

3.7.2 With The Gas Control Unit In The Manual Mode

Follow steps 1 to 10 above.
No Gas Release Shall Take Place In This Mode

Gas release in this mode shall only be effected by either switching to the automatic mode or by activating the break glass unit on the gas control unit.

All pressure dampers shall be closed 60 seconds after a start of gas discharge.

3.7.3 Break Glass Unit Activated

Activation of the break glass unit located on the gas control unit shall directly start steps 2 to 10 of the extinguishing cycle.

Manual release of the extinguishing gas shall always be possible by operation of the break glass unit on the gas control unit, regardless of the mode selected (manual or automatic).

All alarms shall be reported to the main fire panel.

3.8 MEANS OF SYSTEM CONTROL

The system shall be provided with:

3.8.1 Time Delay Device

The gaseous suppression system shall incorporate a pre-discharge alarm with a time delay sufficient to allow personnel evacuation prior to discharge. Time delay devices shall be used only for personnel evacuation or to prepare the hazard area for discharge.

3.8.2 Automatic / Manual Switch

The system shall incorporate a system (preferably a key switch) whereby the system can be controlled either by manual means or via the detection system. Means of mechanical manual actuation shall be provided inside the gas plantroom.

3.8.3 Lock-Off Device

Provision shall be made whereby the system can be isolated for maintenance, etc.

3.8.4 Status Unit Device

These devices to be fitted to each secondary entrance door to a gas protected area and serve to provide the status/indication of the gaseous fire suppression system.

3.8.5 Alarms

Continuous visual and audible alarms at entrances and designed exits inside the protected area and continuous visual alarms outside the protected area, which operate until the protected area has been made safe.

4 DESIGN AND INSTALLATION REQUIREMENTS

4.1 CIRCUIT DESIGN

4.1.1 General

Care should be taken to ensure compatibility of all components that are part of the fire alarm system or connected with it in any way.

Circuits should be so arranged that an indication is given at the control and indicating

equipment within 100 seconds of the occurrence of any disconnection, open or short circuit in a cable that would disable one or more detectors or call points (or both), or of a failure of any other interconnection, and this should be done without giving a false alarm.

Even where the wiring of a system is monitored, regular routine testing is important and should be considered during installation. The contractor shall provide a method of manually testing of circuits.

4.1.2 Circuits That Contain Fire Detectors

The wiring arrangement of the system shall be such that:

- If separate circuits are used for each zone, a fault or faults on one circuit shall not affect any other circuit,
- If any circuit is used for more than one zone, a fault or faults on one circuit shall not affect any other circuit,
- if a circuit is used for more than one zone and multiple faults within one fire compartment could remove protection from an area greater than that allowed for a zone, the circuit within that division is suitably protected, and
- two simultaneous faults shall not remove protection from an area greater than 10 000 m².

If the system is such that the removal of a detector or call point from the circuit could affect the operation of other detectors or call points;

- removal of a detector or call point shall cause a 'fault' signal to be generated at the control equipment, indicating the need to replace the missing detector or call point as soon as possible, and
- the operating instructions shall draw the user's attention to any adverse effects on the remainder of the system due to the removal of one or more detectors or call points (or a combination of these).

All wiring shall be multi strand type

4.1.3 Circuits That Contain Fire Alarm Sounders

If alarm sounders use the same wiring as detectors, no alarm sounder shall be affected by the removal of any detector. Any sounder that is necessary in order to reach the audibility levels recommended shall only be removable by the use of a special tool, and removal shall generate a fault warning at the control and indicating equipment.

The wiring of sounder circuits shall be so arranged that, should a short circuit develop in any part of the wiring of sounder circuits during a fire, at least one alarm sounder will continue to sound. This minimum provision shall ensure that a general alarm can be given at the start of a fire and for a significant period thereafter and that, in the event of the fire's burning through a sounder cable, the alarm will be maintained at, at least one point in the building, usually near the control equipment.

4.1.4 Ring Systems

If devices such as detectors, call points or sounders are connected to control equipment by a ring circuit, then, provided that the devices can receive or send signals in either direction, they will continue to operate even with a single open circuit or high series resistance in the ring. Such faults shall be indicated at the control and indicating equipment within 60 seconds of their occurrence. A simple ring circuit, however, cannot give protection against short-circuit faults and hence such faults have to be Indicated, without giving a false fire alarm, within 100 seconds.

Where sounders are used on simple ring circuits, the distribution wiring to each sounder circuit should be protected against overload owing to a short circuit by a fuse or similar device.

