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Title: **Inspection, Testing and Maintenance of Fire Detection Systems Standard**

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# 1. INTRODUCTION

The performance of the fire detection equipment to function as designed is essential to the overall fire protection program. Fire detection equipment not only provides early occupant warning, but is also used in certain circumstances for the actuating of fire protection systems. This requires a high level of reliability for the operation of fire detection equipment. To achieve the high level, it is necessary to develop a well-conceived and executed schedule for inspection, testing and maintenance of the fire detection and alarm equipment.

Inspections are carried out on a frequent basis to confirm visually the operational status of the equipment, and to identify proactively whether the system, the protected space or hazard has been altered, damaged or compromised.

The purpose of testing is to confirm the correct function and performance of fire detection and alarm systems by providing a definite schedule for exercising, observing and measuring the functional and performance requirements of the equipment against pre-established design criteria.

Scheduled maintenance establishes preventive maintenance of the equipment to minimize the likelihood of a breakdown and to ensure fire detection is kept in a constant state of readiness.

These activities, along with the effectiveness and frequency with which they are conducted, provide the method for reaching the minimum desired level of reliability and availability for fire detection systems.

# 2. SUPPORTING CLAUSES

## 2.1 SCOPE

The effective performance of fire detection systems can only be ensured if:

a) The system is appropriate to the hazard and has been designed and installed in accordance with a recognised design standards.

b) The system has been properly commissioned to confirm that it operates as intended. Verification is provided in the form of baseline data.

c) Service activities are frequently performed to ensure its operational readiness and to confirm functionality and performance through regular testing.

d) This standard covers item (c) above and is predicated on a satisfactory completion of system design and installation (a), which is confirmed during commissioning (b).

e) This standard establishes the minimum requirements for the inspection, testing and maintenance (ITM) of fire detection systems typically encountered in power stations, yet where similar fire detection systems are used at other BU's the applicability remains the same. The functional testing of system interconnections is also addressed albeit at a high level.

f) The Fire Detection System Design Standard is covered in another standard (refer [6]) that is to be used in conjunction with this standard.

g) Detailed preventative fire detection inspections and testing procedures documentation are not covered by this standard, but have to be compiled by each BU according to systems, technologies, configurations and applications present at the BU and related premises.

### 2.1.1 Purpose

The objective of this standard is to maximize the reliability of fire detection systems and equipment such that the systems and equipment meet the functional design intent, and is likely to continue to do so until the next scheduled maintenance activity. It is not related to any design functions.

### 2.1.2 Applicability

This standard is intended to provide a systematic and uniform basis for Eskom personnel to implement and administer inspection, testing and preventative maintenance programs applicable to fire detection and alarm systems to ensure operational integrity of the systems throughout Eskom Holdings Limited Divisions.

This standard has been developed for existing Eskom properties and shall also be applied to any system installed in new buildings and/or plant constructed in the future. It has been developed on a general basis to incorporate systems and equipment found at power station sites, but may also be found at other Eskom properties. Stations and Business Units should extract what is applicable to them, as not all of the systems and equipment components addressed in this standard will be found at every location.

Any system or equipment not addressed in this standard, which is installed at an Eskom location, must meet the requirements of an inspection, testing and maintenance program developed for the specific system or equipment. The program needs to be compiled jointly with the respective fire detection personnel and the manufacturers.

The inspection, testing and maintenance of fire protection systems is covered in Eskom Standard 240-54937454, Inspection, Testing and Maintenance of Fire Protection Systems [7].

This standard should be read and applied in conjunction with the Fire Detection Design standard to complete the package of fire detection systems found in facilities. The fire protection standard [7][4] is referenced in this document where system testing involves interfacing with the protection systems, although the fire detection systems depending on the designs could also interface to other systems such as HVAC, access control, lift controllers, gas and chemical suppression systems, and voice alarm systems.

## 2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this standard shall apply the most recent edition of the documents listed in the following paragraphs.

### 2.2.1 Normative

[1] ISO 9001 Quality Management System

[2] Occupational Health and Safety Act 85 of 1993

[3] National Building Regulations and Building Standards Act 103 of 1977

[4] 240-54937454 Inspection, Testing and Maintenance of Fire Protection Systems Standard

[5] 240-54937450 Fire Protection & Life Safety Design Standard

[6] 240-56737448 Fire Detection and Life Safety Design Standard

[7] NFPA 72 National Fire Alarm and Signalling Code Handbook

[8] 240-55410927 Cyber Security Standard for Operational Technology

[9] 32-124 Eskom Fire Risk Management

### 2.2.2 Informative

#### 2.2.2.1 Eskom Standards

[10] 240-126468603 Operational Standard for Fire Management in Generation

[11] 36-681 Plant Safety Regulations

[12] 240-56355910 Management of Plant Software Standard

[13] 240-129014618 Generation Cyber Security Compliance Guideline

#### 2.2.2.2 South African National Standards

[14] SANS 369-1 Code of Practice for the Operation of Fire Protection Measures – Part 1: Electrical Actuation of Gaseous Total Flooding Extinguishing Systems

[15] SANS 10139 Fire Detection and Alarm Systems for Buildings – System Design, Installation and Servicing

[16] SANS 193 Fire Dampers

[17] SANS 306-4 Fire Extinguishing Installations and Equipment on Premises, Part 4: Specification for Carbon Dioxide Systems

[18] SANS 331 Fire Extinguishing Aerosol Systems

[19] SANS 10400 The Application of the National Building Regulations

[20] SANS 14520-1 Gaseous Fire-Extinguishing Systems – Physical Properties and System Design: Part 1: General Requirements.

[21] SANS 7240-16 Fire detection and alarm systems Part 16: Sound system control and indicating equipment

[22] SANS 7240-19 Fire detection and alarm systems Part 19: Design, installation, commissioning and service of sound systems for emergency purposes

### 2.2.3 National Fire Protection Association

[23] NFPA 12 Standard on Carbon Dioxide Extinguishing Systems

[24] NFPA 13 Standard for the Installation of Sprinkler Systems

[25] NFPA 15 Standard for Water Spray Fixed Systems for Fire Protection

[26] NFPA 17 Standard for Dry Chemical Extinguishing Systems

[27] NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

[28] NFPA 750 Standard on Water Mist Fire Protection Systems

[29] NFPA 850 Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations

[30] NFPA 2001 Standard on Clean Agent Fire Suppression Systems

## 2.3 DEFINITIONS

### 2.3.1 Alarm Pressure Switch

An alarm device connected in the alarm water line. Water pressure forces a diaphragm upward closing a switch that initiates an alarm indicating water flow in the system.

### 2.3.2 Alarm Valve

A valve which may be opened or closed to regulate the flow of water to all or part of a sprinkler system.

### 2.3.3 Automatic Detection Equipment

Equipment that automatically detects heat, flame, smoke, flammable gases, or other conditions likely to produce fire or explosions, and cause automatic actuation of alarm and protection equipment.

### 2.3.4 Checked

A comparison of condition against prescribed criteria or information.

### 2.3.5 Competent Person (Personnel/Contractors)

a) Means a person who is qualified by virtue of his education, training, experience and contextual knowledge of FDS (and related systems being interfaced to), to make a determination regarding the functional and performance requirements.

b) Means a person who can undertake such duties as may be assigned to him/her in terms of the regulations, standards, certification requirements with regards to maintenance and or engineering function and responsibilities on the FDS.

### 2.3.6 Disclosure Classification

**Controlled Disclosure:** Controlled Disclosure to external parties (either enforced by law, or discretionary).

### 2.3.7 Deluge System

A fixed fire protection system in which the pipe system is empty until the deluge valve operates to distribute pressurized water from open water-spray or foam-water nozzles. The deluge valve is activated by operation of a fire detection system installed in the same area as the nozzles. Various types of detection systems may be used, including smoke, heat or flame. The deluge valve is activated by a hydraulic, pneumatic, electric or manual release system or any combination of these.

When the detection device is activated (hydraulic, pneumatic, electric or manual) the deluge valve is tripped and water flows into the piping system, discharging through all nozzles simultaneously.

### 2.3.8 Electric Release System

An electrical system employing smoke, heat or flame detectors to detect a fire and to release a deluge valve. The operation of a detector causes an electrical signal to be sent to the tripping device of the deluge valve, thereby causing the valve to open.

### 2.3.9 Suppressant

A medium or agent that is used to control the spread of fire or to suppress a fire, either by direct application to the fire or by application to a space with a fixed volume. The suppression medium can be water, a gas, an aerosol or a powder.

### 2.3.10 Suppressant Release Panel

An electrical panel that is used to control the release of a fire suppressant upon the activation of relevant automatic fire detection devices, and to control all functions associated with resetting, disabling or manually activating the system.

### 2.3.11 Fire Detection Panel (i.e. FDP, FAP, FIP)

A permanent panel used for the termination, controlling, powering, operating, monitoring, indicating, testing, programming, etc. of different fire detectors, alarms and other input / output units.

### 2.3.12 Fire Detection System (CIE aligned to SANS10139)

The collective description for the complete system with all its components, sub-systems, interfaces, functionalities, performance and capabilities providing fire detection functions and which:

a) are used:

1) to receive signals from the connected detectors, manual call points, or any other devices (e.g. input/output units);

2) to determine whether these signals correspond to a fire alarm condition;

3) to indicate any such fire alarm condition audibly and visually;

4) to indicate the location of the danger; and

5) possibly to record any of this information;

b) are used to monitor the correct functioning of the system and give audible and visible warning of any faults (e.g. short circuit, open circuit, or fault in the power supply);

c) if required, are able to pass on the fire alarms signal:

1) to VACIE system

2) through suitable transmission equipment to an alarm receiving centre; and

3) through further control equipment to an automatic fire extinguishing system

### 2.3.13 Functional Testing (Includes Performance where applicable)

Testing of a fixed fire protection system, fire detection system and FDS interfaces (only as part of a multi-disciplinary test plan) to confirm that it operates as designed.

### 2.3.14 Inspection

A visual examination of a component, sub-system and system or portion thereof to verify that it is in the right location, correctly labelled, appears to be in operating condition, is free from physical damage and or environmental conditions that can impair its operation. The visual inspections further contribute to the assurance of the operational reliability of the FDS, and through the optimised ITM schedules and procedures, the out of service probabilities of the components, sub-systems or systems can be reduced.

Where defects are captured following the inspections, the corrective actions are confirmed and captured in similar (hardcopy and softcopy) formats, and the part of the systems, sub- systems and or components affected are re-inspected, tested, the successful resolution achieved and the outcomes are then recorded.

