ANNEXURE C.3

TECHNICAL SPECIFICATION – GAS SUPPRESSION

TECHNICAL SPECIFICATIONS – GAS SUPPRESSION

INDEX

1 SCOPE OF WORKS

1.1 THE BUILDING

Details of the site is described in the main tender document.

1.2 FIRE DETECTION SYSTEM

Analogue addressable fire detection systems, in compliance with SABS 0139, Code of Practice and Engineer's specifications, NFPA 72 and BS-6266 are required.

Vesda HSSD systems are also required for very early detection of combustion products (smoke).

1.3 FIRE SUPPRESSION SYSTEM

An Ansul Inergen IG541 200bar gas system shall be installed in accordance with the tender design drawings and specifications. Interfacing with other systems is required.

The tenderer shall price in accordance with the B.O.Q.

1.4 EXECUTION OF CONTRACT AND PROGRAMME

The successful tenderer will be required to submit a program for the execution of the work to the satisfaction of the Employer, in accordance with programme. Under no circumstances will the execution of works extend past the contractual dates as stated in these documents.

Sufficient overtime shall be allowed to achieve the program as attached.

1.5 SCOPE OF WORK

In principal the scope of works for this contract are identified as follows:

- Detail design, supply, installation, commissioning, testing and handover of a new Ansul Inergen 200 Bar fire suppression system to areas as shown on the tender drawings
- Detail design, supply and installation, and interfacing of new Vesda high sensitivity fire detection systems as shown on the tender drawings
- Allow for the building in of pressure relief dampers in all buildings
- **This is a fully inclusive tender and all work required for the systems shall be done by the contractor**

All interfacing such as the monitoring and relaying of signals from the fire suppression systems, signals from HSSD detection zones and gas protected areas to the Fire panel, interfacing to HVAC System and SMS modules shall form part of this contract.

As required potential free contactors/interface units/relays shall be provided for each output/input signal as indicated, at the unit to be controlled.

NOTE 1

(a) All the schedules of information and B.O.Q's must be fully and accurately completed.

(b) CVs of all supervisors and labourers to be issued to the Engineer for approval, prior to any site works.

NOTE 2

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

2 GAS SUPPRESSION SYSTEM

2.1 OBJECTIVE

The Clean Agent Fire Extinguishing System will be an Engineered system utilising a fixed nozzle agent distribution network. It will be designed and installed in accordance with the SABS ISO 14520 Code of Practice, and the Engineer's specification, whichever is more stringent. A full 200 bar **Ansul Inergen (IG541)** system, shall be used.

Approval shall be by at least Factory Mutual and one other internationally recognised approval authorities.

The system shall be actuated by detection and control equipment for automatic system operation along with providing local and remote manual operation as required.

Work under this portion of the contract consists of:

- Supply, detail design, delivery and installation of an automated gas flooding fire suppression system, complete with all pipework, valves, nozzles, signage, discharge control units.

2.2 TECHNICAL REQUIREMENTS

The gas system shall consist of total storage banks and be capable of totally flooding the protected areas to a design concentration applicable to the gas offered at an ambient temperature of 21°C. A minimum gas design concentration of 40 % is required in accordance with SANS 14520. A room oxygen concentration of maximum 12.7% (minimum 10.5%) shall be maintained for a period of not less than ten minutes after the gas discharge. Discharge times will be those as specified in the SABS ISO 14520 Code of Practice, alternatively to those concentrations in compliance with the products listings.

In determining the quantity of gas required to achieve the necessary concentration for a period of not less than 10 minutes, the Contractor shall allow for and provide additional gas to compensate for any leakage from the enclosure.

The system design shall be based on the following criteria:

- Indoor temperature (anticipated design) : 21°C

	Altitude	Factor
Sandton	1622	0.8091
Flooding Factor		0.511
Design Concentration	40%	

A complete system, each individual component, design manual and design software approval shall be provided on the total inert gas installation.

Proof of compliance with this requirement shall be by means of certified copies of the original certificates. These approvals shall be submitted together with the tender

document and again with the equipment submittals.

The detailed design shall form part of an approved, integrated design, manufacture and testing process in compliance with ISO9001. Proof of ISO9001 certification shall be provided to the Engineer. As for the components the complete design package shall carry the same approvals. However, should the manufacturer's design approval be based on more stringent requirements, the most stringent criteria shall be followed at no extra cost to the Client.

The design of the fire protection layout shall be done as part of an ISO9001 certified design program. The technical interface as required by the ISO 9001 process shall be the Engineer. Final design verification, as called for by ISO9001, shall be included in the scope of works.

Typical area schedules of protected areas are sampled below. Details are provided on the tender drawings. Should the approval listing be on a higher concentration, this shall be allowed for and the Bills adjusted to suit the required container quantities.

Room	Description	Room Space			Cylinders		
		Area	Height	Volume	Size (m^3)	Qty	Gas (m^3)
Zone 1	Class A & C Fires	***. m²***	***. m***	***. m³***	***16.2 m³***	***X***	***Y***
Zone 2	Class A & C Fires	***. m²***	***. m***	***. m³***	***16.2 m³***	***X***	***Y***
Zone 3	Class A & C Fires	***. m²***	***. m***	***. m³***	***16.2 m³***	***X***	***Y***
Zone 4	Class A & C Fires	***. m²***	***. m***	***. m³***	***16.2 m³***	***X***	***Y***
etc.							
Design Concentration of 40% as per Iso 14520 to be used for the above calculations							

2.3 EXTINGUISHANT

The extinguishant and properties offered by the tenderer to be used for this project shall be filled in below:

PROPERTY	**REQUIREMENT**		
Purity	**% by mass, minimum**		
Moisture Content per gas (by mass, maximum)			

PROPERTY	UNITS	VALUE
Molecular Mass	-	
Boiling point at 1,013 bar (absolute)	°C	
Freezing point	°C	

Critical temperature	°C	
Critical pressure	bar abs	
Critical volume	cm^3/mol	
Critical density	Kg/m°	
Vapour pressure 20°C	bar abs	
Liquid density 20°C	kg/m^3	
Saturated vapour density 20°C	kg/m^3	
Specific volume of superheated vapour at 1.013 bar and 20°C	m^3/kg	
Design Concentration	%	
Components		
Patented Name (if applicable)	ANSUL INERGEN (IG541)	

2.4 MATERIALS

2.4.1 GENERAL

Only equipment and components specifically designed for the proposed use may be used. To this end, all equipment shall be either listed / approved by approved testing laboratory / authority as listed above. Proof of such compliance shall be provided for each item, and in the case of the gaseous extinguishing system, the software, each component and the system as a whole.

2.4.2 TEMPERATURE LIMITATIONS

All devices shall be designed for the service they will encounter and shall not readily be rendered inoperative or susceptible to accidental operation. Devices normally shall be designed to function properly from –20°C to + 50°C, or marked to indicate temperature limitations, or in accordance with manufacturers' specifications which shall be marked on the nameplate, or (where there is no name-plate) in the manufacturer's instruction manual.

2.5 WORKING DOCUMENTS

The contractor shall be responsible for producing the following working documents, which shall include the following items:

(a) drawings, to an indicated scale of extinguishant distribution system, including containers, location of containers, piping and nozzles, valves and pressure – reducing devices, orifice unions and pipe hanger spacing;

(b) enclosure cross-section, full height or schematic diagram, including raised access floor and suspended ceiling;

(c) extinguishing concentration, design concentration and maximum concentration;

(d) specification of containers used, including capacity, storage pressure and mass including extinguishant;

(e) description of nozzle(s) used, including inlet size, orifice port configuration, and

orifice size/code and orifice size of pressure – reducing devices, if applicable.

(f) description and suppliers of pipes, valves and fittings used, including material specifications, grade and pressure rating, mill certificates and batch test reports,

(g) equipment schedule or bill of materials for each piece of equipment or device, showing device name, manufacturer, model or part number, quantity and description.

(h) isometric view of extinguishant distribution system, showing the length and diameter of each pipe segment and node reference numbers relating to the flow calculations;

(i) enclosure pressurization and venting calculations;

(j) description of fire detection, actuation and control systems; and

(k) installation, testing and commissioning instructions and trouble analysis guide and details of all safety protection devices, where applicable.

2.6 CYLINDERS

2.6.1 GENERAL

Containers shall be designed to hold the specific extinguishant. Containers shall not be charged to a full density greater than specified in that part of ISO 14520 relating to the specific extinguishant. Cylinders shall be designed to suit the working pressure of the gas offered. Design pressure shall be at least 1.5 times the working pressure

Container and valve manifolds shall be tested hydraulically to the highest pressure of that specified by SABS ISO 14520, or manufacturer, or 300 bar and be substantiated by a relevant test certificate. All cylinders will be supplied with a pressure relief valve as per manufacturer / SABS ISO 14520 specification.