4.1.5 Circuits Protected Against Cable Faults

In some ring systems (usually those using computer techniques with addressable devices) short-circuit isolating devices can be provided such that a short circuit will only affect the section between the isolators. The isolators could be independent devices, or could be contained within other devices on the circuit. In such a system a single fault, whether to open-circuit or to short-circuit conditions, can affect at most the section of the loop between the nearest isolators. (Other circuit arrangements that have the same general effect are possible. Where the effect of the fault is to reduce to one the number of signal paths to any detector or call point, the control equipment should indicate the fault within 60 seconds of its occurrence and should preferably indicate the position of the fault. It is essential that action be taken to repair such faults since, if a fault is left unprepared, the system has no protection against further faults. However, if, because of redundancy in the circuit design, at least two signal paths to each detector and to each call point remain, it is necessary to ensure the indication of the fault only within 24 hours of its occurrence.

4.1.6 Zones

When a signal of fire is given it is vital that there should be no confusion about the zone from which it is received. To facilitate response by people who provide assistance, the zone should be small enough for a fire to be located quickly. It is often important that there should be adequate fire separation between the zones; this is particularly so if the initial evacuation procedures in the building usually entail movement from the zone of the fire to one of temporary refuge.

On larger premises in particular, the fire alarm system should therefore be so designed and arranged that it is both fully compatible with the emergency procedures and provides at some central or convenient point, or points, an indication of the zone in which an alarm has originated. In the case of two-stage alarms, clear and unambiguous signals should indicate the emergency procedure to be adopted throughout each zone.

In general the signals used in different zones on the same premises should be the same unless the background noise in one or more zones is such as to require different sounders.

If the system has been installed for purposes of safety of life (type L or M), each zone should be readily accessible from the point(s) where the indication of the location of fire is provided. In general, access to any zone should be by normal circulation routes; however, where small areas of the building are defined as zones for specific purposes (such as the existence of a special risk) it might be permissible for access in the

immediate vicinity of that zone to be by another route, for example through another room.

Note In systems other than addressable systems, signals coming from individual detectors or groups of detectors cannot be separately identified. In these systems, therefore, to allow zone identification, it is usual for each zone to be fed by a separate circuit. It has thus become common for the concepts of 'zones' and 'circuits' to be used interchangeably.

In addressable systems, however, several zones (defined as subdivisions of the premises) can be fed from a single circuit while retaining zone identification. It is therefore important that in such systems the concepts of 'zones' and 'circuits' be treated separately.

4.1.7 LOOPS

It shall be possible to connect the following detectors/devices to the control unit addressable loop.

- Multisensors – optical / thermal type
- Optical smoke sensors – analogue type
- Ionization smoke sensors – analogue type
- Heat sensors – analogue type
- Manual call point "break-glass" units
- Addressable relays i.e. Output devices
- Addressable Sounders (Loop Powered)
- Sounder Circuit Controllers
- Addressable Remote LED indicators
- Gas Discharge Control Units
- Gas Status Units
- Line Isolators
- Beam Detectors
- UV/IR Flame Detectors
- Zone Monitor Unit
- Input/Output Unit
- Switch Monitor Unit
- Switch Monitor Plus Unit
- Mini Switch Monitor Unit
- Mini Switch Monitor (Interrupt)

4.2 **CABLES**

4.2.1 General

It is essential that connections between detectors or call points and the control equipment should be able to maintain the alarm without a continued signal from the detector or call point, i.e. destruction of the connection after the initial operation shall not affect the sounding of the alarm.

Where multi-core cable, flexible cable, or flexible cords are used for interconnections in fire alarm circuits, none of the conductors shall be used for circuits other than those of fire alarms.

Electric cables should:

- be suitable in the opinion of the authority that has jurisdiction for a particular application and comply with approved standards where relevant,
- be selected, handled and installed in accordance with SABS 0198-2; SABS 0198-4 and SABS 0198-8,
- be protected from direct exposure to fire, and
- be appropriately insulated and armoured, be enclosed in appropriate conduit, or be mineral-insulated and copper-sheathed.

The following types of cable are normally deemed to be suitable, subject to the restrictions on their use and the recommendations for further protection:

- impregnated-paper-insulated metal-sheathed cables that comply with SABS 97;
- cables designed for the detection of heat that complies with SABS 529;
- polymeric or rubber insulated cables that comply with SABS 1268;
- *cross*-linked *polyethylene (XLPE)-insulated electric cables that comply with the requirements of SABS 1339; and*
- cables with solid dielectric insulation that complies with SABS 1507.

NOTE: ***Multi strand core cables only shall be used. Single strand cables are not permissible***

4.2.2 Applications

A wide variety of different cables can be used in various parts of a fire alarm system. However, because of their varying abilities to resist both fire and electrical or mechanical damage, many of these cables might be restricted in their suitability for specific applications. The applications are classified according to the need for fire protection.

