Eskom	Standard	Generation Engineering

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PCM Reference: **240-53458738 PCM for Perform Low Pressure Services Engineering**

SCOT Study Committee Number/Name: **Generation Auxiliary Study Committee**

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FIGURES

TABLES

1. INTRODUCTION

Fire Protection/Detection Assessments (FPDA's) have a fundamental part to play in the development of fire engineering designs that deliver adequate fire safety in terms of life safety, asset protection and/or business continuity.

Regulatory regimes generally require that designers and managers of industrial premises assess the risk posed by fire in those premises and that they take suitable measures to reduce fire risk to an acceptable level.

The "General Requirements" as per the National Building Regulations and Building Standards Act [2] states the following:

1. Any building shall be so designed, constructed and equipped that in case of fire -
   a) the protection of occupants or users, including persons with disabilities, therein is ensured and that provision is made for the safe evacuation of such occupants or users;
   b) the spread and intensity of such fire within such building and the spread of fire to any other building will be minimized;
   c) sufficient stability will be retained to ensure that such building will not endanger any other building: Provided that in the case of any multi-storey building no major failure of the structural system shall occur;
   d) the generation and spread of smoke will be minimized or controlled to the greatest extent reasonably practicable; and
   e) adequate means of access, and equipment for detecting, fighting, controlling and extinguishing such fire, is provided.

The Eskom Fire Risk Management Standard [3] governs how Fire Risk Management should be applied and implemented in Eskom.

The Fire Protection/Detection Assessment (FPDA) process should be initiated as early in the design process as possibly practical to ensure that the fire prevention, fire protection and fire detection recommendations as described in the Fire Protection Systems and Life Safety Standard [6] and the Fire Detection Systems and Life Safety Standard [7] have been evaluated in view of the facility specific considerations regarding design, layout and anticipated operating requirements etc. The FPDA is an input into the design process.

One of the primary objectives is to evaluate all fire risk reduction measures as part of the FPDA to ensure through design safeguards and administrative controls the fire protection and fire detection requirements are minimised.

However due to the fallibility of the preventative measures, regardless of the reason for such failure or potential failure, provision must be made to adequately protect life and plant in these instances. The risk management approach is aimed at finding that suitably acceptable middle ground.

2. SUPPORTING CLAUSES

2.1 SCOPE

The scope of this Standard is to detail the method of compiling a technical FPDA that can also be used to perform a systematic comparison of different fire risk control and/or reduction options so that a decision can be made as to the optimal design or management solution. This is applicable for any new build, modification, or refurbishment project where the fire protection and fire detection scope must be determined.

This document shall be applied throughout Eskom Holdings and is equally applicable to a single system such as an office block as it is to an entire power station.

2.1.1 Purpose

The purpose of this document is to ensure a standardised approach is followed when a technical FPDA is conducted in Eskom. The FPDA documents the decision-making process in determining the fire prevention, fire detection and fire protection for specific hazards and risks.

2.1.2 Applicability

This document shall apply throughout Eskom Generation.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs as applicable within each division and business unit.

2.2.1 Normative

[1] ISO 9001 Quality Management Systems

[2] National Building Regulations and Building Standards Act No. 103 Of 1977

[3] 32-124 Eskom Fire Risk Management

[4] 240-53458738 Process Control Manual (PCM) for Perform Low Pressure Services Engineering

[5] 240-44443156 Process Control Manual (PCM) for Manage Engineering Accountability

[6] 240-54937450 Fire Protection Systems and Life Safety Standard

[7] 240-56737448 Fire Detection Systems and Life Safety Standard

[8] 240-112287980 Work Instruction for the Application of Standards in Plant/Project Engineering

[9] 240-53113685 Design Review Procedure

2.2.2 Informative

[10] 32-123 Emergency Planning

[11] 32-391 Integrated Risk Management Standard

[12] 240-129709629 Fire Risk Assessment Template (as per 32-124 Eskom Fire Risk Management)

[13] 240-129709945 Fire Safety Plan Template (as per 32-124 Eskom Fire Risk Management)

[14] 240-54937454 Inspection, Testing and Maintenance of Fire Protection Systems

[15] 240-56737654 Inspection, Testing and Maintenance of Fire Detection Systems

[16] 240-126468603 Operational Standard for Fire Management in Generation.