The containers used in these systems shall be designed to meet the requirements of relevant national standards, particularly the Vessels under Pressure Regulations under the Occupational Health and Safety Act (Act 85 of 1993). The Contractor shall provide written proof of compliance with such design code by the manufacturer. Furthermore, the Contractor shall submit test certificates for each and every storage cylinder before bringing them onto site. Where no certificates have been issued, the Contractor shall submit a list of cylinders, including manufacturer, serial number, and the date and test pressure of the latest hydrostatic test stamped on every cylinder.

Where required, the container and valve assembly should be fitted with a pressure relief device complying with the appropriate national standards.

All storage cylinders shall be supplied new, and all cylinders forming part the installation shall be of interchangeable without any modification whatsoever.

Cylinder shipping shall be in accordance with the design code of the cylinders.

Storage cylinders shall be shipped fully charged, and with an approved protective cap over the cylinder valve. Protective caps shall be removed only once cylinders have been finally bracketed into position. All protective caps shall be mounted on a cap rack next to the cylinder bank.

Storage cylinders shall be installed in banks in accordance with the manufacturer’s

specifications and SABS ISO 14520 Code of Practice. All cylinders shall be securely positioned by means of a rigid bracketing assembly, which eliminates any lateral movement of cylinders after installation.

Cylinder stands are as detailed on the drawings.

2.6.2 CONTENTS INDICATION

The Contractor shall hand over a charging certificate for every charged cylinder before commissioning commences, which confirms that charge composition is within the allowable tolerance. The charging certificate shall indicate the cylinder serial number, date of charge, location where charged, and charge contents.

A pressure gauge shall indicate that each container is correctly charged.

2.6.3 CONTAINER ARRANGEMENT

Arrangements shall be made for container and valve assemblies and accessories to be accessible for inspection, testing and other maintenance when required.

Containers shall be adequately mounted and suitably supported according to the systems installation manual so as to provide for convenient individual servicing of the container and its contents.

Containers shall be suitably supported, each with two suitable clamps, each from a rigidly fixed unistrut. At dry wall partition areas the stand shall fully support the cylinders

Containers shall be supported on a steel stand designed to take all containers in a manifold group. Supports shall be level with the false floor and manufactured from steel sections welded and painted black, and solidly bolted to the wall, after being adjusted for correct floor level.

Storage containers shall not be located where they will be subjected to severe weather conditions or to potential damage due to mechanical, chemical or other causes. Where potentially damaging exposure or unauthorized interference is likely a suitable enclosure or guards shall be provided by the contractor.

Different sized storage containers connected to a common manifold may be used for non-liquefied gas containers, provided they are all pressurized to the same nominal working pressure.

2.7 MANIFOLDS

Manifolds manufactured by the Inert Gas Agent equipment manufacturer shall be certified suitable and tested by them. All manifold systems shall be tested and certified by an expert third party. Test shall be witnessed as successfully holding pressure for 15 minutes at 300bar. No manifold may be fabricated on site, or welded on site after pressure testing is complete. All pipework up-stream of the orifice-union shall be regarded to be part of the manifold system and shall be tested to the same specification.

All welding on an Inert Gas agent manifold shall conform to SABS 044, performed by coded welders, and preferably machine welded. Suitable approved electrodes shall be used.

The Engineer retains the right to inspect, at any stage of manufacture, the welds on

any manifold. This right of inspection, whether exercised or not, shall not in any way detract from the right of the Engineer to reject inferior equipment at any stage.

Where the Engineer, at its sole discretion, feels that welds may be of inferior quality, it shall be require of the Contractor that he performs or have performed X-ray testing of such welds, at the Contractor's expense.

All manifolds shall be hot dipped galvanised after manufacturing and galvanizing penetration shall be complete throughout.

Flexible connection hoses shall consist of flexible, steel reinforced hose, with swaged-on threaded connectors on either end, and shall incorporate a check valve to prevent agent loss in case of a discharge with any cylinder disconnected from the hose for any reason. These hoses shall have at least the same pressure handling capability as the manifolds.

2.8 SOLENOID VALVES

At each bank, an electrical solenoid controlled actuator (not detonator type) shall automatically release the gas on receipt of the appropriate fire alarm signal. On the high pressure system a booster section shall accompany the actuator. An actuator and booster reset tool shall be provided per project as part of the testing equipment, and spares part list equipment.

The reset tool shall be placed within one of the cylinder caps with a label "reset tool inside" on the outside of the cap.

2.9 MAIN ORIFICE

The Clean Agent main orifice shall be either a clamped plate orifice or configured as a nipple, and connected on the upstream side to the manifold, and on the downstream side to the distribution pipe system. Contractors shall ensure that the orifice is installed for the right direction flow.

All main orifices shall be supplied by the ISO9001 certified manufacturer of the Clean Agent equipment. No Contractor or other party shall under any circumstances be allowed to perform any drilling, machining, or other work or modification on an orifice assembly, unless approved in writing by ANSUL.

The main orifice shall be certified by its manufacturer as suitable for the application intended, and a certificate to this end handed over to the Engineer, and included in the O&M Manual.

The main orifice shall be positively anchored to the building structure, in accordance with the requirements of the equipment manufacturer, and to the satisfaction of the Engineer, to avoid pipe movement during discharge. The Contractor shall specifically detail his main orifice fixing arrangement on his drawing submittals for approval by the Engineer.

An orifice union shall incorporate a stainless steel orifice plate clamped between bolted clamping flanges or inside a threaded union. The orifice opening shall be drilled by the manufacturer, and the opening size clearly and indelibly stamped on the orifice assembly.

An orifice nipple shall be brass construction, with centre hex for assembly purposes. The orifice opening shall be drilled by the manufacturer, and the opening size clearly and indelibly stamped on the body of the nipple.

2.10 PIPEWORK DISTRIBUTION

2.10.1 GENERAL

Pipework and fittings shall comply with appropriate international standards, shall be non-combustible and able to withstand the expected pressures and temperatures without damage. Where the manufacturer's listings require more stringent specifications in accordance with equipment's listing these shall be followed.

Before final assembly, pipe and fittings shall be inspected visually to ensure they are clean and free of burrs and rust, and that no foreign matter is inside and the full bore is clear.

After assembly, the system shall be thoroughly blown through with dry air or nitrogen.

Dirt traps shall be installed as specified in the installation manual of the manufacture.

Over pressure relief devices shall be designed to operate at a pressure not greater than the test pressure of the pipework, or as required by the manufacturer.

Pressure relief devices, which can include a selector valve assembly, should be fitted so that the discharge, in the event of operation, will not injure or endanger personnel and, if necessary, so that the discharge is piped to an area where it will not become a hazard to personnel.

In the systems using pressure-operated container valves, automatic means shall be provided to vent any container leakage that could build up pressure in the pilot system and cause unwanted opening of the container valve. The means of pressure venting shall not prevent operation of the container valve.

The pipe system shall be provided with an ANSUL listed pressure switch just upstream of the orifice union before any other take-off to provide a potential-free output signal to the main fire alarm system to monitor and report on a gas discharge.

2.10.2 PIPING MATERIALS

Piping shall be of non-combustible material having physical and chemical characteristics such that its integrity under stress can be predicated with reliability. Only seamless black-steel schedule piping shall be used. The pressure handling capabilities shall be the maximum developed pressure plus 50% at a maximum storage temperature of not less than 50°C. If higher operating temperatures are approved for a given system, the design pressure shall be adjusted to the developed pressure plus 50% at maximum temperature. In performing this calculation, all joint factors and threading, grooving or welding allowances shall be taken into account.

Where a static pressure-reducing device is used in a non-liquefied gas system, the maximum working pressure plus 50% in the distribution pipework downstream of the device shall be used in the verification of the downstream pipe wall thickness. **All pipes shall be sleeved where penetrating separating elements**. Sleeves shall be properly sealed after the pipe installation.

<u>The following table provides schedule information for the pipe system:</u>

	DOWN-STREAM OF ORIFACE UNION	UP-STREAM OF ORIFACE UNION
Pipe sizes below 50mm	ASTM A 106 B (Sch. 40) BS 3601 BS 3602	ASTM A 106 B (Sch. 80) API 5 L Grade B (Sch. 80)
Pipe sizes 50mm and above	API 5 L Grade B (Sch. 80) ASTM A 106 B (Sch. 80)	ASTM A 106 B (Sch. 160) API 5 L Grade B (Sch. 160)

Flexible tubing or hoses (including connections) shall be of approved materials in accordance with the system's listings and /or manufacturer's recommendations and shall be suitable for service at the anticipated extinguishant pressure and maximum and minimum temperatures expected during normal and discharge conditions.

Not withstanding the requirements of ISO14520 the expected working pressures for Inert Systems shall be in accordance with NFPA2001.