4.2.3 Applications In Which Prolonged Operation During A Fire Is Required

Cables used for the interconnection of components of a fire alarm system are required to continue operating after a fire is first discovered (e.g. sounders, control and indicating equipment and power supplies) unless they are protected against cable failure. Cables used within protected premises for the transmission of the alarm to a remote centre should also be protected against cable failure. In general it may be assumed that interconnections between sounders, control and indicating equipment and power supplies that can resist fire for at least 0,5 hours will be satisfactory. In special cases, however, longer periods might be required (for example, in buildings with a two-stage alarm system).

Cables that are required to continue operating during exposure to fire should be protected against exposure to the fire by either:

- burial in the structure of the building and protection by the equivalent of at least 12 mm of plaster, or

- separation from any significant fire risk by a wall, partition or floor that will resist a fire for at least 0,5 hours.

NOTE: The mechanical protection of cables by conduit, ducting or trunking should not be considered as giving protection against fire – all wiring shall be laid in galvanised steel conduits. PVC conduit shall not be acceptable.

4.2.4 Applications In Which Prolonged Operation During A Fire Is Not Required

Cables that are not required to continue operating for appreciable periods after the fire is discovered or after they are attacked by fire will usually be only those to detectors or call points, but might also include those to ancillary devices (such as door holders), in which case a failure of the cable due to a fire will not lead to a dangerous condition.

Where prolonged operation during a fire is not required, any of the cables listed may be used without additional fire protection. Cables designed for the detection of heat, or coaxial cable, may be used for the interconnection of detectors within a zone, provided that the system is such that it gives a fire alarm in response to the occurrence of fire at such a cable.

4.2.5 Routing and Protection From Fire

Where possible, cables should be routed through areas of low fire risk. Where cables pass through areas of very low fire risk or where cables are protected by an automatic extinguishing system or sprinkler installation, a reduction in the degree of fire protection recommended might be acceptable following consultation with interested parties.

4.2.6 Protection Of Cables From Electrical Damage

Cables designed for the detection of heat should be used within the manufacturer's ratings.

4.2.7 Protection Of Cables From Mechanical Damage

Some types of cable are not sufficiently robust to withstand the mechanical hazards that they might be exposed to in practice, such as impact, abrasion, or attack by rodents. In order to protect such cables from damage both during and after installation, it will be necessary to provide mechanical protection by installation in conduit:

- Surface mounted cable systems: Galvanised conduits, screwed fittings and supports
- Casted-in cable systems (system in entirety): PVC conduits and glued fittings

The above recommendation for resistance to mechanical damage would be expected to be sufficient for most applications. However, where particularly severe conditions might be experienced (such as impact by forklift trucks), it might be necessary to provide additional protection designed to withstand the expected hazards. Armoured cable should be used where appropriate.

4.2.8 Joints

All joints, except those in detectors, call points, sounders, control and indicating equipment or other similar system components should be enclosed in suitable junction boxes labelled 'FIRE ALARM' to avoid confusion with other services. Jointing and

termination methods should be so chosen as to minimize any reduction in reliability and resistance to fire to below that of enjoined cable.

4.2.9 Segregation Of Wiring

Conductors that carry fire alarm power or signals should be separated from conductors that are used for other systems. The separation may be by one or more of the following methods:

- installation in conduit, ducting, trunking or a channel reserved for fire alarm conductors;
- a mechanically strong, rigid and continuous partition of non-combustible material;
- mounting at a distance of at least 300 mm from conductors of other systems; or
- wiring in mineral-insulated copper-sheathed cable with an insulating sheath or barrier.

If a cable that should be segregated from cables of other services is not enclosed in ducting, trunking or a channel reserved for fire alarm circuits, it should be suitably marked or labelled at intervals not exceeding 2 metres to indicate its function and the need for segregation. Ducting, trunking or a channel reserved for fire alarm circuits should be marked to indicate this reservation. The fire alarm cable should be completely enclosed when the cover of the ducting, trunking or channel is in place, and all covers should be securely fixed.

Segregation of the fire alarm power supply cables need not be applied on the supply side of the isolating protective device. Cables carrying power in excess of extra-low voltage should be separated from other fire alarm cables. In particular, the mains supply cable should not be brought in through the same cable entry as cables carrying extra-low voltage power or signals.

4.2.10 Telecommunication Cables

Public telecommunication operator lines used for the transmission of alarms to the fire brigade should be mechanically protected and should be considered as required to give prolonged operation during a fire.