### 2.3.15 Maintenance

Work (which is not limited to the repair, replacement and services) performed to keep the FDS equipment operable and within the design specifications, which can be undertaken through preventative activities, and or corrective activities.

### 2.3.16 Manually Operated Release System

A manually operated system used to release a deluge valve. The system may be used in conjunction with one of the other deluge valve release systems. The manual release device is arranged to operate as a stand-alone system to ensure operation, regardless of the potential failure of any associated automatic detection and activation system.

### 2.3.17 Pressure Switch

Hi/Lo Supervisory Pressure Switch which is used to monitor and alarm the activation of a Fire Protection System.

### 2.3.18 Remote Alarms

Remote alarms as relating to fire systems shall mean an audible warning buzzer and visual indicator on the fire alarm panel and the FDS HMI in a manned control room (i.e. EOD, SOR, OPCR, etc.).

### 2.3.19 Supervised Valve

A valve that is monitored to indicate an alarm or status should its position, monitored condition or status change.

### 2.3.20 Tamper Switch

An electrical device for the control-valve supervision that initiates an alarm when the control valve is moved from the normal position.

### 2.3.21 Testing

The testing of the systems, sub-systems, and components according the specific test procedures confirming the functions, performance and designed-to capabilities of the FDS. The test results have to be recorded and stored in hardcopy, and softcopy formats (typically in SAP PM or Maximo). Where defects are captured following the testing, the corrective actions are confirmed and captured in similar (hardcopy and softcopy) formats, and the part of the systems, sub systems and components affected are retested for successful resolution and the outcomes are then recorded.

### 2.3.22 Water Flow Alarm

A device so constructed and installed that any flow of water from a sprinkler system equal to or greater than that from a single automatic sprinkler will result in an alarm signal.

### 2.3.23 Water Flow Indicator

A type of indicator in which a paddle is inserted into the riser. When water flows, the paddle is deflected in the direction of water flow, and the control linkage to a switch which signals the water flow.

### 2.3.24 Coding and Labelling

Power Station specific KKS/AKZ function location coding and labelling standards are applied to all the systems, sub-systems and components to enable unique identification of all the systems, sub-systems and components in the “as built” documentation and are further utilised for the purpose of:

a) Configuration Management activities

b) Maintenance and Operational activities

c) Designs and modifications based activities

### 2.3.25 Radio Links

Digital or analogue based transmission of binary states and or analogue values linked with process states and alarms, possible fire conditions, diagnostic statuses and alarms associated the systems and components, which are relayed to the CIE and the central HMI system, where it is displayed to enable monitoring, alarming and recording.

### 2.3.26 Software management

Software management entails the policy, procedures, storage, safe keeping, recovery plans, testing plans, patch management plans and clear roles and the responsibilities and best practises applicable to all the levels of the Fire Detection Systems, it includes aspects of firmware on certain hardware components and aspects of software on components such as servers, workstations, network devices,

FAPs and 3rd party systems forming part of the Fire Detection System and specified in software management standard for Generation [12].

### 2.3.27 Cyber Security Management

The Cybersecurity Management means technologies, processes, practices, and policies that address threats or vulnerabilities in networks, computers, programs/applications and data, flowing from or enabled by connection to digital infrastructure, information systems, and or industrial control systems, (and include both cybersecurity and physical security). The various aspects of cyber security management in compliance with the cyber security standards and guideline as specified in [8][13].

## 2.4 ABBREVIATIONS

| Abbreviation | Note | Description |
|---|---|---|
| BS | 1* | British Standard |
| CIE | 1* | Control and Indicating Equipment (CIE), also called Fire Detection System |
| ECS | | Emergency Communications System, also called the Alarm Voice/Alarm Communication System (EVACS) |
| EN | 1* | European Standard |
| EOD | 1* | Electrical Operating Des, also called the Station Operating Room (SOR) |
| EPPA | | Emergency Preparedness Public Address System, also called the Voice Alarm and Indicating Equipment (VACIE), and others listed in the VACIE abbreviation description. |
| ERP | | Enterprise Resource Planning (SAP PM and or Maximo) |
| EVACS | 1* | Emergency Voice/Alarm Communication System, also called the Emergency Communication System (ECS), Emergency Voice Communication System (EVCS). |
| FAP | 1* | Fire Alarm Panel also called a CIE |
| FDS | 1* | Fire Detection System |
| FIP | | Fire Indication Panel also called a CIE |
| HMI | 1* | Human Machine Interface |
| ITM | 1* | Inspection, Testing and Preventative Maintenance |
| ITP | | Inspection, Testing and Procedures |
| LFL/LEL | | Lower Flammable Limit/Lower Explosive Limit |
| NFPA | 1* | National Fire Protection Association (USA) |
| NRV | 1* | Non-Return Valve |
| OPCR | 1* | Outside Plant Control Room |
| OHS | 1* | Occupational Health and Safety |
| O&M | 1* | Operating and Maintenance |
| SANS | 1* | South African National Standards |
| SOR | | Station Operating Room also called the Electrical Operating Desk (EOD) |
| SAQCC Fire | 1* | South African Qualification & Certification Committee Fire |
| SCADA | | Supervisory Control and Data Acquisition |
| VACIE | 1* | Voice Alarm and Indicating Equipment (VACIE), also called Voice Alarm System (VAS), called the Sound Control and Indicating Equipment (SSCIE), called the Sound System for Emergency Purposes (SSEP), called the |

| Abbreviation | Note | Description |
|---|---|---|
| | | Emergency Preparedness Public Address System (EPPA) |
| VWD | | Visual Warning Device |

Note 1: The Abbreviation as used in the FDS ITM standard.

## 2.5 ROLES AND RESPONSIBILITIES

a) Inspection, testing and maintenance measures detailed in this standard are to be performed by competent persons only. The FDS competent persons are to ensure that they fully comply with the following requirements as per the different classifications of activities undertaken on the Fire Detection Systems:

b) Note: The structures in the Generation, Transmission, Distribution and other BUs, would determine the allocation of responsibilities.

c) The power station O&M Engineers are responsible for the overall maintenance regime at their respective power stations and as such are responsible to ensure that site specific preventative maintenance schedules are drawn up based on this document.

d) In addition the O&M Engineers need to confirm that the quality of the inspection procedures, preventative maintenance procedures and indeed the recorded history are acceptable and contribute to a sustained high level of workmanship.

e) Lastly the maintenance and system administration personnel and O&M Engineers need to ensure that the quality of the information recorded is of a high standard such that it forms the basis which can be used for investigations, analysis and towards the continuous improvement on all the aspects of the FDS.

f) The power stations have the following resources involved in Fire Detection Systems and 3rd party components and or systems making up the Fire Detection Systems:

   i. Fire Officers

   ii. Operating personnel

   iii. Certified Maintenance Personnel

   iv. Engineering Personnel

   v. Certified Contractors (Corrective , Preventative and or System Administration, System Engineering Functions)

The Business Units (BUs) in Eskom (Tx, Dx Properties, Security, Properties, etc.) have different structures which would determine as to whom is responsible for what activities relating to the inspection, testing and maintenance activities.

### 2.5.1 Inspection Personnel and Services (Maintenance and or Fire Officers)

a) These are the individuals who conduct a visual examination of a system or portion thereof to verify that it appears to be in operating condition, in the proper location, and is free of physical damage or conditions that impair the operation.

b) The inspections shall be performed by inspection personnel who have developed competence through training and experience of the Fire Detection System (and where it interfaces to the Fire Protection Systems) and other systems.

c) The inspection personnel shall have attended and certified as competent with regards to the SANS 10139 and other SANS standards, which are applicable to the Fire Detection Systems and the configurations as implemented at the particular BU.

### 2.5.2 Testing Personnel and Services

#### 2.5.2.1 General

a) The testing personnel shall have the knowledge and experience of the testing requirements for fire detection system and its interfaces to other systems (such as Fire Protection Systems, HVAC, etc.).

b) The testing personnel shall have attended and certified as competent with regards to the SANS 10139 and the other SANS standards, which are applicable to the Fire Detection Systems and configurations implemented at the particular BU.

c) The testing shall be performed by testing personnel who have developed competence through training and experience of the Fire Detection System (and where it interfaces to the Fire Protection Systems) and other systems.

#### 2.5.2.2 Testing Activities without Tools (Maintenance personnel or Fire Officers)

These are individuals who perform procedures used to determine the status of the systems as intended, by conducting periodic physical tests and checks on the systems.

#### 2.5.2.3 Testing Activities with Tools (Maintenance personnel)

These are individuals who perform procedures with dedicated and certified tools for the purpose of testing, which are used to determine the status of the systems as intended, by conducting periodic physical tests and checks on the systems.

### 2.5.3 Maintenance Personnel and Services

#### 2.5.3.1 General

a) The maintenance activities shall be performed by the maintenance personnel who have developed maintenance competence through training and experience of the Fire Detection Systems (and where it interfaces to the Fire Protection Systems) and other systems.

b) The maintenance personnel shall have attended and certified as competent with regards to the SANS 10139 and the other SANS standards, which are applicable to the Fire Detection Systems and configurations as implemented at the particular BU.

c) The maintenance personnel shall be declared competent on the Plant Safety Regulations.

#### 2.5.3.2 Maintenance Activities

a) The individuals who perform those procedures, adjustments, replacement of components and maintenance activities as described in the OEM O&M manuals and Eskom Work Instructions, that can affect any aspect of the performance of the fire detection systems, and the systems the fire detection system interfaces to.

b) The maintenance personnel shall be qualified (SAQCC Fire Serviceman) in the maintenance and servicing of the fire detection systems.

c) The maintenance personnel shall have OEM certified training and declared competent on the specific type and brand of fire detection system being serviced at the maintenance support levels.