We summarise as follows:

Minimum Design Working Pressure for Inert Gas Clean Agent System Piping

Agent	Agent Container Charging Pressure at 21°C		Agent Container Charging Pressure at 130°F (55°C)		Piping Upstream of Pressure Reducer		Piping Downstream of Pressure Reducer	
	psig	kPa	psig	kPa	psig	Kpa	psig	kPa
IG-541	2,175	14,997	2,575	17,755	2,175	14,997	1,000	6,895
	2,900	19,996	3,433	23,671	2,900	19,996	1,000	6,895
IG-55 (comparison)	2,222	15,320	2,475	17,065	2,222	15,320	950	6,550
	2,962	20,424	3,300	22,753	2,962	20,424	950	6,550
	4,443	30,633	4,950	34,130	4,443	30,635	950	6,550

Minimum Design Pressure at 70°F (21°C) to be used.

All pipe ends shall be reamed clean of any burrs before assembly. Contractors shall physically check the inner diametric tolerance of particularly smaller pipe sizes for conformity with the prescribed specification.

Contractors are advised to blow through all distribution pipework and nozzles to ensure that no blockages exist, prior to performing the full discharge test.

2.10.3 FITTINGS

Fittings upstream of the orifice union shall have a minimum rated working pressure at 150% to the maximum pressure in the container at 50°C when filled to the maximum allowable fill density for the extinguishant being used. For systems that use a pressure-reducing device in the distribution piping, the fittings downstream of the device (orifice) shall have a minimum rated working pressure at 150% of the maximum anticipated pressure in the downstream piping.

Cast iron fittings shall not be used.

Welding and brazing alloys shall have a melting point above 500°C.

Welding shall be performed in accordance with relevant national standards.

Where copper, stainless steel, or other suitable tubing is joined with compression fittings, the manufacturer's pressure/temperature ratings of the fittings shall not be exceed and care shall be taken to ensure the integrity of the assembly.

The following table provides fitting schedule information and shall be used:

	DOWN-STREAM OF ORIFACE UNION	**UP-STREAM OF ORIFACE UNION**
Joint Type allowed	Welded/Screwed/Flanged	Welded/Screwed/Flanged
Pipe/Fitting Size up to 40mm	BS 3799 (screwed) BS 3799 (socket welded) BS1640 (butt welded)	BS 3799 (screwed) BS 3799 (socket welded) BS1640 (butt welded)
Pipe/Fitting Size from 50mm to 150mm	BS 3799 (screwed) BS 3799 (socket welded) BS1640 (butt welded)	BS 3799 (socket welded) BS1640 (butt welded)
Flange of all sizes	BS 1560 Pt 2 Class 600 ANSI B 16.5 Class 600	BS 1560 Pt 2 Class 2500 ANSI B 16.5 Class 2500

2.11 PROTECTION AGAINST CORROSION

All steelwork shall be adequately protected against corrosion.

Steelwork shall be painted as follows:

- Surfaces shall be thoroughly cleaned in accordance with SABS 064.
- An appropriate primer shall then be applied.
- Finally two coats of paint complying with Grade 1 of SABS 630 shall be applied.
- All pipes to be painted Signal Red.
- Care shall be taken that the entire surface is covered to the same standard and where surfaces have been damaged during the installation; these shall be touched up to the same standard.

All hangers, anchors, brackets, guides and supports inside and outside building shall be treated as described above and painted black.

Nuts, bolts and screw threads shall be cadmium plated or brass, and not painted.

All manifolds shall remain unpainted.

2.12 IDENTIFICATION

Identification colours shall be approved by the Engineer. Identification shall be neat and legible and shall be applied after completion of final finishes. **All gas piping shall be provided with Agent identification stickers neatly applied to the pipes showing Agent and flow direction**. Size and location shall be in accordance with SABS 0140 Identification of pipelines

Each gas bank, Gas Control unit, and Interface shall be labelled with red lettering 50 mm high on a white background. Example GAS BANK MSC

Labels shall be of non-corroding material, shall consist of red lettering with a minimum height of 50mm on a white non-glossy background. Labels shall be screwed into position.

Each gas bank, Gas Control unit, and Interface shall be labelled :
Example GAS BANK MSC, HSSD INTERFACE, HVAC SHUT DOWN INTERFACE

2.13 PIPE SUPPORTS

Pipe supports shall be suitable for the expected temperature and shall be able to withstand the dynamic and static forces involved. Due allowance shall be made for the stresses induced in the pipework by temperature variations. Adequate environmental protection shall be given to supports and associated steelwork.

The distance between pipe supports shall be as specified below:

NOMINAL DIAMETER OF PIPE DN	MAXIMUM PIPEWORK SPAN m
15 20 25	1.5 1.8 2.1
32 40 50	2.4 2.7 3.4
65 80 100	3.5 3.7 4.3

Adequate support shall be provided for nozzles and their reactive forces such that in no case shall the distance from the last support be greater than as follows:

(a) <25mm pipe #100mm
(b) >25mm pipe #250mm

Movement of pipework caused by temperature fluctuations arising from environment or the discharge of extinguishant may be considerable particularly over long lengths and should be considered in the support fixing methods.

All pipe runs and system components shall be so located so as to maintain a minimum clearance of 200mm from electrical conduiting or equipment, unless greater clearance is indicated in the Supplementary Specification or on Tender drawings.

Where equipment is to be bolted down on concrete plinths, anchor studs shall preferably be cast into concrete bases. In such instances, the thread of the anchor studs shall be suitably protected to readily facilitate repeated disassembly of fixing assemblies.

Where equipment is to be fixed to concrete or brickwork surfaces, and where building or casting in is not feasible or desirable, fixing shall be by means of approved expansion type anchor bolts. Due care shall be taken to ensure adequate penetration of any expansion bolt, to eliminate surface damage. Pipes penetrating walls shall be sleeved.

All pipelines shall be firmly bracketed to walls and ceilings to the satisfaction of the

Engineer. Any piping system shall be securely supported with due allowance for expansion and concentration and shall not be subject to possible damage.

The Contractor shall supply all bolts, fasteners, fittings, braces, supports, packings, gaskets, etc. necessary for assembly all equipment supplied by him. All such items required for assembly shall be supplied by the manufacturer of the Clean Agent equipment, or alternatively approved by the manufacturer.

Assembly of equipment shall be done in accordance with the requirements of the Clean Agent equipment manufacturer. Assemblies shall be neat and in accordance with the Client's and Engineer's requirements regarding quality of workmanship.

Typical pipe supports are made of RSA sections welded to steel plate and bolted to the structure. These are to be manufactured as shown on the tender drawings.

Threaded rod hangars shall under no circumstances be acceptable, regardless of the Inergen Installation guide data sheets and schematic drawings

2.14 VALVES

All valves, gaskets, O-rings, sealant and other valve components shall be constructed of materials that are compatible with the extinguishant and shall be suitable for the envisaged pressures and temperatures, and shall be approved by the manufacturer for use in the system. All valves shall be listed for use in the system.

Valves shall be protected against mechanical, chemical or other damage.

Special corrosion- resistant materials or coatings shall be used in severely corrosive atmospheres.

2.15 NOZZLES

2.15.1 CHOICE AND LOCATION

Nozzles, including nozzles directly attached to containers, shall be as supplied by the certified manufacturer of the Clean Agent equipment, and shall be of adequate strength for use with the expected working pressures, able to resist normal mechanical damage, and constructed to withstand expected temperatures with deformation.

All discharge nozzle orifices shall be pre-drilled by the certified manufacturer of the Clean Agent equipment, and the equivalent single orifice size clearly and indelibly stamped on the nozzle body, regardless of shape and number of orifices. This equivalent size shall refer to the size of standard single orifice type with rounded entry and a coefficient of discharge of not less than 0.98, having the same flow rate as the nozzle in question. No Contractor or any other party shall under any circumstances be allowed to modify in any way any pre-drilled nozzle orifice, **unless written approval from ANSUL has been provided.**

Where possible, a minimum of two nozzles shall be provided in every protected space, or any part of subdivision separated from the main part of the protected space by any physical barrier, such as access flooring or ceiling. Single nozzles shall only be used in spaces to small to accommodate two nozzles. Where single nozzles are installed, blind elbows shall be fitted.

All discharge nozzles shall be located to achieve the best results and shall be selected and so positioned that the discharge will not splash flammable liquids or create dust clouds that might spread a fire, create an explosion, or otherwise adversely affect the

contents of the protected space. Nozzles vary in design and discharge characteristics and shall be selected on the basis of their suitability for the use intended.

The type number and placement of nozzles shall be such that:

- the design concentration is achieved in all parts of the enclosure;
- the discharge does not unduly splash flammable liquids or create dust clouds that might extend the fire, create and explosion or otherwise adversely affect the occupants; the velocity of discharge does not adversely affect the enclosure or is contents.
- The discharge shall not dislodge ceiling tiles etc, thus all ceiling mounted nozzles shall be fitted with an ANSUL approved deflector shield

Where clogging by foreign materials is possible, the discharge nozzles shall be provided with frangible discs or blow-out caps. These devices shall provide an unobstructed opening upon system operation and shall be designed and arranged so they will not injure personnel.