4.2.11 Alternative Cables

Types of cable or cable system other than those described above may be used only if it can be shown that, in the application in which they are to be used

- their resistance to heat and fire is suitable for the application,
- their resistance to ambient conditions, including resistance to mechanical impact and abrasion, is suitable for the application,
- they are not prone to faulty assembly or installation,
- their electrical properties under both normal and fault conditions are suitable for the application, and
- they are operated within their manufacturers ratings.

Where possible, alternative types of cable should be certified or approved under a recognized certification or approval scheme as satisfactory for their application.

NOTE: Multi strand core cables only shall be used. Single strand cables are not permissible

4.2.12 Damp, Corrosive Or Underground Locations

Cables intended for installation in damp, corrosive or underground locations, or in plasters or cements that have corrosive effects on metallic sheathing, should be PVC-sheathed overall. Where the environment can attack PVC, a suitable alternative sheath should be adopted. In some locations further protection might be necessary.

4.2.13 Conductors and Sizes

Conductors should:

- be suitable in the opinion of the authority that has jurisdiction for a particular application and comply with approved standards, where relevant, and
- have an appropriate temperature rating for their intended use.

NOTE: The following are normally deemed to be suitable (depending on the particular application):

- heat-resisting wiring cables complying with SABS 529; and
- single-core, PVC insulated, annealed copper conductors of 600 V grade in accordance with SABS 1507.

In selecting conductor sizes, physical strength and limitations imposed by voltage drop should be taken into account. Voltage drop in a cable should not be such as to prevent devices from operating within their specification limits, even under minimum supply and maximum load conditions. Consideration should be given to any possible extensions to the system.

Unless otherwise recommended, conductors should be of copper, each with a cross-sectional area of not less than 0,5 mm². Cables that have a total conductor cross-sectional area of less than 0,5 mm² should not be drawn into conduit. Where twisted-pair cable constructions are used and the pair is contained within a common insulating sheath, individual conductors with cross-sectional areas down to 0,5 mm² may be used.

NOTE: Multi strand core cables only shall be used. Single strand cables are not permissible

4.2.14 Ambient Temperatures

Care should be taken that the combination of ambient temperature and temperature rise caused by load current does not result in a conductor temperature that exceeds the limit for the insulation.

4.2.15 Wiring of Ancillary Equipment

Subject to any overruling consideration, safety factors and consultation with the relevant authority, the fire alarm system may be so designed that detectors or call points (or both), in addition to giving an alarm and calling the fire brigade, will close or open circuits of

ancillary services by means of relays or similar devices.

NOTE Examples of ancillary services include the

- actuation of fixed fire-extinguishing systems,
- closing of windows, smoke and fire doors,
- control of ventilating systems, and
- covering of tanks that contain flammable liquids and controlling their valves to isolate the contents from direct contact with the fire.

Means to temporarily disable an item or items of ancillary equipment for routine servicing or maintenance of that equipment may be provided if it does not affect the operation of the fire alarm system.

If operation of the fire alarm system during servicing or testing can have undesirable effects on ancillary equipment, means should be provided for disabling the automatic operation of the ancillary equipment. The disablement may take the form of a transfer from automatic to manual operation. A visual indication of disablement should be provided.

Power supplies to ancillary services should be such that the power supply to the fire alarm system is not prejudiced. Indications of both the state of ancillary systems and that of ancillary systems that take power only when there is a fire may be operated from the fire alarm supply, but ancillary systems that take power (other than for indicators) in the non-fire state should not be operated from the fire alarm supply. Any additional loads taken by ancillary systems should be taken into account in the calculations of power supply capacity.

4.3 CONDUIT AND TRUNKING

Conduit, ducting and trunking should be suitable in the opinion of the authority that has jurisdiction for a particular application and comply with approved standards where relevant.

4.3.1 Conduit

If fire alarm cables reticulate:

- surface mounted in conduit: screwed, G.I. conduit to be used, or
-
- fully casted in: screwed, quick-fit, glued or rigid PVC conduit may be used, or
-
- trunking or ducting: either metal trunking or ducting, non-metallic ducting or non-flame-propagating trunking should be used.

Rigid PVC conduit should comply with SABS 950, but should not be used where the ambient temperature is likely to exceed 60°C. Where temperatures below –5°C are likely, suitable precautions should be taken to avoid physical damage.

Wireways for electrical cables should comply with SABS 1197, metal conduits for electrical wiring with SABS 1065-1 and metal fittings for use with metal conduits with SABS 1065-2.

Cable trunking and ducting systems for electrical installations should comply with SABS IEC 61084-1.