### 2.5.3.3 Administrative and Engineering Modification Personnel and Services

a) Individuals who perform those procedures, adjustments, replacement of components, maintenance and programming as described in the OEM O&M and Engineering Support & System Administration manuals and Eskom Work Instructions that can affect any aspect of the performance of the fire detection system, and the systems the fire detection system interfaces to.

b) The maintenance personnel shall be qualified (SAQCC Fire Serviceman) in the maintenance and servicing of the fire detection systems.

c) The maintenance personnel shall be OEM certified competent on the specific type and brand of fire detection system being serviced at the maintenance support level (to enable Technical Support functions), and certified competent by the OEM at the engineering and system administrative levels.

d) The individuals who perform the technical, administrative and engineering support functions on the FDS are responsible for the implementation of the software management and cyber security measures on the fire detection systems.

| | Fire Pumps & House | | | Fire Main Pipe Lines | | | Water Storage Tanks | | | Sprinkler Systems | | | Deluge Systems | | | Foam Systems | | | Fire Detection Systems | | | Fire Barriers (eg. Doors) | | | Extinguishers | | | Hydrants & Hosereels | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | T | M | I | T | M | I | T | M | I | T | M | I | T | M | I | T | M | I | T | M | I | T | M | I | T | M | I | T | M |
| Engineering | X | X | | X | | | X | | | X | | | X | | | X | | | X | | | X | | | X | | | X | | |
| Maintenance | | X | X | | | X | | | X | | | X | | | X | | | X | | | X | | | X | | | X | | | X |
| Operating | X | X | | X | X | | X | X | | X | X | | X | X | | X | X | | X | X | | | | | | | | X | X | |
| Fire Department | X | X | | | | | X | | | X | | | X | | | X | | | X | | | X | X | | X | X | | X | X | |

**Figure 1: Example of a RACI for various categories**

## 2.6 PROCESS FOR MONITORING

### 2.6.1 A Maintenance Program Typically Consists of Four Stages

a) Stage 1 – Inspection, testing and preventative maintenance activities. Schedules are used to ensure that key activities are performed at regular intervals. When an activity has been completed, the result is recorded, followed by whether the action resulted in a pass or fail.

b) Stage 2 – Record keeping. Records are required to be kept for each functional activity and should include specific results (as appropriate), and the outcome of the activity through the use of ‘pass/fail’ or ‘yes/no’ criteria. Where the activity fails it is important to provide information as to what causes it to fail (working with categories of failures supports investigation and analysis, which can be further expanded where so required in writing to elaborate.

c) Stage 3 – Reporting and rectification. Where failures have been identified, they should be reported to the relevant Eskom personnel and a works order generated (usually in SAP PM or Maximo) for the rectification works.

d) Stage 4 – Updating of records. Following rectification of identified failures, functional testing should be undertaken to confirm that the system is operating as intended and the records are updated accordingly.

The schedules in this standard are used to document Stages 1 (Inspection), Stage 2 (Testing) and 3&4, for the maintenance activities (both Preventative and Corrective Maintenance).

### 2.6.2 Process for Monitoring

In order to facilitate the implementation of the maintenance program, the following documentation is required (this is a generic requirement; each FDS depending on the technologies applied might have additional documentation requirements):

1. Documentation providing the functional and performance requirements and specifications of the FDS.
2. The written high level narrative providing intent and the system description of the FDS.
3. 'As-built' drawings and diagram(s) of the installation (Civil, Electrical, C&I and Mechanical).
4. Baseline data obtained during commissioning (to be used for measuring system functionality and performance against in the future, and for upgrades).
5. Operating, Engineering and Maintenance manuals.
6. The Engineering, Maintenance and Operating Training Manuals.
7. ITM procedures, schedules and records.
8. Scaled floor plan layouts showing the location of all the devices, the FAPs, networks, SCADA, interfaces.
9. Sequence of operation in either an input/output matrix or in a narrative descriptive form.
10. Equipment technical data sheets.
11. Manufacturers published instructions, including operation, maintenance and engineering instructions.
12. Battery calculations (where batteries are provided)
13. Voltage drop calculations for notification appliance circuits.
14. Completed records (history) of the inspection, testing and maintenance activities into the maintenance management systems (such as SAP PM or Maximo).
15. Records of completion in each of the phases as specified in the SANS 10139 (Completion Certificates in all the phases).
16. Copies of the different software on the FDS in line with the software management requirements ( for points 1 to 3 with the required version control to be in place and for point 4 the storage records information, point 5 to be part of the Maintenance and Engineering FDS support documentation):
    a) OS software.
    b) Application software.
    c) Site specific project software.
    d) Data history software (i.e. alarm and status information, trending information).
17. Information on specific software and hardware settings at all the levels of the FDS.
18. The periodic inspection, testing, and maintenance documentation procedures, schedules.
19. ECM information on all the modifications undertaken on the FDS after the initial project handover, indicating additions, removals and changes on any aspect of the FDS.
20. The OEM Engineering, Maintenance and Operating Manuals of the sub-systems which the FDS interface to such as the Aspirating Systems, Linear Heat Detection System, Gas Suppression Systems etc.)

21. The OEM Engineering, Maintenance and Operating Training Manuals of the sub-systems which FDS interface to such as the Aspirating Systems, Linear Heat Detection System, Gas Suppression Systems etc.)

## 3. FIRE DETECTION AND ALARM SYSTEMS

### 3.1 GENERAL

This Section sets out the ITM schedules for:

a. Fire detection and alarm systems designed to provide occupant warning;
b. Fire detection systems and interfaces designed to control the actuation of fire suppression systems; and
c. Fire detection systems and interfaces designed to control the actuation of smoke management systems, access control system and elevator grounding, voice alarm system.

### 3.2 ITM SCHEDULES

ITM schedules for the various systems can be found in Appendix A by reference to Table 1 below.

**Table 1: Reference table for ITM activities pertaining to the fire detection and alarm systems**

| Element/system | ITM Schedules |
|---|---|
| Fire detection and alarm systems, Special Hazard | Table 3 to Table 5 |

## 4. IMPAIRMENT MANAGEMENT

It is an imperative that any maintenance activities both preventative and corrective in addition to complying with the:

a) Operational management system requirements (i.e. FLIP in Gx and PSR),

b) Maintenance scheduling systems requirements (SAP PM or Maximo)

c) Complies with the requirements and based on the criteria for impairments as applicable to both the FDS and or FPS systems comply with the impairment management and notification requirements as stipulated in the Impairment Management Standard [9].

## 5. SPARES MANAGEMENT

The spares management entail the following items to be in place to support the maintenance activities (both preventative and corrective):

a) Compiled inventory list of all the installed components on the FDS and 3rd party sub systems.

b) Compiled inventory list of the FDS (and the 3rd party sub systems) spares in the stores (Min, Max levels) with regards to assets and consumables.

c) Yearly report with regards to delays in repairs due to non-availability of spares and stock-outs, non-moving spares, etc. as compiled by the responsible FDS System Engineer supported by the Stores Management and Works Management personnel to enable optimisation in all the logistics of spares management.

d) The failure rate on the different components of the FDS (and the 3rd party sub systems) are calculated and compiled in a report on a yearly basis by the FDS System Engineer as supported by the Works Management personnel. The report includes corrective actions and recommended timelines for their achievement. The report needs to state what aspects need to be addressed i.e.

engineering, maintenance practises, environment towards the continuous improvement in the FDS (and 3rd party sub systems) reliability, availability and maintainability.

## 6. FDS SYSTEMS INTERFACE TESTING

### 6.1 GENERAL

Where the fire detection systems are interfaced to other systems, the 'end-to-end' tests are required to confirm that each interfaced system operates in accordance with the approved design. A concurrent test of all the interfaced systems, as would occur in a fire situation, is required to ensure that all the systems work as per their designs and specifications, and that there are no unwanted interactions between systems or unsustainable electrical loads on the systems or the system sub-components.

The required procedures for the concurrent 'end-to-end' tests of the systems and their interfaces to confirm that they operate in accordance with the approved designs need to be compiled by a multi-disciplinary team at each Business Unit (i.e. Engineering, Maintenance, Operations, Fire Risk Management).

The baseline data required to perform the tests include:

a) The system interface diagrams

b) The relevant cause-and-effect matrices

c) The detailed procedures with clear roles and responsibilities defined for each of the parties responsible for the different systems. (both with regards to the testing and recovery following the testing)

d) The power station specific Technical, Risk Assessment, Operational and Regulatory requirements as stipulated and required in exercising the different systems and their interfaces in the 'end- to- end tests', are compiled and signed off by the responsible and accountable parties at the specific Business Unit.

### 6.2 PRECAUTIONS

Prior to commencing any interface testing, the following precautions should be carried out:

a) Ensure that the competent responsible entity(ies) for the co-ordination of the concurrent testing are in attendance as is stipulated in the detailed procedures required, being able to properly conduct the test.

b) The precautions detailed in each relevant Section of this standard and the safety, technical, operational, risk assurance requirements applicable for the specific interface testing.

c) On completion of the exercising of any procedure, ensure that each control and plant components are returned to the condition or state prior to the test. When any function is left impaired, is disabled or is not restored to 'normal', it should be recorded in the system logbook and the SAP PM/Maximo system, and the relevant personnel should be notified to attend to it as a matter of urgency and the impairment reported through the Risk and Assurance processes and systems to the various stakeholders at the Business Unit up to Corporate levels.

d) When the component(s) have been restored to the full functional capability following the maintenance and or engineering interventions such as modification/system administrator functions, repairs/replacements then re-testing is executed.

### 6.3 TEST PLAN

a) As most interface configurations are unique to the particular building or facility, a test plan detailing each step of the interface test procedure must be available to ensure that tests are carried out consistently, and the results are adequately documented.

b) The test plan should be based on the procedures that were used during the commissioning of the systems interfaces.

c) Where a test plan does not exist, it needs to be prepared and documented by competent person(s) having understanding of the systems involved and their interface requirements as per the approved designs and ‘as built’ implementation.

d) The test plan should detail the concurrent attendance of persons specializing in each interfaced system required to achieve the end-to-end test and should include the following:

   i. A list of all interfaced systems (Interfacing with Gas Suppression Systems, HVAC, Lift Controllers, Smoke Extraction Systems, FPS, .

   ii. The systematic test procedure detailing the method for conducting each interface test.

   iii. List of persons and their responsibilities required to test or verify the function of each interface.

   iv. Additional precautions and procedures (e.g. plant shut down, and plant/ system recovery procedures).

   v. A test report

   vi. The System Engineers involved in the interfaced systems should evaluate each of the interfaced tests such as to improve various aspects of the testing, risk assessments, precautions, role clarity, spares, recovery processes, the keeping of records and the lessons learned.