Nozzles shall be suitable for the intended use and shall be approved for discharge characteristics, including area coverage and height limitations.

Nozzle discharge orifice inserts shall be of corrosion – resistant material and nozzles shall be brass with male threaded connections to ANSI B1.20.1, and compatible with the pipe threaded being used.

The Contractor shall individually ensure that the thread on each and every nozzle matches pipe thread before installation commences.

2.15.2 NOZZLES IN CEILING TILES

In order to minimize the possibility of lifting or displacement of lightweight ceiling tiles, precautions shall be taken to securely anchor tiles for a minimum distance of 1.5m from each discharge nozzle. **Deflector shields shall be installed on all ceiling mounted nozzles**.

2.15.3 MARKING

Discharge nozzles shall be permanently marked to identify the manufacturer and size of the orifice.

2.16 PROXIMITY TO ELECTRICAL HAZARDS

Where exposed electrical conductors are present, clearances no smaller than those given in the table below shall be provided, where practicable, between the electrical conductors and all parts of the system that may be approached during maintenance. Where these clearance distances cannot be achieved, warning notices shall be provided and a safe system of maintenance work shall be adopted.

Maximum Rated Voltage kV	Minimum Clearance From Any Point On Or About The Permanent Equipment Where A Person May Be Required To Stand	
	To The Nearest Unscreened Live Conductor In Air (Section Clearance) m	To The Nearest Part Not At Earth Potential Of An Insulator Supporting A Live Conductor (Ground Clearance) m
15	2.6	2.5
33	2.75	
44	2.90	
66	3.10	
88	3.20	
110	3.35	
132	3.50	
165	3.80	
220	4.30	
275	4.60	

2.17 PRESSURE RELIEF DAMPERS

Dampers shall be located as shown on the drawings and shall be combination - Fire and pressure relief damper. Dampers shall be hot dipped galvanized.

Dampers shall be designed to open upon pressure (250pa) exerted onto the damper by the gas during discharge and shall close automatically means of a adjustable spring as the discharge diminish and remain tightly closed after discharge.

The open or closed status of the damper shall be indicated outside the casing.

Dampers shall be sized in accordance to the calculations provided by the supplier of the gas suppression system or be in accordance to the sizes as given by the engineer. The required free area is a function of the enclosure strength.

Dampers shall be installed so as to form part of a continuous barrier to the passage of fire when in a closed position. Where a damper cannot be fitted immediately adjacent to the fire wall, the section of ducting between damper and wall shall be of at least the same metal thickness and fire rating as the damper casing.

Dampers shall be self-supporting in case of fire. Care shall be exercised that the frame be set so that the closing device will be accessible.

Pressure relief dampers shall be manufactured as a 120 minute fire damper construction. Dampers shall comply with the requirements of local authorities, SABS 193 NFPA Bulletin 90A and National Building Regulations Act.

<u>The supplier shall manufacture the unit in strict compliance with the above standard, the only deviation being as follows:</u>

- The damper blades shall be held in the closed position with a stainless or other suitable spring, adjustable and set at an opening pressure of 250 Pa.

- The damper shall be provided with an inlet grille, white epoxy powder coated with a free area of 90%. The grille shall be hinged and secured with wing nuts for maintenance purposes.

- A standard pre filter such as used on HVAC installations shall be mounted in the damper recess, behind the inlet grille. The filter shall be made to fit snugly into the damper housing without obstructing the damper blade operation

- A thin black insect screen shall be fitted to the inside of the inlet grille, and be secured by a frame for easy removal and replacement

- The outlet side of the damper shall be fitted, when emitting to the outside of the building with a galvanized exhaust air louvre. Where the damper is fitted between two rooms (Internal) the grille shall match the inlet grille.

2.18 OPERATION

2.18.1 GAS CONTROL UNITS

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 devices 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 (GCU) shall be fitted at the main entrance door to each gas protected area.

Status units (GSU) shall be fitted at each secondary entrance door to the gas protected area.

2.18.2 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.

2.18.3 CONTROL PROCEDURES

2.18.3.1 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 an early warning system.

The fire protection contractor shall include for hard-wiring of interface signals to HVAC SAM interface panels as may be required

See fire detection specifications for the detailed control procedures.

2.18.3.2 With The Gas Control Unit In The Manual Mode

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 (If motorised) shall be fully closed 60 seconds after a start of gas discharge.

2.18.3.3 Break Glass Unit Activated

Activation of the break glass unit located on the gas control unit shall directly start 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.

2.18.4 MEANS OF SYSTEM CONTROL

<u>The system shall be provided with:</u>

2.18.4.1 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.

2.18.4.2 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.

2.18.4.3 Mechanical manual actuation

Means of mechanical manual actuation shall be provided inside the gas plantroom.

2.18.4.4 Lock-Off Device

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

2.18.4.5 Gas status unit

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.

2.18.5 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.

These shall be provided in strict accordance with the requirements of SABS ISO 14520 Code of Practice.

2.18.6 INSTRUCTIONS FOR USE

Instructions shall consist of:

- Notices, certificates, diagrams, etc., and all notices as required by the SABS ISO 14520 Code of Practice, Manufacturer and Engineer.
- Schematic layout of all systems on which all equipment, control devices and instruments are correctly indicated for that particular plant room. Diagrams shall contain information on set differential bands, throttling ranges, time delays, overload settings and other relevant data necessary for the checking and adjusting of each instrument, control and motor function.
- Wiring diagrams.
- Detailed instructions for working of the system / equipment during emergency and normal use.
- Instructions shall be printed on high quality, non-deteriorating paper framed behind glass.

3 FIRE DETECTION SYSTEM

3.1 OBJECTIVE

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

3.2 TECHNICAL REQUIREMENTS

3.2.1 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 SABS 0139 Code of Practice, the systems to be installed shall be L1 and M as indicated in the scope of work document.

3.2.2 TECHNICAL STANDARDS

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

- SABS 0139 2000 Ed.
- BS 6266 (Computer room areas only)
- 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

3.2.3 POWER SUPPLY

3.2.3.1 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.

3.2.3.2 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.

3.2.3.3 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.

3.2.4 ANALOGUE ADDRESSABLE FIRE PANEL

3.2.4.1 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

3.2.4.2 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

3.2.4.3 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
- Faulty calibration or sensitivity

3.2.4.4 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.

3.2.4.5 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.

3.2.4.6 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

3.2.4.7 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.

3.2.4.8 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

3.2.4.9 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

3.2.4.10 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

3.2.4.11 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.

3.2.4.12 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

3.2.4.13 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.

3.2.4.14 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.

3.2.4.15 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

3.2.4.16 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.

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

Operating Programmes

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.

Configuration Data

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.

3.2.4.17 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.

3.2.4.18 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.

3.2.5 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.

3.2.5.1 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.

3.2.5.2 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.

3.2.5.3 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.

3.2.5.4 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.

3.2.5.5 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.

3.2.5.6 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.

3.2.5.7 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.

3.2.5.8 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.

3.2.5.9 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.

3.2.5.10 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.

3.2.5.11 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.

3.2.5.12 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.

3.2.5.13 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.

3.2.5.14 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.

3.2.6 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 that must consist of the following:.

- 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.

3.2.6.1 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.

3.2.6.2 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.

3.2.6.3 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.

3.2.6.4 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.

3.2.6.5 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.

3.2.7 DEVICES AND LOOP DEVICES

3.2.7.1 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.

3.2.7.2 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.

3.2.7.3 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 750mm².

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

3.2.7.4 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.

3.2.7.5 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.

<u>The detector shall be capable of operating within the following environmental limits:</u>

Description	**Value**
Temperature operating range	–20°C to +60°C.
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.

3.2.7.6 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 SABS 0139 : 2000 Edition.

3.2.7.7 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.

3.2.7.8 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.

3.2.7.9 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.

3.2.7.10 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°. The detector must be capable of operating from 12 or 24V DC.

3.2.7.11 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.

3.2.7.12 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.

3.2.7.13 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.

3.2.7.14 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.

3.2.7.15 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.

3.2.7.16 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.

3.2.7.17 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.

3.2.7.18 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.

3.2.7.19 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.

3.2.7.20 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.

3.2.7.21 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.

3.2.8 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:

3.2.8.1 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.

3.2.8.2 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.

3.2.8.3 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

3.2.8.4 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

3.2.8.5 System Maintenance Reports

The following system maintenance reports shall be available on demand:

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

3.2.8.6 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.

3.2.8.7 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.

3.2.8.8 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.

3.2.8.9 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.

3.2.8.10 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.

<u>It shall be possible, once connected to the site, to:</u>

- 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.