Other types of conduit, ducting or trunking may be used only if it can be shown that, in the application in which they are to be used, their resistance to ambient conditions, including resistance to mechanical impact and abrasion, is not less than that of the types specified as suitable for the application, and they are not prone to failure due to faulty assembly or installation.

All manual call point shall be surface mounted on wall, with conduits chased or built into walls.

4.3.2 Ducting

Where fire alarm systems are to be installed in new buildings, ducts and channels might be required in the structure. Ample facilities should be provided for drawing cables into ducts and into conduits or trunking installed in ducts. Conduit and trunking sizes should permit easy drawing in and out of the cables; it is advisable to allow space for future extensions. Where necessary, access should be provided by means of suitably located removable or hinged covers.

Horizontal ducts or channels might be required between the control point and the vertical ducts and from vertical ducts to the various rooms, etc. These may be formed within the structure or provided by means of conduit or trunking, concealed or surface-mounted as appropriate.

4.4 INSTALLATION AND TERMINATION OF CONDUIT & CONDUIT ACCESSORIES

4.4.1 Flexible Conduit

In installations where the equipment has to be moved frequently to enable adjustment during normal operation, for the connection of motors or any out vibrating equipment, for the connection of thermostats and sensors on equipment, for stove connections and where otherwise required, flexible conduit shall be used for the final connection to the equipment.

Flexible conduit shall be connected the remainder of the installation by means of a draw box. The flexible conduit may be connected directly to the end of a conduit if an existing draw box is available within 2m of the junction and if the flexible conduit can easily be rewired.

Flexible conduit shall consist of metal reinforced plastic conduit of PVS covered galvanised metal conduit with an internal diameter of at least 15mm, unless approved to the contrary. In false ceiling voids, flexible conduit of galvanised steel construction may be used.

Connectors for coupling to the flexible conduit shall be of the gland or screw in type, manufactured of either brass or mild steel plated with either zinc or cadmium.

4.4.2 Positions of Outlets

All accessories such as boxes for outlets etc. shall be accurately positioned. It is the responsibility of the contractor to ensure that all accessories are installed level and square at the correct height form the floor, ceiling or roof level as specified. It shall be the

responsibility of the Contractor to determine the correct final floor, ceiling and roof levels in conjunction with the Main Contractor.

Draw boxes shall not be installed in positions where they will be inaccessible after completion of the installation. Draw boxes shall be installed in inconspicuous positions to the approval of the Engineer's representative and shall be indicated on the "as built" drawings.

4.4.3 Flush Mounted Outlets Boxes

The edges of flush mounted outlet boxes shall not be deeper than 10mm form the final surface. Spacer springs shall be used under screws where necessary.

Oversize cover plates shall be provided on all flush mounted round conduit boxes, where required. Surface mounted boxes shall be provided with standard size cover plates.

4.4.4 Installation In Roof Voids And Exposed Areas

Conduit in roof spaces shall be installed parallel or at right angles to the roof members and shall be secured at intervals not exceeding 1,5m by means of saddles screwed to the roof structure.

Where non-metallic conduit has been specified in roof spaces for a particular service, the conduit shall be supported and fixed with saddles with a maximum spacing of 450mm throughout the installation.

Under roofs, in false ceilings or where there is less than 0,9m of clearance, or should the ceiling be insulated with glass wool or other insulating material, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

All conduits shall be installed horizontally or vertically as determined by the route and the Contractor shall take measures to ensure a neat installation.

4.4.5 Saddles

Conduits shall be firmly secured by means of saddles and screws and in accordance with SABS standards. Conduits shall be secured within 150mm before and after each 90 degrees bend. Nails or crumpets will not be allowed.

4.4.6 Fixing to Walls

Only approved plugging materials suck as fibre plugs or plastic plugs, etc., and round head brass screw shall be used when fixing saddles, etc., to walls. Wood plugs are not acceptable nor should plugs be installed in joints in brick wall

4.5 INSTALLATION OF DEVICES AND EQUPMENT

All devices and equipment shall be neatly installed throughout the facility and in positions as required to achieve optimum performance. Where a conflict between the engineering design and the equipment manufacturers recommendations exist, it shall be referred back to the Engineer for decision.

5 COMMISSIONING AND ACCEPTANCE

5.1 GENERAL

Commissioning includes the setting to work and regulation of the installation.