[17] 240-126467640 Operational Standard for Fire Fighter Training in Generation

[18] 240-126467668 Operational Standard for Inspection, Testing of Fire and Rescue Non-Plant Equipment in Generation

[19] 240-49230100 Safety Engineering Analysis Guideline

[20] SANS 10400 The Application of the National Building Regulations Part A: Administration

[21] SANS 10400 The Application of the National Building Regulations Part T: Fire Protection

[22] SANS 10400 The Application of the National Building Regulations Part W: Fire Installation

[23] NFPA 850 Recommended Practice for Fire Protection for Electric Generating Plants

2.3 DEFINITIONS

Definition	Description
Approved by	The accountability of the Approver of the document is equivalent to the specified role of Functional Responsible/Owner as identified in [9] 240-53114186 and 32-6 for Documents and Records Management.
Competent Person to perform a Fire Protection/Detection Assessment (Assessor)	The person who uses this document for the purpose of performing a Fire Protection / Detection Assessment must: 1. Be a competent person in fire engineering as defined in SANS 10400 W [22]: Competent person (fire engineering) is a person who a. is registered in terms of the Engineering Profession Act, 2000 (Act No. 46 of 2000), as either a Professional Engineer or a Professional Engineering Technologist, and b. is generally recognized as having the necessary experience and training to undertake rational assessments or rational designs in the field of fire engineering. 2. Have accepted accountability for the specific task as per MEA. This means that the competency of a person is defined as per the Eskom Manage Engineering Accountability (MEA) PCM, and any individual in Eskom undertaking a Fire Protection/Detection Assessment must accept accountability in the MEA application system for the task "Perform Fire Protection / Detection Assessment". **NOTE** – item 2 generally only applies to Generation Engineering.
Critical	The facility or any part or area of the facility is seen to be critical if its loss during a fire incident has the potential to cause the following, either immediately or within a 6-12 hour period after the incident: • A multiple-unit load loss or trip; • Loss of transmission or distribution capability; • Permanent loss of production or products; or • Danger to fire-fighting personnel involved in fighting the fire (refer to Appendix A for clarity regarding the fire fighting personnel)
Facility	Facility refers to a property or plant controlled by Eskom and consists of all or some of the relevant buildings, rooms or plant areas relevant to the specific assessment. Typically, these include, but are not limited to the following: • One or more plant areas, buildings or rooms on a Power Station. • Office areas such as Megawatt Park. • Training facilities such as the Eskom Academy of Learning.
Facility Manager	Facility Manager typically refers to the person in charge of maintaining the service provision or properties and assets of a company. This role may be fulfilled by a dedicated Facilities Manager (this can be the entire facility or a specific area in a facility) or by the Engineering Manager on a power station.
Fire Engineering Department	Fire Engineering Department may refer to the facility fire system engineer or to an engineer working on fire systems in Generation Engineering (generally the Low Pressure Services and/or Control and Instrumentation departments), or a combination of these engineers.
Fire Protection/Detection Assessment (FPDA)	A Fire Protection/Detection Assessment is the initial, multi-disciplinary process in which reasonably foreseeable hazards are identified, the impact of the potential harm, to people and plant, is assessed, and reasonable engineering solutions to mitigate these hazards are proposed.
Hazard	A hazard is that which has the potential to cause harm.

Definition	Description
Risk	A risk is a function of both the likelihood of a specific hazard being realised and the consequence of that realisation.

2.3.1 Disclosure Classification

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

2.4 ABBREVIATIONS

Abbreviation	Description
ALARP	As Low As is Reasonably Practicable
C&I	Control and Instrumentation
CBA	Cost-Benefit Analysis
EAL	Eskom Academy of Learning
ECSA	Engineering Council of South Africa
ETA	Event Tree Analysis
FD	Fire Detection
FMEA	Failure Mode and Effects Analysis
FP	Fire Protection
FPDA	Fire Protection / Detection Assessment
FRF	Fire Resistant Fluid
FTA	Fault Tree Analysis
HAZOPS	Hazard and Operability Study
HVAC	Heating, Ventilation and Air Conditioning
LPG	Liquefied Petroleum Gas
MEA	Manage Engineering Accountability
MWP	Megawatt Park
PCM	Process Control Manual
PPE	Personal Protective Equipment
PS	Power Station
QRA	Quantitative Risk Analysis
WRT	With Regards To

2.5 ROLES AND RESPONSIBILITIES

The compilation of a FPDA, as detailed in this document, shall only be performed by a competent person as defined in Section 2.3. This assessment can be performed by an individual who is “Candidate” registered with ECSA, if it is reviewed by a “Professionally” registered individual.