3.3 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.

3.3.1 ACCESS LEVELS

Access to the system shall be protected as follows:

3.3.1.1 Control Key

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

3.3.1.2 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.

3.3.1.3 Door Lock

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

3.3.1.4 Non-Volatile Memory Switch

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

3.3.2 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

3.3.3 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

3.3.4 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)
- ype 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.

3.3.5 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 devices 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.

3.3.6 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.

3.3.7 CONTROL PROCEDURES

3.3.7.1 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 HVAC units off. FP contractor shall include for hard-wiring of interface signals to HVAC units or interface panels as may be required

HSSD Signal : (Switch-off AC-System – automatic reset by timer in detection panel)

First knock : (First smoke detector detects a fire)

Step 1: Activate alarm (outside room) - alert tone.
Activate evacuation signs flashing mode

Step 2: Open motorised relief-dampers (if fitted)

Step 3: Shut off HVAC (manual reset) unit and close fresh air damper, and switch off fresh air fan

Step 4: Close all fire dampers

Second knock: (Second smoke detector detects a fire)
Step 5: Activate alarm bells (inside room) - evacuation tone.
Step 6: Activate pre-release timer adjustable from 20 to 120 seconds set at 45 seconds
Step 7: Activate evacuation signs – steady-on mode
Step 8: Release gas

After gas release:
Step 9: Close motorised relief dampers (if fitted) delay action - post pressure switch signal
Step 10: Manual reset to restart the system
Step 11: Fire detection shunt function override switch activated to restart AC system

3.3.7.2 With The Gas Control Unit In The Manual Mode

Follow steps 1 to 11 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 fully closed 60 seconds after a start of gas discharge.

3.3.7.3 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.

3.3.8 ALARM MATRIX

VODACOM
Phase 6 Interfacing matrix

Area	Cause			Effect
	HSSD	1st Detector	2nd Detector	
All Gas areas	*			HVAC Shut down, auto restart in 3 minutes
				Alarm on Fire panel and GS Win only
All Gas areas		*		HVAC shut down, Manual Restart
				Sirens and strobes outside room on
				Evac sign inside room on Flashing mode
All Gas areas			*	Evac Sign inside room on steady mode
				Sirens and strobes inside room on
				Gas discharge timer activates
Fresh air fan	*			Damper Shut. Fan stops
				Alarm on Fire panel and GS Win only
				Fan restarts on fire panel reset only
Fresh air fan		*		Damper Shut. Fan stops
				Alarm on Fire panel and GS Win only
				Fan restarts on fire panel reset only

3.3.9 MEANS OF SYSTEM CONTROL

The system shall be provided with:

3.3.9.1 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.

3.3.9.2 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.

3.3.9.3 Lock-Off Device

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

3.3.9.4 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.

3.3.9.5 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.

3.4 DESIGN AND INSTALLATION REQUIREMENTS

3.4.1 CIRCUIT DESIGN

3.4.1.1 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.

3.4.1.2 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 m^2.

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).

3.4.1.3 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.

3.4.1.4 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.

3.4.1.5 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.

3.4.1.6 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.

3.4.1.7 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)

3.4.2 CABLES

3.4.2.1 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

3.4.2.2 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.

3.4.2.3 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.

3.4.2.4 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.

3.4.2.5 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.

3.4.2.6 Protection Of Cables From Electrical Damage

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

3.4.2.7 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
- Cast-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.

3.4.2.8 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.

3.4.2.9 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.

3.4.2.10 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.

3.4.2.11 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.

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

3.4.2.12 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.

3.4.2.13 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.

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

3.4.2.14 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.

3.4.2.15 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.

3.4.3 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.

3.4.3.1 Conduit

<u>If fire alarm cables reticulate:</u>

- 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 points, gas control units, interface units etc shall be surface mounted on wall, with GI conduits surface mounted in passages, and drilled through the walls in the data Area. In new build buildings no vertical surface conduits are acceptable

3.4.3.2 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.

Epoxy coated, black trunking shall be used in the service passages

3.4.4 INSTALLATION AND TERMINATION OF CONDUIT & CONDUIT ACCESSORIES

3.4.4.1 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 be Reyroll Adapta-flex black.

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.

3.4.4.2 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.

3.4.4.3 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.

3.4.4.4 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.

3.4.4.5 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.

3.4.4.6 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

3.4.5 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.

3.4.6 INSTALLATION OF INTERFACE UNITS

All interface units, (input and output) such as HVAC 3 channel units, HSSD 3 channel units as gas discharge relay units shall be mounted in transparent cover casings.

The three channel interface units housing shall be as above with dimensions 310 (H) x 240 (W) x 160 (D).

HVAC unit interface shall be 500mm above false floor. HSSD interface shall be at 2500mm above floor, gas release interface shall be directly above manifold level.

3.4.7 POWER SUPPLY UNITS

Due to the power drawn by the HSSD units, gas release actuators and flashing signs, power supply units are provided.

Units are required as shown on the drawings

4 HIGH SENSITIVITY ASPIRATING SMOKE DETECTION SYSTEM

4.1 SCOPE

This document provides specification details for the VESDA LaserFOCUS aspirating smoke detection product.

The VESDA LaserFOCUS, very early warning aspirated smoke detector, shall be installed throughout the areas nominated on the drawings.

The system consists of highly sensitive laser based smoke detector using aspirated air sampling and is connected to sampling pipes. It shall be provided with a single sample inlet, internal flow monitoring, smoke detection and a facility for exhaust pipe connection. Reset, disable and fault determination functions will be available via the field service access door. System configuration will be provided through the AutoLearn functions, also available via the field service access door.

4.2 APPROVALS

The Very Early Smoke Detection System must be of a type submitted to, tested, approved, and/or listed by:

- UL (Underwriters Laboratories Inc), US
- FM (Factory Mutual), US
- ULC (Underwriters Laboratories Canada), Canada
- LPCB (Loss Prevention Certification Board), UK
- SSL (Scientific Services Laboratory), Australia
- VdS (Verband der Sachversicherer e. V.), Germany
- AFNOR – France
- NTC - China
- Codes, Standards or Regulations
- The LaserFOCUS smoke detector shall be installed to comply with one or more of the following codes or standards:
- AS 1670, AS1603 NZ Part 2, 4, 8, ASNZS 3000
- NZ 4512 1994
- Local codes and standards

4.3 SYSTEM DESCRIPTION

4.3.1 DESIGN REQUIREMENTS

The detector shall consist of a highly sensitive laser based smoke detector, an aspirator, and a dual-stage filter cartridge.

The detector shall have control switches for Reset, Disable and restricted access switches for Alarm Setup and Flow Setup.

The detector shall have individual illuminated indicators for:

- Four alarm levels (Alert, Action, Fire1 & Fire 2).
- Fault, Power & Disabled.
- Alarm Setup and Flow Setup.

The detector shall have a front-panel, 10 segment, illuminated, yellow-colored smoke dial for the purpose of indicating current smoke level and detector status.

The detector shall have individual relay outputs for Fault, Action and Fire 1

The detector shall have an RS232-compatible serial control port for the purpose of configuration, control, status monitoring, event log extraction and upgrade.

The detector shall provide for the addition of one interface card.

The detector shall provide a general-purpose input to allow either; Reset, Disable, Standby, Alarm set 1, Alarm set 2 & External (external equipment trigger).

The detector may also be configured by a PC and allow programming of four smoke threshold alarm levels, time delays, faults including airflow, detector, power and filter as well as an indication of the urgency of the fault and three relay outputs for remote indication of alarm and fault.

The detector shall consist of an air sampling pipe network to transport air to the detection system and supports standard designs. Complex designs are supported by calculations from a computer-based design-modeling tool.

4.3.2 PERFORMANCE REQUIREMENTS

The detector shall be approved to provide very early smoke detection and provide up to four output levels corresponding to Alert, Action, Fire 1 and Fire 2. Alert and Action shall be programmable and able to be set at sensitivities ranging from 0.025 to 2.0% obs/m. Fire 1 and Fire 2 shall be programmable and able to be set at sensitivities ranging from 0.025 to 20% obs/m.

The detector shall provide fault indication on the unit using the Instant Fault Finder function.

The detector shall be self-monitoring for filter contamination.

The detector shall incorporate an ultrasonic flow sensor in the pipe inlet port and provide staged airflow faults.

4.4 SUBMITTALS

Product data and site drawings shall be submitted and shall include pipe layout, operational calculations (refer to the User Manual for simple pre-engineered designs, or use ASPIRE2) and performance criteria.

A copy of the manufacturer’s product manual shall be supplied upon completion of the installation.

System commissioning data shall be supplied (in a format recommended by the manufacturer and per the instructions provided by the manufacturer) within 30 days of completion of the installation.

4.5 QUALITY ASSURANCE

4.5.1 MANUFACTURER QUALIFICATIONS

The manufacturer shall have a minimum of 10 years production experience in the

manufacturer and design of high sensitivity aspiration-type smoke detection systems.