Check all installations and commissioning in accordance with the Contract Documents including but not limited to the following:

- Co-operation with the Engineer to produce a co-ordinated programme for the testing and commissioning, of the complete Contract Works. Fault testing and continuity of loops shall be tested prior to inviting the Engineer for witnessing of tests
- Provision of all consumable materials.
- Provision of such temporary communication apparatus as is necessary to enable members of the commissioning team who are unable to be in aural contact with each other to carry out their tasks safely and effectively. Such apparatus shall not cause interference with equipment owned or operated by any other parties.
- Provision of proper and permanent records of relevant readings of all quantities taken during the checking pre-commissioning procedures. The form of the records shall be agreed with the Employer in advance of commissioning and the record for each complete commissioning procedure shall be dated and signed by the person whom the contractor has appointed to be formally in charge of commissioning.
- All labelling as per specification
- Zone plan position and orientation
- Power feed and standby batteries.
- Cable installation and termination

5.2 PERFORMANCE TESTS

When the Contractor has completed the commissioning of the whole of Contract Works he shall give to the Engineer written certification of this fact. The certificate shall be signed by the Site Agent responsible for the contract.

Only when this written certification has been received by the Employer will performance tests be allowed to commence. Unless otherwise agreed by the Employer in writing, where engineering systems involve the works of more than one Contractor, performance tests will only be allowed to commence when written certification from all the relevant Contractors has been received.

Carry out during this period full tests on the complete Contract Works to demonstrate that the works meet the requirements of the Contract Documents.

The Employer may at his discretion waive any part of the full test procedure if he considers it has been satisfactorily demonstrated, recorded and properly certified at any earlier time but the Contractor shall however allow in his costs for carrying out all of the provisions in this clause.

5.2.1 Tests

- Cables and wiring should be insulation tested at 500V after installation. The insulation resistance to earth and between conductors should comply with the EE Wiring Regulations. This test to be carried out prior to the connection of equipment. Completed installation to be tested at a low, non damaging voltage as recommended by the manufacturer. Resistance to be as per the 9th Ed. IEE rules (1988).
-
- Earth continuity to be tested as per IEE Wiring Regulations

- Each detector and MCP must be tested to ensure it works and that the control equipment gives the correct indications and other responses. Systems which give signals to ancillary equipment (i.e. door release units, fire dampers, over pressure vents, gas release systems etc.) must be checked for the correct signals and intensity

- Alarm sounders must be tested to ensure correct sound levels are achieved.

- Radio-link systems must be checked for signal strength with allowance for future degradation. Links to the fire brigade or remote manned areas must be checked and tested.

5.3 INSPECTION AND TESTING CERTIFICATES

5.3.1 Procedures

Schedule and submit an integrated programme in respect of those elements of the Contract Works for which inspections and tests shall be carried out and for which inspection and test records shall be maintained. These elements shall include in particular those which will be covered up during construction, and other matters described under Certificates for Materials and Equipment

5.3.2 Certificates for materials and equipment

All materials shall be manufactured and tested in accordance with the appropriate specified Standard. Should the Contractor propose an alternative item without the appropriate certification, independent testing shall be carried out at the Contractor's expense to determine compliance with the Contract Documents.

Where and if appropriate all materials delivered to the site shall bear the manufacturer's name, brand name and any other data that may be required to verify their exact nature and relate it to the requirements of the Contract Documents.

5.3.3 Works tests certificates

Works tests certificates shall include, whenever applicable, full information to enable the item tested to be identified, such as project title, Contractor's name, manufacturer’s nameplate or serial numbers, the location in the Works and the delivery or batch which the sample represents.

5.3.4 Certification

Contractors shall submit with his bid a list of four (4) Smoke detection system installations, two (2) of which are similar industrial projects, all within the past five (5) years, which were successfully, completed using the equipment proposed. Contract names and telephone numbers of references familiar with the Contractor's installation shall be provided.

Together with the shop drawings, the contractor shall submit a certification that the system design, equipment and devices to be installed, and the detection systems meet this specification

Prior to final acceptance the Contractor shall deliver to the Engineer, copies of material and test certificates relating to all relevant equipment installed.

5.3.5 Progressive Testing of the works

Elementally inspect and test sections of the works as it progresses. Maintain comprehensive records of the Contractor's own inspections and tests.

Correct all known defects before submitting elements of the works to the Engineer for his progressive inspection and witness testing.

Progressively submit, giving a minimum of 14 days notice, elements of the works for inspection and witness testing. Provide evidence, in the form of inspection and test certificates, that the works submitted have been qualitatively inspected, tested and are free of defects. Provide attendance at all times during the Engineer's inspections and witness of the test. Diligently correct defects advised by the Engineer and, thereafter, repeat the process until the works are free of all defects. A specimen sheet for "Request for Inspection" is included below.

Though it is understood that the contract will interfere with the existing activities in buildings, the testing shall be done progressively, to ensure a minimum time delay with the final switch over.