## 6.4 INTERFACE DIAGRAM

An example of a Systems Interface Diagram is given in Fig 2 below.

| | | Effect | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Stair pressurization | Door release | Roof vents | Sound systems for emergency purposes | Plant shutdown | Fuel isolation | Elevator override | Alarm monitoring | Smoke exhaust fans | Smoke curtains | Smoke spill mode | HVAC shutdown | Damper closure |
| Cause | Sprinkler systems | • | • | • | • | • | | | • | • | | • | • | |
| | Fire detection and alarm systems | • | • | • | • | • | • | • | • | • | • | • | • | • |
| | Smoke/heat alarm systems | • | • | | | | | • | • | • | • | • | • | • |
| | Gaseous systems | | • | | • | • | • | | • | | | | • | • |
| | Aerosol systems | | • | | • | • | • | | • | | | | • | • |
| | Water mist systems | • | • | • | • | • | | • | | | | | | |
| | Hydrants | | | | | | | | • | | | | • | |
| | Hose reels | | | | | | | | • | | | | • | |

**Figure 2: Example of Systems Interface Diagram**

## 6.5 RESULTS

a) Pass or fail test results for each interfaced system should be recorded in the respective system records with detailed of results in interface test report.

b) Recorded test results may be electronically based; however, a hard copy record of the system interface tests should be kept on site and be available at all times.

c) The records include names and signatures of all persons that assessed the compliance of the interfaces to the requirements of the approved designs including the dates when the tests were performed.

d) Any defects identified in the interface tests should be recorded on the respective system's yearly condition report, and carried over to the ERP System (SAP/Maximo) for the issuing of the defect notifications for repairs/resolution.

e) The testing of the systems the FDS is interfaced to, other than the Sprinkler/Deluge referred to in Table 3 is not part of the Fire Detection System ITM standard. The integrated testing of systems end to end, require a combined multi-disciplinary test plan which is developed and executed in a co-ordinated manner through the involvement of the different disciplines.

f) The Fire Detection ITM standard mainly focusses on the FDS as a system and the interfaces to the other systems mentioned below.

g) The boundary of the Fire Detection System commences from the AC Power Supply to the FDS, up to and including the interface devices to the 3rd party systems.

h) The testing of other systems are typically directed by laws, regulations, standards and procedures applicable to the specific systems.

i) The integrated test plan has to take into consideration the following:

i. The site specific design and configuration of the systems.

ii. The technologies as applied at a site and their related functionalities and performance.

iii. The risk assessments on the individual and combined systems done by the multi-disciplinary team, such as to understand and anticipate the proper co-ordinated operation of the systems in an integrated manner, secondly the typical failure modes and their criticality, and how to recover should there be failure(s) affecting plant operations and or place the plants at risk when being tested.

iv. A typical example would be the testing of FDS which if connected to the Access Control System of a critical area such as an Equipment Room and or Data Centre Server Room, could provide unauthorised access to Critical Cyber Assets (as defined in the NERC-CIP standard) during the testing, if left unattended and following the testing.

The examples of the typical interfaces to the other systems can be found in Table 2.

**Table 2: Reference Table for the Possible Type of Interfaces with the Fire Detection Systems**

| **Element/system** |
|---|
| 1) Sprinkler/Deluge systems |
| 2) Special Hazard System (Gas Suppression) |
| 3) HVAC and Fire Fan Control panel |
| 4) Voice Alarm Control and Indicating Equipment |
| 5) Lift Controllers (Elevators Grounding) |
| 6) Access Control System (Door Unlocking) |
| 7) 3rd Party Systems such as for example ASD, VIFD systems, etc.(typically interfaced through a dedicated interface card/device) |

## 7. AUTHORISATION

This document has been seen and accepted by:

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| | Document Approved by TDAC ROD 16 July and Special Approval 18 October 2013 |
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## 8. REVISIONS

| Date | Rev. | Compiler | Remarks |
|---|---|---|---|
| July 2013 | 0 | R Ramraj | Compile as First Draft as guideline for doing maintenance on Fire Detection Systems within Eskom |
| July 2013 | 1 | R Ramraj | Final Document for Authorisation |
| May 2014 | 1.1 | A van den Berg | The related Fire and Life Safety Design Standard was revised and certain elements of the changes in that document influenced the content of this document. |
| June 2014 | 1.2 | A van den Berg | Incorporate review comments from formal document review process. |
| October 2014 | 1.3 | A van den Berg | Incorporate review comments from LPS Study Group |
| October 2014 | 1.4 | A van den Berg | Final draft for 2nd Review |
| October 2014 | 2 | A van den Berg | Final Document for Authorisation and Publication |
| September 2019 | 2.1 | Jorge Nunes | The related Fire and Life Safety Design Standard was revised and certain elements of the changes in that document influenced the content of this document.<br>a) Removal of the VACIE ITM Schedules.<br>b) Removal of the EVACS ITM Schedules.<br>c) Update on various FDS technologies such as VIFD, ASD, etc.<br>d) Update of all the sections based on the newest standards and best practises.<br>e) Incorporating of comments from Fire and Life Safety Care Group members and stakeholders in the Authorisation List. |

| Date | Rev. | Compiler | Remarks |
|---|---|---|---|
| | | | f) Incorporating Cyber Security and Software Management practices. |
| November 2019 | 2.2 | Jorge Nunes | Final Draft after Comments Review Process |
| November 2019 | 3 | Jorge Nunes | Final Document for Authorisation and Publication |

## 9. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- Jorge Nunes
- Marius Engelbrecht
- Mbali Mathebula
- Mauritz van der Bank

## 10. ACKNOWLEDGEMENTS

All who contributed to the content and or reviewed the content for correctness and completeness.

# APPENDIX A: FIRE DETECTION TEST MEDIA AND TEST EQUIPMENT

## A.1 The test media, sources and test equipment for testing the different type of detectors as follow:

a) **Heat detectors (Fixed and rate of rise)** - a source of heated air is the preferred medium. The temperature of the air shall be controlled to produce a predictable rate of increase. The upper temperature shall be limited to a value appropriate to the detector being tested.

b) **Note:** The use of radiant heat is not recommended. Care should be taken in the use of radiant heat as the effect on the detector can vary significantly with the collection area the detector presents to the tester.

c) **Smoke detectors** - a source of particulate material that does not contaminate the sensing chamber or entry screen and which contains particles in the size range appropriate to the detector.

d) **Carbon monoxide (CO) detectors**—a source of gas that does not adversely affect the sensing element, or entry screen, of the detector and which contains gas appropriate to the detector.

e) **Aspirating Smoke Detection Systems** – a source of particulate material that do not excessively contaminate impact the test result or be of a nature that adheres to the internal surfaces of the aspirating smoke detector pipe system.

**Note:**

i. The emitted medium for sensitivity testing of smoke detectors (b) and carbon monoxide detectors (c) should be controlled so as to produce a predictable concentration.

ii. Where the ASD has the capability to monitor certain gas concentrations (additional sensor module) the test gas concentration used should be of a known value.

f) **Video Image Fire Detection System** - It is important to always follow the manufacturer's recommendations for testing, servicing, maintenance and replacement requirements. It may be desirable that, in some installations where the effect of potential false alarm sources cannot be fully determined, a period of trial is undertaken before completing the commissioning of the system and handing it over to the client.

A method, appropriate to the risk, would then be required for testing the effectiveness of the VIFD at both the commissioning stage and during the subsequent service and maintenance support contractual phase (this requirement needs to be captured in the contracts with the equipment manufacturers or system implementer). Tests and optimisation of the filters should be conducted and documented in accordance with this method of regular evaluation, optimisation and recording).

g) **Linear Heat Detection System**: – For fast results heat or cool a 20-30cm length of fibre optic sensor cable with a hair dryer (where power is available), alternatively use a freeze spray aerosol in areas where power supply is not readily available. With regards to heating or cooling the fibre based LHD cable, it only needs a temperature rise/cooling of 20-30 degrees Celsius above ambient to provide an indication of both the rate of rise alarm, and or temperature values it has risen to.

h) **Flame Detector:** Through the use of the Flame Simulator Test Lamp for the testing of UV and UV/IR and multiple IR flame detectors the functional testing of the Flame Detector can be undertaken in safe manner.

i) **Optical Beam Detector** (Might be Spot Beam Detector or Multi Beam Detector): Functional testing of the Optical Beam Detector is tested by introducing smoke, aerosol or the blocking of the sensor in a safe manner.

j) **Multi sensor testing:** The testing devices can work in multiple modes namely single, simultaneous and sequential modes depending on what the multi criteria sensor device can accommodate. The multisensory fire detectors should be physically tested by a method that confirms that products of combustion in the vicinity of the detector can reach the sensors and that the detector responds appropriately. A test method purely reliant on an electronic and / or mechanical means is not sufficient to comply with this requirement. (The multi sensor detector can be a combination of smoke, heat and CO).

Note: The multi sensors devices could contribute to a single alarm output (representing any or all of the sensing devices as a single alarm), or the multi sensor and multi criteria device can produce multiple alarm outputs based on the different criteria associated with the multiple sensors on the device.

k) **Flammable Gas and Combustible Vapour Detector:** The test gas used must be matched to the gas/vapour detection sensor type being tested and calibrated for. This type of gas detectors display their concentrations in ppm or %LFL depending on the type gas/vapour being monitored. The gas/vapour detectors are calibrated on the type and range of the gas/vapours being monitored and can provide analogue and binary outputs based on alarm set points.

l) **Air Flow Detector:** The sensor shall be tested to ensure that the Battery Room extraction is sufficient, switching off extraction fans and ensuring the low flow alarm is received.

m) **HVAC** Shut-off Dampers: Where dampers are electrical dampers shall be tested with double knock system test.

## A.2 The Test Equipment

a) The smoke, heat and CO detectors are tested with OEM, or OEM approved test equipment and consumables. Typical test equipment consists of telescopic pole with a tester cup for the smoke, heat, CO based capabilities to provide the stimuli for these detectors (individual or multi sensor & criteria detectors).

b) The test/calibration equipment, the consumables used (i.e. test gases) and the methods applied during testing need to be in line with the requirements of the OEM, such that it does not compromise the functionality and integrity of the FDS sensors, and or invalidate the calibration and testing results.

# APPENDIX B: FIRE DETECTION SYSTEM TESTING STRATEGIES

## GENERAL

Report all detectors that fail the test and replace with new detectors.

## B.1 POINT-TYPE HEAT DETECTOR FUNCTIONAL TEST

i. Test a representative sample per annum of all detector models and types or grades and environmental locations consisting of 20% of the detectors per circuit including the last detector on a circuit (for collective circuits, the one nearest to the end of line device) so that all detectors are tested over a five year period.

ii. For non-resettable fixed temperature detectors (e.g. fusible links), hardwired/if it has test function, simulate an alarm on the circuit.

## B.2 LINEAR HEAT DETECTOR FUNCTIONAL TEST

For resettable linear type heat detectors (Fibre and dissimilar conductors), test the operation using a suitable heat/cooling source at a random location and different locations from previous tests.

## B.3 POINT-TYPE SMOKE DETECTOR FUNCTIONAL TEST

Test in situ the operation of at least 50% of all smoke detectors per annum on each circuit using a test medium as specified so that all smoke detectors are tested over a two year period, except where this requirement is satisfied under the sensitivity test.

## B.4 POINT-TYPE SMOKE DETECTOR SENSITIVITY TEST

Unless the sensitivity is tested or verified using the procedure in this standard at every 10 years period from the date of installation, all the smoke detectors shall be replaced with cleaned and recalibrated, or new detectors followed by the functional test.