The manufacturer shall be certified as meeting ISO 9001:2000 for manufacturing.

4.5.2 TECHNOLOGY

Both light scattering and particle counting shall be utilized in this device as follows:

- The laser detection chamber shall be of the mass light scattering type and capable of detecting a wide range of smoke particle types of varying size.

A particle counting method shall be employed for the purposes of:

- Preventing large particles from affecting the true smoke reading.
- Monitoring contamination of the filter (dust & dirt etc.) to automatically notify when maintenance is required.

Note: The particle counting mechanism shall not be used for the purpose of smoke density measurement.

The laser detection chamber shall incorporate a separate secondary clean air feed from the filter to provide clean air barriers across critical detector optics to eliminate internal detector contamination.

The detector shall not use adaptive algorithms to adjust the sensitivity from that set during commissioning. A learning tool shall be provided to ensure the best selection of appropriate alarm thresholds during the commissioning process.

4.5.3 EQUIPMENT SUPPLIER

The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test and maintain the aspirating system and shall be able to produce a certificate stating such on request.

4.6 DETECTOR ASSEMBLY

The detector, filter, aspirator and relay outputs shall be housed in an enclosure and shall be arranged in such a way that air is drawn from the fire risk area and a sample of air is passed through the dual stage filter and detector by the aspirator.

The detector shall be laser based type and shall have an obscuration sensitivity range of 0.025 – 20% obs/m.

The detector shall have four independent field programmable smoke alarm thresholds across its sensitivity range with adjustable time delays for each threshold between 0 - 60 seconds.

The detector shall also incorporate the facility to transmit a fault either via a relay or via a VESDAnet card as an option.

The detector shall have a single pipe inlet that must contain an ultrasonic flow sensor. High flow fault (urgent and non-urgent) and low flow fault (urgent and non-urgent) can be reported.

The filter must be a two-stage disposable filter cartridge. The first stage shall be capable of filtering particles in excess of 20 microns from the air sample. The second stage shall be ultra- fine, removing more than 99% of contaminant particles of 0.3

microns or larger, to provide a clean air barrier around the detector's optics to prevent contamination and increase service life.

The aspirator shall be a purpose-designed aspirator assembly.

VESDA LaserFOCUS (VLF-500) shall be capable of supporting a single pipe run of 50 m, (Max 24 holes)or two pipe runs of 30 m (Max 12 holes per branch), with a transport time of less than 60 seconds or as appropriate codes dictate.

The assembly must contain relays for basic alarm and fault conditions. The relays shall be software programmable (latching or non-latching). The relays must be rated at 2 A at 30 VDC. Remote relays shall be offered as an option with a VESDAnet Interface card and either configured to replicate those on the detector or programmed differently.

The assembly shall have built-in event and smoke logging. It shall have separate event log storage for smoke levels, alarm conditions, operator actions and faults. The date and time of each even shall be recorded. Each detector (zone) shall be capable of storing up to 18,000 events.

4.7 DISPLAYS

The detector will be provided with LED indicators.

Each Detector shall provide the following features at a minimum:

- Alert, Alarm, Fire 1 and Fire 2 corresponding to the alarm thresholds of the detector
- Smoke Dial display represents the level of smoke present
- Fault indicator
- Power indicator
- Disabled indicator

Buttons supporting the following features shall be accessible to authorized personnel:

- Reset – Unlatches all latched alarm and faults.
- Disable – Disables the fire relay outputs from actuating and indicates a fault.

4.8 DEVICE NETWORKING REQUIREMENTS (VESDANET CARD REQUIRED)

The devices in the smoke detection system shall be capable of communicating with each other via twisted pair RS485 cable with the addition of a VESDAnet Interface card. The network shall be able to support up to 250 devices (detectors, displays and programmers), of which at least 100 detectors can be supported.

Backward compatibility with VESDA Laser Product via VESDAnet card
The unit shall be capable of being configured in a fault tolerant loop for both short circuit and open circuit.
PC based configuration tools shall be available to configure and manage the network of detectors.

4.8.1 DIGITAL COMMUNICATION PORT

An RS 232 compatible serial port will be provided on the detector for configuration, status monitoring, command input, event log extraction and software upgrades. It shall comply with EIA RS232 Protocol.

4.9 APPLICATION

4.9.1 DETECTION ALARM LEVELS

The standard laser based aspirating detection system is supplied with two alarm outputs (Alert and Fire 1). For four relay alarm levels use the optional Relay Interface card.

The standard alarm outputs may be used as follows:

- **Alert** (Alarm Level 1) - activate a visual and audible alarm in the fire risk area.
- **Fire 1** (Alarm Level 3) - activate an alarm condition in the Fire Alarm Control Panel to call the Fire Brigade and activate all warning systems.
- The additional alarm outputs, with the optional Relay Interface card may be used as follows:
- **Action** (Alarm Level 2) - activates the electrical/electronic equipment shutdown relay and activates visual and audible alarms in the Security Office or other appropriate location.
- **Fire 2** (Alarm Level 4) - activate a suppression system and/or other suitable countermeasures (e.g. evacuation action or shutdown of systems).

Note: The alarm level functions as listed are possible scenarios. Consideration should be given to the best utilization of these facilities for each application and the requirements of local authorities (e.g. Authorities Having Jurisdiction in the US).

4.9.2 INITIAL DETECTION ALARM SETTINGS

Initial settings for the alarm levels shall be determined by the requirements of the fire zone.

Default settings of the unit shall be:

- Alarm Level 1 (Alert) 0.08% obs/m
- Alarm Level 2 (Action) 0.14% obs/m
- Alarm Level 3 (Fire 1) 0.20% obs/m
- Alarm Level 4 (Fire 2) 2.00% obs/m

Initial (factory default) Alarm Delay Thresholds

Standard settings of the unit shall be:

- Alarm Level 1 (Alert) 0.025% obs/m
- Alarm Level 2 (Action) 0.027% obs/m
- Alarm Level 3 (Fire 1) 0.030% obs/m
- Alarm Level 4 (Fire 2) 0.035% obs/m

Initial (factory default) Alarm Delay Thresholds

Initial (factory default) settings for the alarm delay threshold shall be:

- Alarm Level 1 (Alert) 10 seconds
- Alarm Level 2 (Action) 10 seconds
- Alarm Level 3 (Fire 1) 10 seconds
- Alarm Level 4 (Fire 2) 10 seconds
- Fault Alarm 5 seconds

4.9.3 FAULT ALARMS

The detector fault relay shall be connected to the appropriate alarm zone on the Fire Alarm Control Panel in such a way that a detector fault would register a fault condition on the FACP. The fault relay shall also be connected to the appropriate control system.

4.9.4 POWER SUPPLY AND BATTERIES

The system shall be powered from a regulated supply of nominally 24V DC. The battery charger and battery shall comply with the relevant Codes and Standards.

Local Power Supply Standards that may apply include:

ASNZ 1603 Part 4 –1987

4.10 SAMPLING PIPE DESIGN

4.10.1 SAMPLING PIPE

The sampling pipe shall be smooth bore with an internal diameter between 19 - 21 mm. Normally, pipe with an outside diameter of OD 25 mm and internal diameter of ID 21mm should be used.

The pipe material should be suitable for the environment in which it is installed, or of material as required by the Specifying Body.

All joints in the sampling pipe must be air tight and made by using solvent cement, except at entry to the detector.

The pipe shall be identified as Air Sampling/Aspirating Smoke Detector Pipe (or similar wording) along its entire length at regular intervals not exceeding the manufacturers recommendation or that of local codes and standards.

To minimize flexing, all pipes should be supported every 1.5 m or less, or at a distance described in local codes and standards.

The far end of each trunk or branch pipe shall be fitted with an end cap and made air tight by using solvent cement. Use of an end vent will be dependent on pre-engineered pipe design or ASPIRE2 calculations.

4.10.2 SAMPLING HOLES

Sampling holes of 3 mm or otherwise appropriately sized holes (see Section Air

Sampling Pipe Network Calculations), shall not be separated by more than the maximum distance allowable for conventional point detectors as specified in the local codes and standards. Intervals may vary according to calculations. For AS1670 the maximum allowable distance is 10.2 m.

Each sampling hole shall be identified in accordance with Codes or Standards.
Consideration shall be given to the manufacturers recommendations and standards in relation to the number of sampling holes and the distance of the sampling holes from the ceiling or roof structure and forced ventilation systems.

4.11 INSTALLATION

4.11.1 THE DETECTION SYSTEM

The contractor shall install the system in accordance with the manufacturer's System Design Manual.

4.11.2 THE CAPILLARY SAMPLING NETWORK

Where false ceilings are installed, the sampling pipe shall be installed above the ceiling, and capillary-sampling points shall be installed on the ceiling and connected by means of a capillary tube.