2.6 PROCESS FOR MONITORING

FPDA Reports shall be reviewed and approved as per the Design Review Procedure [9].

If the FPDA contains an alternative fire system solution the Work Instruction for the Application of Standards in Plant/Project Engineering [8] shall be followed to approve the deviation.

2.7 RELATED/SUPPORTING DOCUMENTS

Not applicable.

3. FIRE PROTECTION/DETECTION ASSESSMENT STANDARD

3.1 BACKGROUND

3.1.1 Approach and Application

The FPDA should be initiated as early in the design process as practical to ensure the fire prevention and fire protection recommendations, as part of the FPDA recommendations, are incorporated in the design process.

The findings from a FPDA can be used to inform decisions as to whether fire precautions and fire safety management procedures are sufficient to control fire risks to a satisfactory level, or whether additional fire risk reduction measures are required.

A FPDA can also be used to perform a systematic comparison of different fire risk control and/or reduction options so that a decision can be made as to the optimal design or management solution. It is not appropriate to carry out a FPDA to justify a decision that has already been made. A FPDA is input to the decision-making process, not an output from that process.

In Eskom the FPDA is the technical risk assessment that will be done to document the fire and life safety approach for a specific scope.

Before embarking upon a FPDA, it is important to determine the scope objectives and stakeholders of that assessment and, if appropriate, to agree that scope with those who will refer to it, this may include facility system engineers, engineering managers, power station manager, facility managers and insurance auditors.

Almost all FPDA's include an element of judgment, in either the identification of the hazards, the assessment of possible consequences or the estimation of their likelihood. For this reason, it is important that the assessment is undertaken by persons with skills and experience appropriate to the fire risks being assessed as well as the scope of plant being assessed.

In cases where the FPDA involves a straightforward and unvarying application of good industry practice, the assessor might need no detailed knowledge of fire behaviour. However, where the FPDA uses techniques that might result in solutions that depart significantly from guidance, it will be necessary for the assessors to have the relevant competence in fire safety engineering and/or fire safety management to appreciate the consequences of that departure on fire risk in the premises. This will require understanding of the fire hazards or fire risks that the Fire Protection System and Life Safety Standard [6] and Fire Detection System and Life Safety Standards [7] address and the reasons why these Standards recommend a particular controlling measure. It is only with this knowledge that the assessor can make informed decisions as to the significance of variation from that measure.

It may not be possible for an engineer working on fire systems to assess the fire risks associated with certain hazards (e.g. in determining whether certain equipment is 'critical' if assessing fire risk to business or process continuity). In this case, it will be both necessary and appropriate to draw on the skills and experience of others to undertake an adequate assessment of fire risk.

The identification of fuel sources and ignition sources are essential to this process. Guidance on this is provided in Appendix B. To ensure a comprehensive and accurate technical FPDA report can be delivered, a table is provided in Appendix C that gives typical information that should be gathered and observations that must be made during this process.

3.1.2 Identification of Hazards and Risks

Several definitions are available for the term “Hazard” and “Risk”, and these concepts are fundamental to any FPDA process. It is therefore essential to define what is meant by these terms:

- **Hazard**: A hazard is that which has the potential to cause harm.
- **Risk**: Risk is a function of both the likelihood of a specific hazard being realised and the consequence of that realisation.

It is essential that all reasonably foreseeable fire hazards and risks are identified and considered in the FPDA process. It is not always necessary to carry out a detailed risk analysis (i.e. to consider every fire risk or all possible fire risk scenarios). Nevertheless, it should be recorded that those fire risks have been considered and have been found to be ‘acceptable’ from a risk point of view.

It is also relevant to point out that the hazard may always exist, but that it is possible to substantially reduce the risk of this hazard being realised (i.e. to take place within a particular environment). It is true that to eliminate the risk to zero is almost impossible. However, to reduce it to an acceptable level is possible, and, in fact, this should be the core aim of a FPDA.