Deluge interface testing shall be done only in the presence of the owner, a suitably qualified sprinkler contractor and the Engineer.

5.3.6 Inspection, and testing records

Maintain records of all inspections and testing performed to substantiate conformity with the Contract documents including those carried out by the Contractor and/or third party testing agencies, together with manufacturers' or suppliers' certificates of test.

Any record, which indicates that any part of the Contract Works inspected or tested does not comply with the Contract Documents, shall be submitted without delay in order that the Contractor's proposals for rectification may be assessed.

5.4 TESTING, BALANCING AND COMMISSIONING DURING ERECTION

Preliminary testing, balancing and commissioning shall be done as systems are installed and consist of the following:

- Operational testing of all devices, zones individually and all zones simultaneously.

- All testing operations shall be witnessed and approved by the engineer, all operational and tests shall be documented.

5.5 TEST FOR SYSTEM ACCEPTANCE

Once the installation has been completed it should be inspected to ensure that the workmanship is satisfactory, and that the system complies with the codes.

Provide the services of a competent, factory trained engineer or technician, to technically supervise and participate during all of the adjustments and tests for the fire suppression system. Make all final adjustments and tests in the presence of the engineer.

When the systems have been completed and prior to the final inspection, perform the following tests in the presence of the engineer. Perform the following tests again in the presence of the engineer or duly designated representative at the final inspection.

Zone by zone manual and automatic activation of all devices, and line relays to other systems.

5.6 FINAL INSPECTION

At the final inspection a trained representative of the Contractor shall perform the tests. In addition, the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of the engineer or duly designated representative.

5.7 UNSUCCESSFUL TESTS

The Contractor shall pay any costs incurred by the Employer or any other consultants in connection with unsuccessful tests, including costs incurred due to the inability of the contractor to make or complete a test. All costs due to unsuccessful tests or inferior installation standards shall be borne by the contractor.

5.8 DOCUMENTATION

The installer shall provide to the user a completion certificate, a complete set of instructions, calculations and drawings showing the system as-installed, and a statement that the system complies with all the appropriate requirements of SABS 0139, Manufacturer and Engineer and give details of any departure from appropriate recommendations. The certificate shall give reports of any additional tests.

<u>All approval documents shall be handed over to the Engineer, including:</u>

- Operating and Maintenance Manuals
- Instructions for routine maintenance
- Instructions for any necessary end user test procedures
- Record drawings (as-built) showing positions of equipment and wiring
- System logbook

<u>All approval certificates shall be handed over to the Engineer, including:</u>

- Certificates **for design**
- Certificates **for installation**
- Certificates for commissioning
- Certificates for acceptance
- Certificates for inspection and servicing
- Certificates for modifications
- Batteries calculation certificate

6 HEALTH AND SAFETY ACT

The Contractor is to comply with all requirements of the Occupational Health and Safety Act (Act 85 of 1993) and all subsequent revisions thereof. Further, the Contractor undertakes to employ only people who have been duly authorised in terms thereof and who have received sufficient health and safety training to ensure that they can comply therewith. In addition, the Contractor warrants that it shall enforce the terms of this clause on any sub-contractor employed by the Contractor in connection with the contract.

7 AUDIO EVACUATION SYSTEM

7.1 System Description

An audio evacuation system shall be installed incorporation the following:

- Zone selection unit for public announcements in individual zones or in all zones simultaneously.
- Booster amplifiers to feed evacuation to individual zones.
- Automatic and direct addressing from the main control room

Zones are as indicated on the zone schematic:

In essence the buildings consist of Block A to E and IDC 2. Each floor of each Block is a separate evacuation zone.

An electronic automatic messaging unit shall be incorporated. A fire signal from the fire panel shall automatically start the voice message.

One main audio evacuation system shall be provided and installed to serve the different evacuation zones and areas as listed. This evacuation rack shall be located in the main control room in the IDC building.

It shall be possible to address all zones individually or simultaneously from the main control room. A separate call station shall be provided in the Esterhuizen house building

All equipment for the audio evacuation system shall be housed in suitable 19 inch racks or enclosures approved by the engineer. Suitable power supply units shall be provided in the evacuation panel to provide electrical power to all the audio evacuation equipment. The rack shall also be equipped with ventilation fan units to prevent overheating of the

equipment installed in the panels.

The audio evacuation system shall be carefully integrated with the smoke detection system. When a fire condition is detected in a specific fire zone, the evacuation system shall generate and transmit evacuation message in the affected area automatically.