## B.5 POINT SMOKE DETECTOR IN SITU SENSITIVITY TEST

i. Test the sensitivity of all the detectors in situ, using the test equipment (listed and calibrated in accordance with a national or international standards), using the procedure provided in the manufacturers (OEM) manual. The in situ sensitivity test is done after 10 years from the date of installation, and then every five years thereafter.

## B6. SMOKE DETECTORS CAPABLE OF REPORTING 'OUT OF SENSITIVITY RANGE

i. Where the sensitivity or 'out of sensitivity range' can be indicated or read at either the CIE or at the detectors, carry out the relevant procedure in accordance with the manufacturer's instructions yearly.

ii. Report all detectors that indicate they are at the end of the manufacturer's sensitivity range and put into place a system for replacing detectors in a timely manner.

## B.7 BEAM TYPE SMOKE DETECTORS FUNCTIONAL TEST

Test yearly the operation of each linear beam type smoke detector using natural light density filters of the appropriate obscuration percentages for the alarm or fault simulation.

Note: Where information is not available on the appropriate total obscuration then:

i. For direct beams types, a 60% obscuration filter should be used

ii. For reflected beam types a 30% obscuration filter.

iii. For faults a greater than 95% obscuration filter (opaque) should be used.

### B.8 ASPIRATING SMOKE DETECTOR (ASD) TRANSPORT TIME TEST

The procedure shall be as follows:

a) Test yearly the operation and overall integrity of the ASD system pipe network by introducing smoke or other suitable aerosol through the last sampling point on each pipe run or branch of the system.

b) Record the transport time (TT) for each pipe run or branch. Verify the transport time taken is within 10% or ±5 s whichever is the greater, of the transport time recorded in the baseline data but not more than 120 s.

c) Where the transport time of any pipe run or branch exceeds 10% or ±5 s, whichever is the greater, of the baseline data or the transport time is more than 120 s, perform the following:

i. Inspect each sampling hole on the pipe run or branch and clean as needed.

ii. Inspect any filter or filter media between the pipe network or branch and the aspirating smoke detector.

iii. Verify the aspirating smoke detector sensitivity.

iv. Inspect the pipe work and all sampling points to verify overall system integrity.

v. High ceiling areas may require the use of ladders, scaffolding, portable platforms etc.

**Single pipe systems – The following apply:**

a) An increase in transport time determines that contamination is most likely nearer to the end cap.

b) A decrease in transport time determines that contamination is most likely nearer the detector.

**Multiple pipe systems – The following apply**:

a) An increase in transport time determines that contamination is most likely on the same pipe.

b) A decrease in transport time determines that contamination is on a different pipe.

c) Where ASD systems are installed and utilize capillary tube connections to room sampling points, test in situ the operation of at least 20% sampling points of the system so that all sampling points are tested over a five-year period.

d) ASD system pipe networks can be installed in varying applications and environments some of which may require increased levels of routine service. Therefore, it is recommended that to ensure reliable operation and performance in systems that do not have an increased planned maintenance regime that pipe ‘back flushing’ of the network be undertaken as per the manufacturer’s instructions on at least a yearly basis over and above the requirements as detailed within this document.

### B.9 ASPIRATING SMOKE DETECTOR SENSITIVITY TEST

a) Verify and record that the sensitivity calibration of the detection device is within 5% of the original calibration value.

b) This may require that the detector or part of the detector be returned to the manufacturer.

### B.10 FLAME DETECTOR FUNCTION TEST

a) Test the operation of all flame detectors annually, and inspect the area of coverage to confirm there has been no change from the approved design.

b) The functional testing shall be carried out using an OEM approved light source suitable for the type of flame detectors being tested.

### B.11 FLAME DETECTOR SENSITIVITY TEST

a) Verify or measure and record the sensitivity of each flame detector at the manufacturer's recommendations intervals, but not exceeding five-yearly intervals from the date of installation. Verify that this falls within the manufacturer's range and approved design.

b) Alternatively, replace with new or recalibrated flame detector. Where the date of installation is unknown, test the sensitivity or replace detector at the next annual test.

### B.12 CO DETECTOR FUNCTIONAL TEST

Test the operation of at least 50% of CO detectors annually, using a test medium as defined so that all detectors are tested over a two-year period.

### B.13 CO DETECTOR SENSITIVITY TEST

a) Verify or measure and record the sensitivity of each detector at intervals in accordance with the manufacturer's specifications but no later than 10 years from the date of detector manufacture.

b) Verify that the sensitivity falls within ±25% of the listed range of the approved design. Alternatively, replace with new or recalibrated CO fire detector. Where the date of manufacture is unknown, test the sensitivity and replace detector at the next annual test.

### B.14 MULTI-SENSOR AND COMBINED DETECTORS

#### B.14.1 General

a) Multi-sensor smoke/CO/heat detectors are primarily smoke detectors or CO fire detectors with their sensitivity enhanced by the presence of a rate or rise in temperature. This provides a faster flaming fire response, but still detects cold smoke or CO from fire. Test them as smoke, CO or heat detectors in accordance with the manufacturer's instructions.

b) Combined detectors have more than one sensor that can initiate an alarm without a signal from another sensor. If the detectors are installed on the basis of one sensor type only (e.g. smoke, CO, flame or heat), and the other sensors are supplementary, test them individually according to the type installed.

c) Where a fire detector is installed in combination with another detector as a deemed to satisfy (e.g. a combined CO and heat detector), test each sensor in accordance with its type.

d) If detectors are installed as an engineered solution requiring more than one sensor, then test each sensor sequentially according to the type.

Note: Engineered solutions may have an engineered maintenance schedule as an alternative to this document.

### B.14.2 Multi-sensors that do not respond to any one single sensor signal

a) If the detectors are installed as smoke or CO detectors, functionally test them with a test medium that includes components specifically designed for this type of detector.

b) If detectors are installed with a multi-sensor setting that cannot be verified electronically at the CIE or at the detectors, functionally test the interaction of all sensors according to the manufacturer's specified procedure.

### B15. Manual Call Points Functional Test

The manual activation of the MCP can be done through an activation which is reset through the use of a reset key, this will indicate that there is a fire which will then initiates an alarm.

### B16. Fibre Optic Linear Heat Detector Functional Test

a) Heat or cool a 300mm length of fibre optic sensor cable with a hair dryer/hot air gun (where the power is available) or freeze spray (utilise freeze aerosol coolant system that instantly freezes surfaces), be careful with the application of the heat as a gradient change is all that is required) the application of heat or cooling should be applied well below the temperatures where permanent damage can result.

b) The laying plan of the linear head detector cable should be outlined. Meter markings of the cables at the object beginning, splicing locations, zone boundaries, etc., should be registered in the laying plan generated when the Fiber optic based laying was implemented and commissioned.

**B17. Strobes and Sirens Functional Test**: The test of the strobes and sirens form part of the testing of other input devices that cause the Fire Alarm Panel to activate the strobes and sirens in a specific alarm zone as per the designs.

### B18: Ember Detectors: Functional Test

Place a heated mobile soldering tip at a pre-set distance from the Ember detectors, and monitor that it reacts in the time specified by the manufacturer. Evaluate the local indication of the alarm activation at the ember detector and the remote alarming at the HMI display.

### B19: Output Interface Module Functional Tests

The following output interfaces should be tested as part of multi-disciplinary and multi-system test procedures (including risk assessments and recovery actions), with the competent persons on each of the systems involved:

a) Door Unlocking

b) Elevator Recall

c) HVAC Shutdown

d) Fire/Smoke Dampers

e) Elevator Shunt Trip

f) VACIE interface

g) Special Hazard System

**B20: Fire Smoke Extraction System**

a) The smoke extraction activation and de-activation are in most cases a manual function undertaken by the responsible persons in the Maintenance and or Fire Management Departments. Following a fire which has been brought under control the Fire Smoke Extraction is utilised to extract smoke left after the fire to assist the Fire Fighters and or recovery personnel to start the process of normalising the environment and the location of the fire.

b) The testing of the Fire Smoke Extraction System should follow the testing of the HVAC and Fire Dampers shut down activation and be tested as part of a multi-disciplinary and multi-system test procedures (including risk assessments and recovery actions), with the competent persons on each of the systems involved.

**B21: Input Interface Module Functional Test**

The following input interfaces should be tested as part of multi-disciplinary and multi-system test procedures (including risk assessments and recovery actions), with the competent persons on each of the systems involved:

a) Gas Suppression System

b) VACIE Interface

c) 3rd party Systems such as (ASD, VIFD, etc.)

**B22: VACIE input interface**

Depending on the design there could be an interface per alarm area between the Fire Alarm Panel and the VACIE, which would cause the FDS to suppress the siren and strobes such as to enable the message from the VACIE to be heard intelligibility.

**B23: Remote radio links (Sender and Receiver)**

At both the digital radio transmitter (remote location) and the digital radio receiver (base station) the following needs to be verified:

a) The battery status and conditions of all the systems that form part of the FDS remote radio links.

b) Transmission end to end of FDS devices tested in the remote locations up to the Main Fire Alarm Panel and into the FDS HMI Stations.

c) The health status of the remote Fire Alarm Panel, the Remote Radio Transmitter, the Base Station Receiver.

d) The activation of the system fault signals at the remote Fire Alarm Panel, the Remote Radio Transmitter, and at the Base Station Radio Receiver and its monitoring and alarming at the Main Fire Alarm Panel and HMI Stations.

# APPENDIX C: CONSEQUENCES OF FAILURE

## C.1: Consequences of failed detector functional tests

a) Should one or more detectors fail on any of the tests per circuit, further sampling and testing of not less than 10 of the remaining detectors per circuit shall be conducted until the results can be claimed to be truly representative.

b) Should there be a further failure on the extended testing, the balance of all the detectors on the circuit shall be tested. All detectors that fail the test shall be replaced.

## C. 2: Consequences for detectors or equipment outside their service life

Detectors, equipment or other items that have defined service life, should be replaced before the service life is exceeded.

# APPENDIX D: MODIFICATIONS INITIATED TESTING

## D.1: Modifications to the Plant and Project Data Changes

a) If a sensor device or output device is replaced due to maintenance activities then only that device replaced have to be tested up to the CIE and up to the FDS HMI Stations.

b) If any new sensor device or output device is implemented as part of a modification, the sensor or output device will be tested up to the CIE and FDS HMI Stations and all the functions it affects (100% testing of the end to end functions associated with the modifications are required)

c) In addition it is required for the testing of at least 10% of the sensor devices and input/output devices not associated with the modification but forming part of the loop.