The minimum internal diameter of the capillary tube shall be 5 mm, the maximum length of the capillary tube shall be 1.8 m unless the manufacturer in consultation with the engineer have specified otherwise.

The capillary tube shall terminate at a ceiling sampling hole specifically designed and approved by the manufacturer. The performance characteristics of the sampling holes shall be taken into account during the system design.

4.11.3 AIR SAMPLING PIPE NETWORK CALCULATIONS

Pre-engineered pipework setups are provided in the VESDA LaserFOCUS Product Manual. For specific performance requirements that fall outside the pre-engineered designs, a sampling pipe aspiration-modeling program such as ASPIRE2 shall provide air sampling pipe network calculations. Pipe calculations shall be supplied with the proposed pipe layout design to indicate the following performance criteria.

Transport Time

The manufacturer’s recommended transport time (i.e. the time taken by smoke sampled to reach the detector) for the least favorable sampling hole is less than 60 seconds for open hole sampling and less than 90 seconds for capillary tubes.

Local codes and standards may also apply. For example:

- AS1670, Part 1 Australia90 Seconds
- BFPSA Code of Practice UK 120 Seconds
- NFPA72 The Americas 120 Seconds
- The maximum transport time must never exceed the local codes.

5 TESTING AND COMMISSIONING

5.1 GAS SUPRESSION SYSTEM COMMISSIONING AND ACCEPTANCE

This clause sets out the minimum requirements for the commissioning and acceptance

of the gaseous extinguishing system:

5.1.1 TESTS

The completed system shall be reviewed and tested by a competent person to meet the approval of the engineer and authority. Only equipment and devices designed to national standards and higher shall be used in the systems. To determine that the system has been properly installed and will function as specified, the tests as determined in this specification shall be completed.

5.1.2 REVIEW OF MECHANICAL COMPONENTS

The piping distribution system shall be inspected to determine that it is in compliance with the design and installation documents.

Nozzles and pipe size and, if appropriate, pressure – reducing devices, shall be in accordance with system drawings. The means for pipe size reduction and attitudes of tees shall be checked for conformance to the design.

Piping joints, discharge nozzles piping supports etc. shall be securely fastened to prevent unacceptable vertical or lateral movement during discharge. Discharge nozzles shall be installed in such a manner that piping cannot become detached during discharge.

During assembly, the piping distribution system shall be inspected internally to detect the possibility of any oil or particulate matter which could soil the hazard area or affect the extinguishant distribution due to a reduction in the effective nozzle orifice area.

The discharge nozzles shall be oriented in such a manner that optimum extinguishant dispersal can be effected.

Where deflectors are installed, they shall be positioned to obtain the maximum benefit.

The discharge nozzles, piping, and mounting brackets shall be installed in such a manner that they will not potentially cause injury to personnel. Extinguishant shall not directly impinge on areas where personnel may be found in the normal work area, or on any loose objects or shelves, cabinet tops, or similar surfaces where loos objects could be present and become missiles.

All extinguishant storage containers shall be properly located in accordance with ‘approved for construction’ set of system drawings.

All containers and mounting brackets shall be securely fastened in accordance with the manufacturer’s requirements.

During the discharge test to be conducted, the concentration measurements should be made at a minimum of three points, one at the highest hazard level, one intermediate and one below floor. Recordable and calibrated instrumentation shall be used

An adequate quantity of extinguishant to produce the desired specified concentration shall be provided. The actual enclosure volumes shall be checked against those indicated on the system drawings to ensure the proper quantity of extinguishant. Fan rundown and damper closure time shall be taken into consideration.

5.1.3 FLUSHING OF PIPE WORK

After installation of the pipe work it is required to flush the pipe work in order to remove

remains/impurities, sealing material, cutting burrs etc as well as to verify that flow is continuous and that the piping is unobstructed.

The flushing to be performed prior to the installation of the discharge nozzles, and prior to the pressure test.

The flushing is to be performed by the use of compressed Air, suppression gas or N_2.

If gaseous media is used it must be insured that the pipe work has not been sealed of in any way.

5.1.4 PRESSURE TESTING OF PIPEWORK

5.1.4.1 General

After the installation of the open-ended pipe work has been completed, all Nozzle connections shall be plugged.

The connection upstream of the orifice dismantled and the distribution pipe inlet fitted with a test valve holding a hose connection to the pressure testing equipment.

Nitrogen or instrument air shall be used as test media.. A test pressure of 1000kPa for 10 minutes shall be maintained.

The piping shall be blown through with instrument air or N_2 until all moisture has been removed.

Disconnect all discharge hoses from the manifold before connecting the pressure testing equipment to the pipe system.

Before the pressure testing is performed:

Verification, mill and batch test documents for the pipes and fittings shall be present. The installation has been visual inspected and found in good order.

Holding time of 10 minutes in order to be assured that the pipe and fittings and their assembly will withstand the operating pressure expected at 90BAR.

Pressure drop not to be accepted. If the applied pressure cannot be maintained for the required time, all connections shall be checked for leakage. The leaking connection shall be tightened and the pressure test repeated until the system is tight.

5.1.4.2 Precautions

Pneumatic testing using gas involves the hazard of released energy stored in the compressed gas. Particular care must therefore be taken to minimize the chance of system failure during the pneumatic test.

Security against personnel injuries while the pipes are under pressure shall be ensured i.e. proper safety distance to the pipe work shall be kept as well as total evacuation of the area involved shall have been ensured prior and during the pressure testing.

The pressure testing to be performed from outside the room holding the pipe work. Gas pressure only to be applied and released slowly through a pressure regulator. When a pressure of approx 2 bar is attained, a preliminary check shall be made, including examination of joints/fittings etc. After the inspection and all joints/fitting etc found to be right, the pressure shall be gradually increased in steps until the test

pressure of 10 BAR is reached, holding the pressure at each step long enough to equalize piping strains. The test pressure shall at be maintained for 10 min.

During the period of installation pressure testing it shall be assured that no entrance into the room is made until after the pressure has been relieved from the pipe installation. Approval from local authorities, building owner, insurer and user must be obtained prior to testing.

5.1.5 REVIEW OF ENCLOSURE INTEGRITY

It is important that an effective extinguishant concentration not only be achieved, but is maintained for a sufficient period of time to allow effective emergency action. This is equally important in all classes of fires since a persistent ignition source (e.g. an arc, heat source, oxyacetylene torch, or “deep-seated” fire) can lead to resurgence of the initial event once the extinguishant has dissipated.

It is essential to determine the likely period during which the extinguishing concentration will be maintained within the protected enclosure. This is known as the hold time.

The predicted hold time shall be determined by the door fan test specified elsewhere, or full discharge test based on the following criteria:

- At the start of the hold time, the concentration throughout the enclosure shall be the design concentration
- At the end of the hold time, the extinguishant concentration throughout the enclosure shall be the design concentration.
- The hold time shall be not less than 10 min, unless otherwise specified by the authority.

- A written report shall be prepared on completion of the test containing the following information:

  - the enclosure leak flow characteristics;
  - the design concentration of extinguishant;
  - The gross volume of the enclosure;
  - The quantity of extinguishant provided;
  - The height of the enclosure;
  - The height of the highest hazard;

- The predicted minimum hold time and whether or not the value complies with the Code i.e. whether it is less than 10 min or the higher necessary value, as appropriate;
- The sketch plan used in the evaluation of the enclosure;
- The current calibration data for the fan unit and the pressure-measuring devices, and if available, corresponding certificates;
- The test results, including a record of the test measurements and any appropriate computer printout.

5.1.6 PERFORMANCE TESTING

5.1.6.1 ***Test 1 :*** LACTOSE / CALCIUM CHLORATE MIXTURE TEST PROCEDURE

Apparatus

Ignition mixture of 0.5 volumes of lactose to 1 volume of potassium chlorate
Non-combustible crucible or open cup
Non-combustible, insulated support to prevent damage to floor
Stop watch accurate to 1s

Procedure

Place mixture in crucible and immediately ignite.

Requirement

Fire detection system should operate within 120s of ignition.

5.1.6.2 ***Test 2*** : POLYURETHANE MATS TEST PROCEDURE

Apparatus

Polyurethane mats of following spec:

- uniform cell structure appearance and free from splits, streaks or large air pockets
- dimensions 500 x 500 x 20 mm
- density 20kg/m³
- mats shall burn for minimum of 180 seconds to satisfy test

Note: A typical mat complying with the above specification weights between 85 and 100g.

Trays to be of non-combustible material, lined with aluminium foil. Support on which to place the trays will be required. The stop-watch to b accurate to1second.

Procedure

Ignite a corner of each mat

Requirement

The fire detection system should operate within 180s of ignition

5.1.7 CERTIFICATION

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 this part of ISO 14520, Manufacturer and Engineer and give details of any departure from appropriate recommendations. The certificate shall give the design concentrations and, if carried out, reports of any additional test including the door fan test.