3.1.3 Fire Prevention and Mitigation Measures

In the scheme of risk management, the proverb “prevention is better than cure” is true. The minimisation of the likelihood of occurrence of an undesired event is much more cost effective than implementation of measures which will reduce the severity/impact of the associated undesired consequences. It is a fact that it is much more cost effective to prevent a fire from occurring than to install and maintain fire detection and suppression systems, and in the end having to clean up following the occurrence of a fire and subsequent operation of protective systems.

Industry norm and world best practice evaluates the requirement of fire protection and fire detection based on a hierarchy of fire risk reduction measures being implemented as indicated in Table 1, and detailed in the paragraphs that follow.

It is imperative that the items in Column 1 “Design Safeguards” and Column 2 “Administrative Controls” of Table 1 are adhered to first before the items in the remaining columns are put in place. Fire detection and fire protection measures are the ‘last line of defence’, only operating once all other measures have failed to prevent a fire from occurring. In general, if the focus on Design Safeguards and Administrative Controls was improved the risk of fire would drastically reduce and money would not have to be spent on unnecessary fire detection and protection systems in areas where it is not required.

3.1.3.1 Design Safeguards

The fire prevention and mitigation measures start during the design process. Various regulations and standards identify hazards and risks in specific environments and give guidance on the mitigations that must be put in place for these hazards and risks. As part of the approach the process should focus on eliminating the hazard or risk as part of the design. When elimination of the hazard or risk is not possible or practical, the focus moves to containing the hazard or the risk passively.

Where the hazard or risk, with all the above-mentioned risk mitigation measures in place, is still at an unacceptably high-level appropriate fire and life safety systems should be incorporated in the design to mitigate the hazard or risk.

3.1.3.1.1 Remove the Hazard or Risk with Design

Remember when analysing the hazard or risk to consider secondary incidents that can occur because of the initial incident. For example, a small fire in a switchgear room may cause electric power interruption to the extraction system in the battery room. This may in turn cause a build-up of hydrogen gas in the battery room, resulting in an explosion hazard that now exists.

The aim is to remove the hazard or risk in the design phase, examples of this is as follow:

- Moving an LPG tank from its current location next to an office block to a location that is remote from all other plant and occupied areas.
- Replacing the oil in a piece of equipment with a FRF type of oil.

Table 1: Fire Risk Reduction Measures

<table>
<tr><td colspan="7">FIRE RISK REDUCTION MEASURES</td></tr>
<tr><td colspan="2">FIRE PREVENTION AND MITIGATION MEASURES
(Minimise risk of fire initiation)</td><td>FIRE DETECTION MEASURES
(Systems for early warning / alarming)</td><td colspan="2">FIRE PROTECTION MEASURES
(Systems to control / extinguish / suppress a fire)</td><td>EMERGENCY MANAGEMENT SYSTEM</td></tr>
<tr><td colspan="2">• 32-124 Eskom Fire Risk Management [3]
• 240-54937439 Fire Protection/Detection Assessment Standard</td><td>• 240-56737448 Fire Detection Systems and Life Safety Standard [7]
• 240-56737654 Inspection, Testing and Maintenance of Fire Detection Systems [15]</td><td colspan="2">• 240-54937450 Fire Protection Systems and Life Safety Standard [6]
• 240-54937454 Inspection, Testing and Maintenance of Fire Protection Systems [13]
• 240-126468603 Operational Standard for Fire Management in Generation [16]
• 240-126467640 Operational Standard for Fire Fighter Training in Generation [17]
• 240-126467668 Operational Standard for Inspection, Testing of Fire and Rescue Non-Plant Equipment in Generation [18]</td><td>• 32-123 Emergency Planning [10]</td></tr>
<tr><td>DESIGN SAFEGUARDS</td><td>ADMINISTRATIVE CONTROLS</td><td>FIRE DETECTION</td><td>FIRE PROTECTION</td><td>SITE FIRE FIGHTING FACILITIES</td><td>EMERGENCY PROCEDURES FOR SAFE EGRESS</td></tr>
<tr><td>• Regulations / Standards
• Remove the hazard / risk with design
• Contain the hazard / risk passively
• Process design and safeguards
• Plant layout</td><td>• Inspections, Testing
• Preventative Maintenance
• Competent people
• Safe work procedures
• Housekeeping procedures
• No smoking policy
• Hot work permits and procedures
• Safety and evacuation signage, awareness and exercises
• Internal and external Audits</td><td>• Fire / Smoke / Heat detectors
• Fire Detection panel
• Human-machine interface
• Interfaces to other systems such as fire protection / HVAC
• MCP's
• Gas detectors</td><td>• Passive Protection
• Manual Fire Protection Equipment
• Fire water supply, pumping and piping
• Automatic and manually activated active fire protection equipment / systems</td><td>• Regulations
• Site Standards
• Fire Prevention Programs
• Alarm Response Procedures
• Pre-determined fire emergency plans
• Fire safety officers
• Trained personnel
• Site fire brigade
• Mobile fire fighting equipment</td><td>• Evacuation Procedures
• Emergency planning structures
• Contingency plans
• Awareness and exercises</td></tr>
</table>