## D.2: The modification/Upgrade of Firmware on a FAP

The modification of firmware on a FAP would require the 10% testing of all the sensors and output devices per loop associated with the FAP.

## D.3: The modification/Upgrade to the OS, Application and or Project Specific Software on the FDS

The modification of the OS, Application and or Project Specific software on the FDS and or FDS SCADA require a 10% testing of all the sensor and output devices across all the loops such as to confirm the integrity of the FDS system is still intact.

# APPENDIX E: ITM SCHEDULES

## Table 3: Inspection Schedule and Record – Fire Detection and Alarm Systems and interfaces to Special Hazard Systems and Smoke Management Systems

Note: The conditions should be noted on the inspection report, for the follow-up corrective actions to be undertaken, the verification of the corrective actions being successfully undertaken, and the closed out/on in the maintenance management system (SAP PM or Maximo).

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | | Records |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quarterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| 1.1 | FDS External alarms (Sounder and or Beacon) | INSPECT the following:<br><br>a) On large sites with multiple buildings, or in case of large buildings with multiple entrances/exits, INSPECT the external alarm (siren/ bell and or strobe light/beacon).<br>b) Inspect to ensure the external alarm label is legible with the word 'FIRE ALARM' in characters not less than 25 mm in height.<br>c) CHECK if all plant labelling and reference labels are provided, properly affixed and legible.<br>d) Uniquely identified with the KKS or AKZ codes, and in certain circumstances it has a system unique code (for identification during PM and or defect notification).<br><br>The following have to be evaluated during the visual inspection:<br><br>a) Ensure that there is no obstructions in front of the | | | | ✓ | | | | Where plant labelling are not provided, missing or not legible then new replacement labels must be obtained and correctly affixed to the relevant system components |

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| | | annunciators<br>b) Physical damage ,<br>c) Tampering,<br>d) Incorrect t labels, dirty labels or no labels.<br>e) Inspect the physical conditions of the Sounder and Beacon<br>f) The Sounder and Beacon being intact and in a good condition physically, the wiring connected, and cleanliness of the devices (clean from dust and contaminants). | | | | | | | | |
| 1.2 | Control and indicating equipment (CIE) | INSPECT the following on the CIE:<br>Fire Alarm Panel (FIP), Sub Alarm Panel (SAPP), Repeater Panel, Mimic Panel:<br>a) Ensure that they are clearly visible, readily accessible and free from dust and contaminants; and<br>b) Where a panel is obscured by a door, check that the door is correctly labelled.<br>c) The components are verified to be in a healthy status<br>i. Fuses<br>ii. Lamps and LEDS<br>iii. Primary (main) power supply<br>iv. Interfaced equipment<br>v. Fiber-Optic cable connections<br>i. Copper based UTP connections.. | | | | | ✓<br>✓<br>✓<br>✓<br>✓<br>✓ | | | |
| 1.3 | CIE Batteries and battery enclosure | 1. Where vented batteries are used, INSPECT the battery enclosure for evidence of corrosion.<br>2. For all the batteries CHECK for the following on the fire alarm panel batteries:<br>a) Lose terminals or connections<br>b) Corrosion on terminals,<br>c) Damaged cabling,<br>d) Visually Electrolyte levels(where applicable),<br>e) Battery damage and deformity.<br>f) Verify marking of the month and year if manufacturing<br>g) CHECK charging equipment for lose terminals corrosion at terminals, damaged cabling. | | ✓ | | | | | | |
| | The different batteries should be inspected as | Lead acid | | ✓ | | | | | | |

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| | stipulated in point 1.3 at the frequencies stipulated. | | | | | | | | | |
| | | Nickel Cadmium | | | | ✓ | | | | |
| | | Sealed lead acid | | | | ✓ | | | | |
| 1.4 | Zone Block Plan | INSPECT zone block plans (Detection zones) to ensure that they are securely mounted and legible and supplementary zone drawings, where required, are available and legible. | | ✓ | | | | | | |
| 1.5 | Manual call points | a) Physically in a good condition, properly mounted, the cabling connected and the Manual Call Points free of conditions likely to adversely affect its function (dust and water ingress) .<br>b) Confirm unobstructed view and access to the MCPs<br>c) Where manual call points use replaceable frangible elements, ENSURE that at least one replacement element and tool is available for replacing the element where required.<br>d) MCP can be identified through its functional location code (KKS, AKZ and Unique identifier).<br>e) Incorrect labels no labels, dirty labels or damaged labels. | | | | | ✓ | | | |
| 1.6 | Projected beam smoke detectors | a) Free of mechanical damage<br>b) Free of water damage<br>c) Clean of debris and dust.<br>d) Are properly secured.<br>e) Verify the beam path is unobstructed.<br>f) Are not painted over which can inhibit its function.<br>g) Building conditions i.e. civil changes have not affected the function or effectiveness of the devices.<br>h) Are not adversely affected by temporary/permanent obstructions typically during constructions or modifications in the surroundings.<br>i) Incorrect labels, no labels, dirty labels or damaged labels. | | | | ✓ | | | | |
| 1.7 | Smoke Detectors | a) Free of mechanical damage<br>b) Free of water damage<br>c) Clean of debris and dust.<br>d) Are properly secured<br>e) Are not painted over which can inhibit its function. | | | | ✓ | | | | |

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| | | f) Building conditions i.e. civil changes have not affected the function or effectiveness of the devices.<br>g) Are not adversely affected by temporary/permanent obstructions typically during constructions or modifications in the surroundings.<br>h) Incorrect labels, no labels, dirty labels or damaged labels. | | | | | | | | |
| 1.8 | Air Duct Detectors | a) Verify that the detectors are rigidly fixed<br>b) Confirm that no penetrations exist in the return air duct in the vicinity of the detector.<br>c) Confirm that the duct detector and sampling tubes are inspected to ensure that there are no obstructions for smoke entry in the sensing chamber from dust dirt or debris.<br>d) h) Incorrect labels, no labels, dirty labels or damaged labels. | | | | ✓ | | | | |
| 1.9 | Air sampling system | a) Verify that the inline filters are clean, verify that the system piping and fittings are installed correctly and airtight and permanently fixed.<br>b) Verify that the sample ports or points are not obstructed.<br>c) Verify that there are no sustained alarms . | | | | ✓ | | | | |
| 1.10 | Heat Detectors | a) Free of mechanical damage<br>b) Free of water damage<br>c) Clean of debris and dust.<br>d) Are properly secured<br>e) Are not painted over which can inhibit its function.<br>f) Building conditions i.e. civil changes have not affected the function or effectiveness of the devices.<br>g) Are not adversely affected by temporary/permanent obstructions typically during constructions or modifications in the surroundings.<br>h) Incorrect labels no labels, dirty labels or damaged labels. | | | | ✓ | | | | |
| 1.11 | Radiant Heat detectors (Flame or Amber Detectors) | a) These detectors are line of sight it is therefore important to ensure there are no physical obstructions between the detectors and the area being protected.<br>b) Clean from debris, dust or contaminants.<br>c) Confirm the orientation of the detector against the original drawing and being directed towards the area of protection.<br>d) Incorrect labels no labels, dirty labels or damaged labels. | | | ✓ | | | | | |
| 1.12 | Video Image Smoke and | a) Verify that no point requiring detection is obstructed or outside | | ✓ | | | | | | |

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| | Fire Detectors | the VIFD camera detector's field of view.<br>b) The inspection of camera condition and status on the VIFD HMI Station<br>c) The VIFD camera must be clean from debris, dust or contaminants.<br>d) Confirm the orientation of the VIFD camera against the original drawing and being directed towards the area of protection.<br>e) Confirm that the application of the software filters in the VIFD system is still applicable and not unnecessarily masking detection areas. Evaluate if various false alarms are being generated, through environment, activities or physical orientation (Optimise through the various means available filtering, change orientation or evaluate activities causing false activations, etc.).<br>f) Verify that there are no incorrect labels, no labels, dirty labels or damaged labels. | | | | | | | | |
| 1.13 | Electro/mechanical releasing switches | To be inspected for condition on a regular basis (Shutter releases and electrically locked doors) | | | | ✓ | | | | |
| 1.14 | Fire extinguishing systems switches /suppression system switches | To be inspected for condition on a regular basis | | | | ✓ | | | | |
| 1.15 | Supervisory signal devices<br>(Pressure and flow switches) | a) Visual inspection of the initiating device installed outdoors confirms that there is no physical damage of the supervisory device, seals and covers.<br>b) Free of water damage.<br>c) Clean of debris and dust.<br>d) Are properly secured.<br>e) Incorrect labels no labels, dirty labels or damaged labels. | | | ✓ | | | | | |
| 1.16 | Carbon Monoxide detectors/systems | a) Visual inspection of the initiating device installed outdoors confirms that there is no physical damage of the supervisory device, seals and covers.<br>b) Free of water damage.<br>c) Clean of debris and dust.<br>d) Are properly secured.<br>e) Incorrect labels no labels, dirty labels or damaged labels. | | | | ✓ | | | | |

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| | | f) Readings on display screen is visible and readable. | | | | | | | | |
| 1.17 | Devices not accessible during normal operations | Devices or equipment that is inaccessible for safety considerations (e.g., continuous process operations, energized electrical equipment, radiation, and excessive height) shall be permitted to be inspected during scheduled shutdowns. | | | | | | | | Note to guide the approach which requires outages. Typically part of the 04 Activities and Work Packages to be done during the IR, MGO and GO outage scopes. |
| 1.18 | Multi-Criteria and Multi sensor detectors | a) Free of mechanical damage<br>b) Free of water damage<br>c) Clean of debris and dust.<br>d) Are properly secured<br>e) Are not painted over which can inhibit its function.<br>f) Building conditions i.e. civil changes have not affected the function or effectiveness of the devices.<br>g) Are not adversely affected by temporary/permanent obstructions typically during constructions or modifications in the surroundings.<br>h) Correct labels, Incorrect labels, no labels, dirty labels or damaged labels. | | | | ✓ | | | | |
| 1.19 | Gas concentration detection devices. | a) Visual inspection of the initiating device installed outdoors confirms that there is no physical damage of the supervisory device, seals and covers.<br>b) Free of water damage.<br>c) Clean of debris and dust.<br>d) Are properly secured.<br>e) Incorrect labels no labels, dirty labels or damaged labels.<br>f) Readings on display screen is visible and readable. | | | | ✓ | | | | |
| 1.20 | Function Interfaces | HVAC, Smoke Control and Extraction, Elevator Shutdown, Elevator Recall, Door unlock interface.<br>a) Visual inspection of the interface devices that confirms that there is no physical damage of the interface device, seals and covers are in place and in good condition.<br>b) Free of water damage.<br>c) Clean of debris and dust.<br>d) Are properly secured.<br>e) Correct labels, incorrect labels, no labels, dirty labels or | | | | ✓ | | | | |