The transmission of alarm and/or evacuation tones in any specific evacuation zone, or in all of the zones simultaneously, shall also be possible through operator control from the main panel, or remote panel. It shall also be possible to make public announcements over the evacuation system in any one, or in all of the different zones simultaneously. The sounding of announcement chimes shall precede public announcements. Suitable input modules located in the panel shall generate these chimes.

Backup batteries shall be provided and installed in the panel. These batteries shall be suitable to maintain the evacuation – and the smoke detection systems operational in the event of normal power failure to the panel. The batteries shall be rated to maintain the evacuation system operational for a period of four hours after normal power failure. The batteries shall during this period of four hours also maintain all monitoring functions associated with the evacuation system and have sufficient power at the end of the four hours to transmit an evacuation tone, in all zones associated with the panel, simultaneously for a duration of five minutes. Suitable battery charging circuitry to maintain the batteries in a fully charged state shall be provided in the panel.

7.2 Microphone Units

These units shall include a 300mm dynamic microphone with cardioid response for speech frequencies with gooseneck stem attached to a small desk console and a press-to-talk button with lamp indicator.

7.3 Slave Amplifiers

The amplifiers shall be fully protected against open and short circuits as well as against overloads and reactive loads. They shall be designed for continuous operation at maximum rated power.

<u>These amplifiers shall comply with the following:</u>

Mains input	:	240V, 50Hz, 1-phase
Output power	:	360W, 200W or 120W as required
Output	:	100V line balance
Frequency response	:	50Hz to 20KHz
Distortion	:	<1%
Output noise	:	> - 80 dB
Input	:	To suit pre-amp / mixer
Controls	:	ON / OFF with lamp indicator

7.4 Speakers

Provide and install loudspeakers in the positions as indicated on the drawings. The required 100V line transformers shall be located inside the back box of each speaker.

<u>Speakers shall comply with the following requirements:</u>

7.4.1 Ceiling Mount Speakers

Size	:	150mm
Resonant frequency	:	100Hz
Frequency response	:	0Hz to 16KHz 10dB
Sensitivity	:	86dB 3dB 1W/1M
Watts related	:	5 Watts
Distortion	:	5%
Impedance	:	4 Ohm
Transformer	:	Primary Voltage: 100 Volt
		Secondary Voltage: com, 4 ohm
		Trappings: com, 2, 4, 5 Watt
		Grille
		Material: Powder coated mild steel
		Size: 220 Dia., 20mm thick
		Color: White
		Back box: Material: ABS plastic
		Color: White
		Size: To fit speaker

7.4.2 Horn type Speakers

Size	:	200mm
Resonant frequency	:	100Hz
Frequency response	:	0 to 12 KHz ± 10 dB
Sensitivity	:	120 dB ± 3 dB 1W/1M
Watts related	:	15 Watts RMS Continuous
Dispersion	:	110 degrees
Impedance	:	8 Ohm
Transformer	:	Primary Voltage: 100 Volt Secondary Voltage: com, 8 ohm Trappings: com, 3.8, 7.5, 15 Watt (Set at 7.5W) Material: Powder coated mild steel

7.5 POWER SUPPLY

Electrical power supply shall be provided by the Electrician at the main panel and all power supply units only. Installation of the electrical supply shall be in accordance with SABS regulations and shall be done by a qualified electrician.

7.6 CABLING AND WIRING

The loop-in system shall be followed throughout and no joints of any description will be permitted.

Fire resistant and screened cable shall be used for the fire detection and audio evacuation system. All cable shall be multi stranded. Single strand cables shall not be permitted. Fire resistant cables shall comply with a minimum of the following:

1 mm^2 2 core silicone insulated, aluminium foil screen, fire resistant cabling being either
BS 6387: 3h @ 950 °C or
IEC 60331: 3h @ 750 °C

All conduit runs as required to accommodate the different cable runs, as indicated on the drawings, not cast into the concrete structure, shall form part of this contract. Conduits shall be 25 mm diameter, PVC. As this is an office environment, the conduits are accepted as being PVC.

8 FIRE GRAPHIC DISPLAY

The fire panel as well as the evacuation system shall be connected to a graphic+ display via a computer with the following specifications:

- Computer:
- Entry level Mecer Pentium 4
- 1024 Meg RAM
- 40 GIG hard drive
- Key board
- Optical Mouse
- LG 48” LCD screen
- The latest version GS WIN package and Windows XP shall be included, and shall incorporate the evacuation as well as detection system.
- Alternatively the latest version of a suitable graphics package

The programme shall be such that the detection and evacuation maps can be recalled onto the display at random. In the event of a fire condition, the block plan where the alarm condition is active, shall automatically display, and a button to activate the evacuation in the zone shall illuminate on the display.