3.1.3.1.2 Contain the Hazard or Risk Passively

Where the hazard or risk cannot be removed/segregated the second-best option is to reduce the hazard or risk to a level that is acceptable to all applicable parties, examples of this is as follow:

- A high-pressure oil pipeline is modified to run within another closed pipeline, thus reducing the risk of oil spray if the inner pipeline ruptures.
- Increase the fire rating of the walls, fire doors and fire dampers of a specific area that contains or needs protection from a high risk.

- Portions of plant can be segregated from each other with a physical barrier, where fire and blast walls are constructed between large power transformers.

3.1.3.1.3 Other Safeguards

This is where the designer of the system must think of ways to mitigate the hazard or the risk of the actual system if there is no way to contain the hazard or risk passive while the system is in operation, examples of this is as follow:

- Shields.
- Emergency stops.
- Ensure that all plant and equipment are designed and operated to avoid overheating (ventilation holes to be cleaned regularly) and situated so that it does not catch fire from external sources.
- Escape routes.

3.1.3.2 Administrative Controls

Administrative controls mainly include work procedures such as written safety policies, rules, supervision, schedules, and training with the goal of reducing the duration, frequency, and severity of exposure to hazardous chemicals or situations, examples of this are as follow:

- Preventative and corrective maintenance, inspections and testing to be carried out as per maintenance strategy requirements on primary plant systems. This is CRITICAL as it is the most common root cause of fires – Primary Plant areas (e.g. Conveyor Systems, Fuel Oil / Hydraulic Oil System, Turbine Bearding oil soaked lagging left in place etc.) is not inspected, tested and maintained as per procedures resulting in fires.
- No Smoking policy and signs.
- Hot Work permits and procedures.
- Housekeeping and Vegetation control.
- All dangers with regards to combustibles / flammables and heat sources must be reported.
- Procedure for security to monitor actions of employees/contractors to prevent arson attacks.
- Improving housekeeping to ensure that no build-up of flammable coal dust occurs in the coal transfer houses.

3.1.4 General Acceptability Criteria

When undertaking these assessments, it is important to understand what can be regarded as an acceptable level of risk from fire. In most cases, the objective will be to reduce risks to be ‘as low as is reasonably practicable’ (ALARP). ALARP involves assessing the fire risk against the effort, time and money needed to control it. Thus, it describes the level to which it is expected that fire hazards and risks are controlled. If the fire risk reduction benefit is proportionate to the time, effort, and money necessary to implement the relevant fire risk reduction measure(s), then that fire risk reduction measure must usually be implemented.

In fire safety within Eskom, the practical definition of the level of fire risk that can be regarded as ALARP is set by the Fire Protection System and Life Safety Standard [6] and the Fire Detection System and Life Safety Standard [7] and adherence to such standards (where relevant and appropriate) will tend to demonstrate that risks from fire are acceptably controlled.

The FPDA needs to consider all possible sources of ignition, fire hazards and other risks in each area. It also needs to consider the potential action of people during normal working conditions as well as during an emergency situation.

3.1.5 Assessment Techniques

Various fire risk assessment techniques exist. Some of these techniques, considerations and pitfalls are described in more detail in Appendix A In Eskom the FPDA is the technical assessment that will be done to document the fire and life safety approach for the specific scope.