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| | | damaged labels.<br>f) Status indicators are visible and indicate as to being powered and the health status of the interface device. | | | | | | | | |
| 1.21 | Other warning devices | Where other warning devices are used as the alarm-indicating devices, INSPECT all devices to ensure that they are in place, in good condition and clean of dust and contaminants. | | | | | ✓ | | | |
| 1.22 | Service life | INSPECT detectors, equipment or other items having a defined service life and report where the service life is exceeded or will be exceeded before the next scheduled service. | | | | | ✓ | | | |
| 1.23 | Protected areas survey | SURVEY all areas of the building from floor level and check—<br>a) that the fire detection and alarm system has not been altered from the approved design, damaged or compromised;<br>b) detection device and remote indicators are appropriate for the current use;<br>c) for any condition that may cause a nuisance alarm or the unintentional operation of a suppression system;<br>d) all exposed cabling, conduits, junction boxes and the like for any condition that may impact on the performance of the system and is labelled in accordance with approved design; and<br>e) all CIE (FAP/FIP) to ensure all components are appropriately mounted and secure. | | | ✓ | | | | | |
| 1.24 | Baseline data documentation | CHECK that baseline documentation is available and legible, and kept in the following places:<br>Design and Specification Department Archives associated with the respective BU's.<br>Documentation necessary for maintenance to be kept in designated Maintenance Documentation Management areas.<br>Ensure that baseline documentation is kept updated in line with Engineering Change Management processes, project phases and project completion deliverables. | | | ✓ | | | | | |

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| | **SPECIAL HAZARD SYSTEMS – ADDITIONAL ACTIVITIES** | | | | | | | | | |
| 1.25 | Extinguishant release panel (ERP) | a) Ensure that they are clearly visible readily accessible and free from dust and contaminants. | | ✓ | | | | | | |
| | | b) Check that the door is correctly labelled, locked and in the correct state.<br>c) Visual inspection of the interface devices that confirms that there is no physical damage of the interface device, seals and covers are in place and in good condition.<br>d) Free of water damage.<br>e) Clean of debris and dust.<br>f) Are properly secured.<br>g) Correct labels, incorrect labels, no labels, dirty labels or damaged labels.<br>h) Status indicators are visible and indicate as to being powered and the health status of the interface device. | | ✓ | | | | | | |
| 1.26 | Visual warning devices | INSPECT all visual displays for any condition or damage that is likely to adversely affect their function, including: | | ✓ | | | | | | |
| | | DO NOT ENTER | | ✓ | | | | | | |
| | | EVACUATE | | ✓ | | | | | | |
| | | FIRE ALARM | | ✓ | | | | | | |
| | | SYSTEM INOPERATIVE | | ✓ | | | | | | |

## Table 4: Test Schedule and Record – Fire Detection and Alarm Systems and interfaces to Special Hazard Systems and Smoke Management Systems

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | Records | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quaterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| 2.1 | Fire alarm | SIMULATE an alarm condition and confirm that all required common or general visual and audible indications operate and the external alarm is activated.<br>Where the system is monitored ensure the alarm has activated the alarm signalling equipment. Where CIE is a sub-indicator panel, confirm that the alarm condition is indicated at the FIP and up to FDS HMI. | | ✓ | | | | | | |
| 2.2 | Occupant warning system | SIMULATE an alarm and confirm the alarm initiates the occupant warning system including any visual warning devices (VWD).<br>Repeat for all combination of detection and alarm zones. | | ✓ | | | | | | |
| 2.3 | Isolate/Disable | INITIATE an isolate/disable condition at the fire indicator panel and confirm that all required common or general visual and audible indications operate.<br>Where the system is monitored, ensure the signal is received by the monitoring CIE alarm signalling equipment up to the FDS HMI. Where the panel is an SIP, confirm that the isolate/disable condition is indicated at the FIP as either a fault or isolate/disabled. | | ✓ | | | | | | |
| 2.4 | Filament visual indicators | TEST and monitor the operation of each filament type visual indicators. | | ✓ | | | | | | |
| 2.5 | Manual call points | TEST and monitor the operation of each manual call point. | | | | | ✓ | | | |
| 2.6 | Panel switches and keypads | TEST and monitor the operation of each control. | | | | | ✓ | | | |

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | Records | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quaterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| 2.7 | Visual indicators | TEST and monitor the operation of each visual indicator and alphanumeric displays. | | | | | ✓ | | | |
| 2.8 | Battery | MEASURE/CALCULATE system standby time and maximum alarm currents.<br>Calculate the required battery capacity and CHECK the nominal capacity of the installed batteries is not less than the calculated capacity.<br>Verify that the measured currents are the same as recorded in the baseline data. | | | | | ✓ | | | Standby ……...$I_Q$<br>Required capacity …….Ah<br>Installed capacity ……Ah |
| 2.9 | Fire Detectors | TEST and monitor detectors as specified in **Appendix A** and **Appendix B** and confirm the correct associated alarm zone indications. Where the detectors are used as part of special hazards systems 100% of the detectors shall be functionally tested. | | | | | ✓ | | | |
| 2.10 | Audibility | TEST and monitor the occupant warning system and check the signals are distinctly audible in all areas of the building.<br>. | | ✓ | | | | | | |
| 2.11 | Occupant warning system sound pressure level ( Sounders) | MEASURE and record the sound pressure levels from at least one reference point for each amplifier used and ensure at each reference point the measured value is consistent with the baseline sound pressure level at each of the reference points. | | | | | ✓ | | | Location of reference points…….<br>Baseline SPL ……...dBA<br>Measured test SPL ..…...dBA |
| 2.12 | Alarm acknowledgement facility | TEST and monitor no less than 20% of installed fire detection devices and alarm annunciation and associated alarm acknowledgement facilities on FDS SCADA in such a manner that over a 5-year period, all the facilities are tested.<br>CHECK the alarm acknowledgement facility functions in | | | | | ✓ | | | |

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | Records | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quaterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| | | accordance with the approved design. | | | | | | | | |
| 2.13 | Alarm investigation facility | TEST and evaluate the alarm investigation facility if enabled and check it functions in accordance with the approved design.<br>Test and or evaluate the alarm archiving functionality on the FDS SCADA.<br>Test and evaluate the a) historic (long term storage) and b) archived alarm re-call functionality on the FDS SCADA. | | | | | ✓ | | | |
| 2.14 | Batteries condition | When the battery has not been replaced in the previous two years, verify the battery condition by carrying out a battery discharge test. | | | | | ✓ | | | Date last replaced or;<br>Test load current……..A<br>Final test voltage……..V |
| 2.15 | Baseline data | CHECK that baseline documentation is available and legible, and kept in the following places:<br>Design and Specification Department Archives associated with the respective BU's.<br>Documentation necessary for maintenance to be kept in designated Maintenance Documentation Management areas.<br>Ensure that baseline documentation is kept updated in line with Engineering Change Management processes, project phases and project completion deliverables. | | | | | ✓ | | | |
| 2.16 | Interfaced system initiation | Simulate alarm(s) to verify that each interface transmission path initiates the corresponding interfaced system(s) in accordance with the approved design. | | | | | ✓ | | | This requires a detailed test plan and the involvement of the multi-disciplinary team when this type of testing is undertaken. |
| 2.17 | Supervised circuits | TEST each input and output supervised circuit for any condition that prevents the transmission of the required | | | | | | ✓ | | |

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | Records | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quaterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| | | signal and ensure a fault is registered at the FIP. | | | | | | | | |
| 2.18 | Fault | SIMULATE a circuit fault condition at the FIP and confirm that all required common or general visual and audible indications operate locally and remote (FDS SCADA).<br>Where such faults are monitored, ensure the fault has activated the alarm signalling equipment.<br>Where the panel is a SIP confirm that the fault condition is indicated at the FIP up to the FDS SCADA need to be done. | | | | | | ✓ | | |
| 2.19 | Power supply supervision | Where the system is monitored, REDUCE the CIE operating voltage to trigger a power supply supervision fault and CONFIRM that it is received by the FDS SCADA.<br>Where the panel is an SIP or a distributed power supply, confirm that the power supply supervision fault condition is indicated at least as a fault at the FIP. | | | | | | ✓ | | |
| 2.20 | Collective detection circuits | For each collective fire detection circuit, REMOVE the last detector or device on the circuit and confirm that a fault signal is registered at the CIE and at the FDS SCADA. | | | | | | ✓ | | |
| 2.21 | Interface and control test | CONDUCT a functional test with each system interface in accordance with the interface diagram and CHECK that each interfaced system responds to the signal in accordance with the approved design. | | | | | | ✓ | | This requires a detailed test plan and the involvement of the multi-disciplinary team when this type of testing is undertaken. |
| 2.22 | Occupant warning system speaker circuits | MEASURE and record the impedance of each loudspeaker circuit and check that it has not changed by more than 15% from the last test nor exceeded the rated output in the baseline data for amplifier. | | | | | | ✓ | | Baseline……Ω<br>Impedance per circuit…….Ω |
| 2.23 | Monitoring connection | Where the system is monitored, TEST that the loss of each | | | | | | ✓ | | |

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | Records | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quaterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| | | of the monitoring links is indicated at the monitored site. | | | | | | | | |
| 2.24 | Alarm verification facility | TEST one detector of each type per circuit with alarm verification facility enabled to check that it functions in accordance with the approved design (TEST and monitor no less than 20% of installed fire detection devices and alarm annunciation and associated alarms, such that all the devices are tested over a 5 year period). | | | | | | ✓ | | |
| | **SPECIAL HAZARD SYSTEMS – ADDITIONAL ACTIVITIES** | | | | | | | | | |
| 2.25 | Precautions | Take precautions to prevent the discharge of the system during the tests associated to gas, water or chemical discharge facilities. | | | | ✓ | | | | |
| 2.26 | Extinguishant release panel (ERP) discharge inhibit switch | TEST the operation of each inhibit or auto/manual switch and confirm that:<br>a) It prevents the automatic discharge of suppression system. | | | | ✓ | | | | |
| | | b) Stops and resets the normal system discharge sequence. | | | | ✓ | | | | |
| | | c) Causes the illumination of a visual indicator at the ERP and the system FIP. | | | | ✓ | | | | |
| | | d) Causes an audible indication. | | | | ✓ | | | | |
| | | e) Does not override the operation of the manual discharge switch. | | | | ✓ | | | | |
| 2.27 | Extinguishant release panel (ERP) manual initiate switch | TEST the operation of the manual initiate switch and confirm normal system discharge sequence, including fire and evacuation alarms, time delays equipment shutdowns, and that it overrides the ERP discharge inhibit switch. | | | | ✓ | | | | |