All approval certificates shall be handed over to the Engineer, including:

- Designer certificate of competency.
- Approval by ISO9001 certified manufacturer of detail design
- Storage cylinder test certificates.
- Distribution manifold test certificate.
- Materials certificates.

5.1.8 GAS REPLACEMENT GUARANTEE

The contractor shall guarantee that the full gas charge can be replenished within 24 hours after a discharge. This will be a written guarantee from the gas refilling company.

The supplier (ANSUL) shall guarantee that any cylinder leakage within 10 years shall be repaired and cylinder refilled free of charge

5.2 FIRE DETECTION SYSTEM COMMISSIONING AND ACCEPTANCE

5.2.1 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.

5.2.2 PERFORMANCE TESTS

5.2.2.1 Device list

A print out from the fire panel showing all devices shall be provided. This shall be verified on site to correspond as installed with the list.

5.2.2.2 Testing devices

All smoke detectors (100% test) shall be tested. Sequence and device address shall be recorded and then after testing compared with the panel event log.

Testing shall be done on an area by area basis, and recorded as such.

Testing of gas control units and sounders are included up to the gas release interface.

5.2.2.3 Testing interfacing

All interfaces shall be tested as follows (based on a room by room basis):

<u>HSSD testing</u>

Activate the HSSD by means of a hot wire test. HSSD shall alarm within 120 seconds .

Gas release interface

All actuators and boosters shall be removed from the cylinders. A double knock singal shall trigger all gas release interface units, and all actuators shall activate.

After the detection panel is reset, the actuators are reset with the correct tools and refitted to the cylinders.

5.2.2.4 Cable testing

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

5.3 HSSD COMMISSIONING AND ACCEPTANCE (VESDA COMMISSIONING GUIDE)

5.3.1 COMMISSIONING TESTS

The contractor shall allow for the manufacturer's representative to attend commissioning of the entire installation in the presence of the owner and/or its representative.

The Contractor shall provide all necessary instrumentation, equipment, materials and labor.

The Contractor shall record all tests and system calibrations and a copy of these results shall be retained on site in the System Log Book.

5.3.2 INTRODUCTION TO VESDA COMMISSIONING

The commissioning of a VESDA laser system is the final stage of any VESDA installation. It forges together the elements of designing and installing a pipe network, installing the detectors, cabling for power and VESDAnet (if appropriate), and the powering up of the system. Your objective and outcome of the commissioning process is to provide a fully functional VESDA laser system that matches your customers specification.

5.3.3 THE COMMISSIONING PROCESS

The commissioning process is a step by step process designed to systematically check and validate all the operational aspects of a VESDA laser system. The process benchmarks the performance levels tailored for each site and generates necessary documentation for the effective management and maintenance of the system. The steps required in a typical commissioning are listed below.

Commissioning Step	Action
1. Pre-Commissioning	Gather site information
(Before going to the customer site)	Obtain a copy of:

	• Pipe network design records • Pipe network installation form • Site plans and pipe layout plans
	Start to fill in: • Commissioning forms • Any regulatory forms required
2. Pre-Commissioning (Once you are on site)	Check cables
	Power up system
	Preliminary system check
3. Configuration & Thresholds	Configure the system
	Set thresholds
	Record in commissioning form: •Settings • Pipe network specifications (or attach a copy of the ASPIRE2 Installation Data Pack)
4. Test the System	Smoke test
	Sample hole pressure test (if required)
	Relay function
	Devices
	Record results on commissioning forms
5. Hand Over	Complete commissioning forms and attachments
	Forward copies along with attachments to all relevant persons

Table 1 - Commissioning process steps

5.3.4 TEST THE SYSTEM

VESDA systems can be tested in a number of different ways. Most sites will require different types of testing for different customer environments. Before conducting smoke tests you must check to see if the local codes and standards specify which type of smoke test is to be performed. Local codes and standards may also require changes to the general instructions below, where local codes and standards are different to the VESDA suggestions, **ALWAYS** follow the local codes and standards.

Performance testing is done during commissioning and **may** be required during service, but is not essential. We highly recommend pipe integrity testing be performed each year.

Performance Based Smoke Testing

A smoke test is necessary to prove the integrity of the pipe network and to measure the response time.

The type of smoke test required will depend upon the site and the application:

- Warehouses and open areas can use either a smoke pellet test, a polyurethane mat test, or possibly a wooden block test. Please check with the local codes and standards to find the most appropriate type of test for the environment.
- Very sensitive sites can use the electrical overload (PVC coated wire burn test), or the smouldering test coil test. (UK customers can refer to BFPSA Code of Practice Appendix A for system performance test methods).

We recommend that at least two tests are conducted. You must allow the environment to return to the normal conditions before beginning the second test.

Record the date and the type of smoke test used on the commissioning or testing forms. Please re-read the detector manuals if you are unsure of how to interpret smoke levels, alert, alarm or Fire1.

At a minimum, testing requires that you conduct pipe integrity smoke testing.

5.3.4.1 Wire Burn Smoke Testing

This test is performed by using a transformer to overload the power running through two meters of PVC-coated wire. To simulate the early stages of a fire, a length of wire is electrically overloaded so that smoke or vapors are driven off. This method is suitable for the testing of high sensitivity fire detection systems. This test may also be undertaken in underfloor spaces or ceiling voids.

Note: The wire used in this testing must be 1 m in length, of 10/0.1 mm strands insulated with PVC to a radial thickness of 0.3 mm, the cross sectional area of the conductor being 0.078 mm^2.
Vision Fire & Security have developed a test kit to assist field testing of wire burns. For more information please contact your nearest VESDA office and ask for information on VTT 10000.

These instructions are written assuming that you are using a VTT-100 test kit.

Warning: This test will burn the PVC coating off the wire. Do not hold the wire during testing. Do not breath in the smoke as it is harmful to your health. We recommend you remotely turn the transformer on or use appropriate protective equipment.

5.3.5 THE VESDA COMMISSIONING FORM

The VESDA Commissioning Form must be completed for every VESDA installation. Once the form has been completed and signed it should be forwarded along with relevant attachments to all those mentioned in *Documenting Test Results* on page 16. A copy of the form is given on the next page. You should make a copy of this page as you will need to fill one out for each site that you commission.

5.3.6 VESDA COMMISSIONING FORM

This is the main commissioning form for each customer site.

Customer Name		
Site Address		
Installer (Name & Contact)		
Commissioner (Name & Contact)		
Checks		
• Wiring Checked • Detector Diagnostics • Display Diagnostic • Test Relays		Dates:
Client Representative Name: Test Witnessed By:	Date:	
Hand Over Documents		
• Copy of this form • Aspire2 Installation Data Pack • Aspire2 Build of Materials • Commissioning form for each detector • Commissioning form for each relay card • Smoke test results • Ancillary devices form • Forms to comply with the local codes & standards		
Customer's Signature: Commissioner's Signature:	Date:	

Address set up					
Threshold	Alert		**Airflow**		
	Pre-Alarm		**Raw Flow**	Pipe 1	
	Fire		**% Flow**	Pipe 1	
Delay	Alert		**Flow Threshold**	High Urgent %	
	Pre-Alarm			High Minor %	
	Fire			Low Minor %	
Filter	Service Period			Low Urgent %	
Reference Detector	Address No.			Delay (Seconds)	
	Dilution%		**Instant Fire**	Enable/Disable	
	Delay Seconds		**Smoke Change**	%	
Simultaneous/ Cumulative	Simultaneous /Cumulative				

Relay	**1**	**2**	**3**
Configuration	D	E	E
Fault/Alert Overlay	Y		
Pre-Alarm		Y	
Fire			Y

D = De-energized; E = Energized; L = Latching

5.3.6.1 Display/Relay Module Configuration:

Display Module No.											
Button Lockout Enabled/Disabled	**Mode/Test**										
	Silence/Scan										
	Reset										
	Isolate										
Relays Connected Yes/No											
Isolate Reminder Yes/No											

5.3.6.2 Ancillary Devices

VESDA Zone No.										
VESDA Zone Name										
Device Name										
Device No.										
Software Version										
Location										

5.3.6.3 Smoke Test

- Test Results:
- Test Method:
- Type of Smoke:
- Test Date:

5.3.6.4 Air sampling

Pipe No.		1	2	3	4	5	6	7	8
Test Type	**Transport Time from End Cap Hole**								
Test 1	**Initial Response**								
	Alert								
	Action/Pre-Alarm								
	Fire 1/Fire								
	Fire 2								
	Peak Smoke								
Test 2	**Initial Response**								
	Alert								
	Action/Pre-Alarm								
	Fire 1/Fire								
	Fire 2								
	Peak Smoke								

Note: The as built ASPIRE2 calculations may be attached instead of completing the Air Sampling and the System sections.

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.