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | Records | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quaterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| 2.28 | System inoperative visual warning device (VWD) | CONFIRM the system inoperative VWD operates for:<br>a) Operation of a service switches (discharge initiating circuit electrical isolation). | | | | ✓ | | | | |
| | | b) Fault in the discharge actuator circuit. | | | | ✓ | | | | |
| | | c) Operation of a lock-off valve (where fitted). | | | | ✓ | | | | |
| | | d) Operation of a manual inhibit switch (where fitted). | | | | ✓ | | | | |
| | | e) Isolation or fault in any part of the fire detection or control system that prevents the automatic or electrical manual discharge of the suppression system. | | | | ✓ | | | | |
| 2.29 | System operation and logic | TEST the system logic (e.g. dual detector operation or dependency on more than one alarm) and confirm that the operation is in accordance with the approved design of –<br>a) VWDs | | | | ✓ | | | | |
| | | b) audible alarms | | | | ✓ | | | | |
| | | c) directional valve signal/output | | | | ✓ | | | | |
| | | d) equipment fire mode signal/output | | | | ✓ | | | | |
| | | e) HVAC fire mode signal/output | | | | ✓ | | | | |
| | | f) system discharge actuator | | | | ✓ | | | | |
| | | g) door and damper release and | | | | ✓ | | | | |
| | | h) ancillary controls | | | | ✓ | | | | |
| 2.30 | Actuator circuit faults | TEST each supervised actuator circuit to ensure a fault is registered at the FIP and FDS SCADA. | | | | ✓ | | | | |

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | Records | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quaterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| 2.31 | Extinguishant Release Actuator | Ensure that each actuator has been mechanically isolated or temporarily removed from the extinguishant supply to prevent unintended discharge.<br>TEST the function of each actuator and ensure that each actuator operates correctly.<br>For non-resettable actuators (e.g. pyrotechnic types) substitute the actuator with a load of equivalent value and CONFIRM the operating current is in accordance with baseline data. | | | | ✓ | | | | |
| 2.32 | Status monitoring | TEST the each suppression system status monitored function (e.g. container level, pressure switches, pump controllers, isolation valves) and CHECK each monitored function indicates at the suppression system control panel and where interfaced to the FDS SCADA on it as well. | | | | | ✓ | | | |
| 2.33 | Suppression system directional valves | SIMULATE the system operation and confirm that each electrical directional valve operates according to the approved design. | | | | | ✓ | | | |
| 2.34 | Discharge time delay | TEST and RECORD the system discharge sequence and confirm the time delay period is in accordance with the approved design. | | | | | ✓ | | | |
| 2.35 | Extinguishant release indication | TEST the extinguishant release detection device (e.g. pressure switch) and confirm the operation of the extinguishant release is indicated at the FIP and where interfaced to the FDS SCADA on it as well. | | | | | ✓ | | | |
| | **SMOKE MANAGEMENT SYSTEMS – ADDITIONAL ACTIVITIES** | | | | | | | | | |
| 2.36 | FFCP latching and reset | CHECK that after initiation by a signal from the FIP, the FFCP remains operating in the fire mode until reset by the | | | | | ✓ | | | This requires a detailed test plan and the involvement of the multi-disciplinary team when this type of testing is undertaken. |

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | Records | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quaterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| | | reset switch on the FFCP. | | | | | | | | |
| 2.37 | Manual override controls | CHECK that manual override ON-AUTO-OFF control operates.<br>NOTE: Manual override should function in normal mode and fire mode. | | | | | ✓ | | | |
| 2.38 | Airflow fault indicator | CHECK the operation of the airflow fault indicator | | | | | ✓ | | | |
| 2.39 | Open-circuit fault indicator | CHECK the operation of the air-handling equipment interconnecting cable open-circuit fault indicator. | | | | | ✓ | | | |
| 2.40 | Closed-circuit fault indicator | CHECK the operation of the air-handling equipment interconnecting cable closed-circuit fault indicator. | | | | | ✓ | | | |
| 2.41 | Electrical | CHECK the operation of the electricity phase fail fault indicator. | | | | | ✓ | | | |
| 2.42 | Fan-running indicator | CHECK the operation of the fan-running indicator. | | | | | ✓ | | | |
| 2.43 | Fan-stopped indicator | CHECK the operation of the fan-stopped indicator. | | | | | ✓ | | | |
| 2.44 | Fan fault indicator | CHECK the operation of the fan-fault indicator. | | | | | ✓ | | | |
| 2.45 | FFCP latching and reset | CHECK that after initiation by a signal from the FIP, the FFCP remains operating in the fire mode until reset by the reset switch on the FFCP. | | | | | ✓ | | | |
| 2.46 | Manual override controls | CHECK that manual override ON-AUTO-OFF control operates.<br>NOTE: Manual override should function in normal mode and fire mode. | | | | | ✓ | | | |
| | **SPECIAL HAZARD SYSTEMS – ADDITIONAL ACTIVITIES** | | | | | | | | | |
| 3.1 | Precautions | Take precautions to prevent the discharge of the system | | | | ✓ | | | | |

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | Records | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quaterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| | | during these tests (refer to [4]). | | | | | | | | |
| 3.2 | Extinguishant release panel (ERP) discharge inhibit switch | TEST the operation of each inhibit or auto/manual switch and confirm that:<br>a) It prevents the automatic discharge of suppression system. | | | | ✓ | | | | |
| | | b) Stops and resets the normal system discharge sequence. | | | | ✓ | | | | |
| | | c) Causes the illumination of a visual indicator at the ERP and the system FIP. | | | | ✓ | | | | |
| | | d) Causes an audible indication. | | | | ✓ | | | | |
| | | e) Does not override the operation of the manual discharge switch. | | | | ✓ | | | | |
| 3.3 | Extinguishant release panel (ERP) manual initiate switch | TEST the operation of the manual initiate switch and confirm normal system discharge sequence, including fire and evacuation alarms, time delays equipment shutdowns, and that it overrides the ERP discharge inhibit switch. | | | | ✓ | | | | |
| 3.4 | System inoperative visual warning device (VWD) | CONFIRM the system inoperative VWD operates for:<br>a) Operation of a service switch (discharge initiating circuit electrical isolation). | | | | ✓ | | | | |

**Table 5: Preventative Maintenance Schedule and Record – Fire Detection and Alarm Systems and interfaces to the FPS, Special Hazard Systems, to the VACIE, HVAC and Smoke Management Systems**

| No. | Item | Action required & pass/fail criterion | Frequency | | | | | | Records | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weekly | Monthly | Quarterly | Six-monthly | Yearly | Five-yearly | Pass/fail | Result/Comments |
| 4.1 | All the components of the Fire Detection System, 3rd party components and associated interfaces need to be maintained taking the following into consideration. | The tasks and activities take the following into consideration:<br>a) The design of the FDS, the interfaces and the 3rd party components utilised.<br>b) The technologies applied and their functions, features and performance.<br>c) The environment and its effect on the FDS, 3rd party and interface functions and performance.<br>d) The requirement to utilise the approved and in certain circumstances certified tools and equipment to do the maintenance and testing.<br>e) The requirement for personnel to be competent and certified through OEM based training. | | | | | | | | When compiling preventative maintenance activities the following need to be considered in determining the eventual preventative maintenance activities ( i.e. strategy, content and frequencies):<br>a) The OEMS instructions and maintenance strategies for all the components of the FDS system, interfaces and 3rd party systems.<br>b) Eskom's maintenance strategies, best practises, experiences with the type of technologies and or similar installations.<br>c) The legal and regulatory and operational requirements and processes. |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | d) The environmental conditions at the different sites<br>e) The requirement for testing following any corrective and preventative maintenance activities.<br>f) The systematic capturing of history and record keeping in the ERP Maintenance System, such to enable optimisation on different aspects, metrics as part of continuous improvement.<br>g) Ensuring that competent and certified personnel execute their respective tasks according to their roles and responsibilities.<br>h) The focus on components, systems and across systems (interfaces included) preventative maintenance and testing tasks to ensure the components and system's functionality, performance, reliability, availability and integrity is maintained within designed specifications. |
| 4.2 | The devices and Fire Detection Components: **Preventative Maintenance** | Preventative maintenance is executed on all the devices and components in line with the manufacturer's recommendations/instructions, the Eskom' best practises, technologies and the associated Maintenance Strategy. | ✓ | ✓ | ✓ | | ✓ | ✓ | | Preventative maintenance is followed by the retesting of the device, component and or system(s) to confirm that it meets the full functionality and performance requirements. |
| 4.3 | The devices and Fire | Corrective maintenance is executed on all the | ✓ | ✓ | ✓ | | ✓ | ✓ | | Corrective maintenance is followed by |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Detection components: **Corrective Maintenance** | devices and components in the Fire Detection in line with the manufacturer's recommendations/instructions, the Eskom' best practises, technologies and the associated Maintenance Strategy. | | | | | | | | the retesting of the device, component and or system(s) to confirm that it meets the full functionality and performance requirements. |
| 4.4 | The devices and Fire Detection components: **Modifications ( Engineering Change Management)** | Testing and preventative maintenance is executed on all the devices and components in the Fire Detection in line with the manufacturer's recommendations/instructions, the Eskom' best practises, technologies and the associated Maintenance Strategy. | ✓ | ✓ | ✓ | | ✓ | ✓ | | Testing and preventative maintenance is executed following a modification of the device, component and or system(s) to confirm that it meets the full functionality and performance requirements. |
| 4.5 | Cyber Security functions and measures on the Fire Detection System | The requirements of the Cyber Security standard for operational technology 240-55410927(latest revision) is complied with on the Fire Detection Systems.<br>In addition for Generation, the Generation Cyber Security Compliance Guideline 240-129014618 guides as to how to implement Cyber Security on OT based systems. | ✓ | ✓ | ✓ | | ✓ | ✓ | | Changes brought about by Cyber Security Measures might require some form and level of re-testing following the changes made. A risk assessment and evaluation of affected parts of the Fire Detection System, interfaces and or 3rd party components determines the extent of retesting required. |
| 4.6 | Software Management functions and measures on the Fire Detection System | The software on all the components of the Fire Detection System are managed in line with the requirements stipulated in the Management of Plant Software Standard 240-56355910 (latest revision). | ✓ | ✓ | ✓ | | ✓ | ✓ | | Changes brought about by Software Management Updates/Upgrade have some form and level of re-testing required following the software/hardware changes made. A risk assessment and evaluation of affected parts of the Fire Detection System, interfaces and or 3rd party components determines the extent of retesting required. |