3.2 THE FIRE PROTECTION/DETECTION ASSESSMENT STEPS

The FPDA is a formalised assessment used for the management of existing and future fire protection, detection and alarm systems (fire systems). This includes both design and review of fire protection and detection within Eskom Holdings infrastructure.

In many cases, it is possible to assess risk quite straightforwardly by reference to the Fire Protection System and Life Safety Standard [5] and the Fire Detection System and Life Safety Standard [7]. Indeed, it should be the case that, before any FPDA is carried out, the assessor should review the Fire and Life Safety Standards and determine what suitable solution can be straightforwardly applied.

The following would be possible exceptions:

- If it were to be applied to an existing area of plant, the cost of compliance with the guidance would be grossly disproportionate to the fire risk reduction achieved.
- The situation under consideration has inherently and significantly lower or greater fire risk than that for which the Fire and Life Safety Standards were developed.
- The operations or works include alternative means of controlling the risks to a comparable or better level.

The Fire and Life Safety Standards encompasses industry good practice, industry and regulatory codes, approved codes of practice and regulatory guides, as well as practices adopted successfully by similar organisations.

In practice, if relevant good practice exists and is adopted for all reasonably foreseeable hazards, further detailed evaluation of risk need not usually be made. The FPDA duty is discharged by the appropriate adoption of that good practice. It is therefore very important to ensure that the good practice is:

- Appropriate to the activities being considered;
- Up to date;
- Both relevant to and covers all significant fire risks from the circumstances being considered.

This section has been developed to assist the assessor to document all relevant information during the compilation of FPDA. Figure 1 gives the high-level steps that are required. These high-level steps are detailed in the paragraphs below.

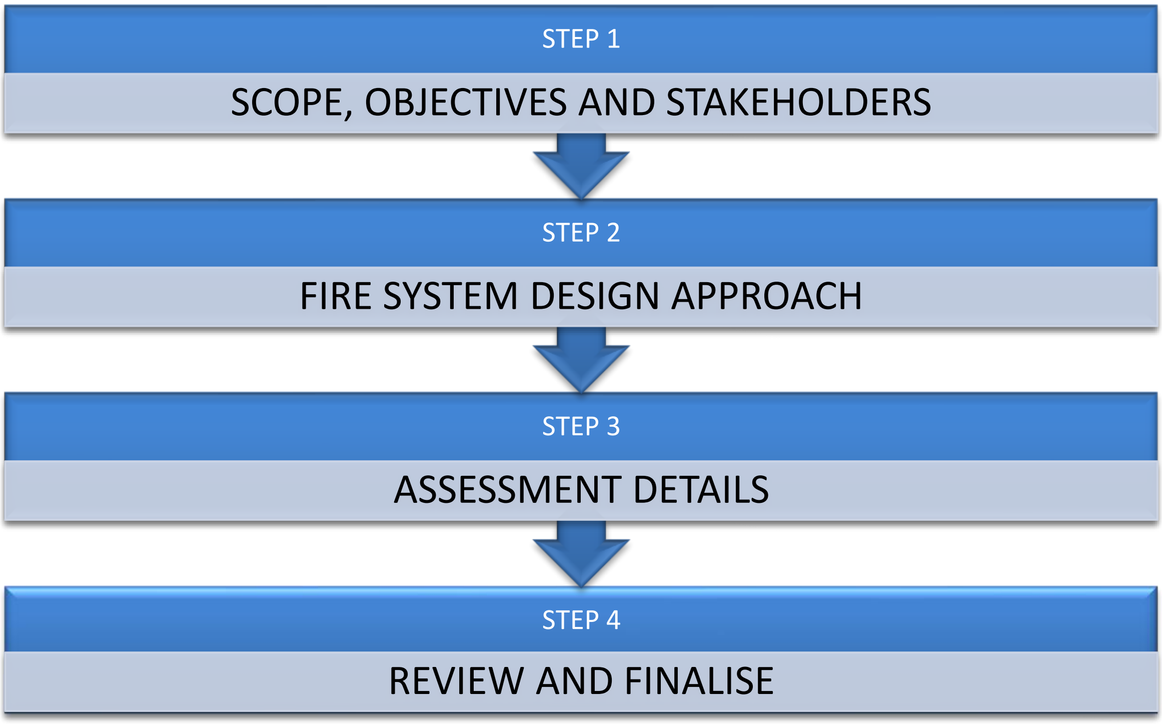

Figure 1: Fire Protection/Detection Assessment Steps

3.2.1 STEP 1: Scope, Objectives and Stakeholders

In some cases, it may be straightforward to define the scope and objectives of the FPDA, for example where the assessment is aimed only at satisfying fire safety codes of practise in simple premises. In other cases, the scope may need more careful definition, especially:

- When the purpose of the FPDA is to support the acceptability of the design of complex or critical systems;
- Where fire risks to **critical assets or business continuity are being assessed**.

Determining the scope requires defining the geographic area of the facility to be included in the FPDA. Some examples of the areas at a facility that could be selected for assessment include, a bulk fuel oil pump house, cable tunnels, a maintenance workshop, the coal plant, office area, storeroom, or sometimes the entire facility. If a large area is selected, it is best to subdivide it into smaller parts and then combine the results later.

Methods of determining the areas where the assessment are to be conducted include:

- Areas where new plant is being installed,
- Areas where a building / plant is being physically modified such that the fire risk profile is altered,
- Areas raised as a concern in the insurance surveys,
- Areas that have experienced fires on other facilities.

Conduct an assessment of each identified area and combine these results to assess the hazards in the larger area.

Ensure all stakeholders whom the assessment will have an impact on are identified and involved in the compilation and/or review of the assessment. Choose the group that will assist with carrying out the assessment. The people involved in this activity should be knowledgeable about the applicable area of the facility or the entire facility that is being assessed. For example, in carrying out a FPDA at a bulk fuel oil plant the group will likely consist of a fire protection system engineer, fire detection system engineer, fuel oil plant system engineer, fire risk practitioner, outside plant maintenance personnel, outside plant operating personnel, as well as fire brigade representatives.

If the FPDA needs to be carried out over multiple interconnected systems of the facility, then groups of people should be assigned to areas that they are experienced with. The findings from the various experienced groups can be combined for a detailed assessment of that particular area or facility.

3.2.2 STEP 2: Fire System Design Approach

The scope in question must be evaluated to confirm all possible and practical fire prevention and mitigation measures have been applied.

The fire system design approach is the key to the identification of the relevant fire systems that must be provided for specific plant areas or facilities. The fire system design approach must be documented as part of the FPDA Report and completed for a specific plant area or facility.

This approach has been presented in this standard in the form of a flow chart (See STEP 2 detailed in Figure 2) to assist users to understand and apply when conducting a FPDA.

There are two (2) possible legislative routes that can be taken in the review or development of fire systems:

1. By prescriptively applying South African National Standards (SANS) to assess existing or develop new fire systems. This approach is referred to as the 'Deemed to Satisfy' (DTS) approach as outlined in our regulations.
2. By taking a 'Rational Design Approach'. This is an alternative to the DTS approach and optionally may follow one (1) of two (2) paths:
   a) Compliance with an 'Alternative Code or Standard' (i.e. to a standard or code being an alternative to a SANS compliant DTS approach). Also called a Code Compliant Design.
   b) Fire Engineered Design (i.e. a design that incorporates first principles fire engineering design and does not necessarily utilise any standard or code.)

The Eskom Fire Protection and Life Safety Standard [6] and the Eskom Fire Detection and Life Safety Standard [7] detail the recommended Eskom fire system requirements for identified hazards and risks found in most Eskom facilities. This is done to ensure a standardised approach is followed when the type of protection and detection is selected for similar hazards and risks. Situations will arise where the Eskom recommended fire system may not be the most suitable solutions for the specific hazard and risk under evaluation. Under these circumstances alternative solutions can be evaluated but approval to proceed with an alternative fire system solution must be obtained by following the process as set out in the Work Instruction for the Application of Standards in Plant/Project Engineering [7].

Every FPDA compiled must identify if the recommended Eskom fire system requirements will be fulfilled or justify why an alternative fire system solution is more suitable for the specific hazard and risk under evaluation.

Following a SANS DTS approach, the minimum requirements could indicate that no fixed fire protection or fire detection is required. **It is imperative that <u>equipment criticality / business continuity</u> requirements are also considered before the FPDA can be finalised**.

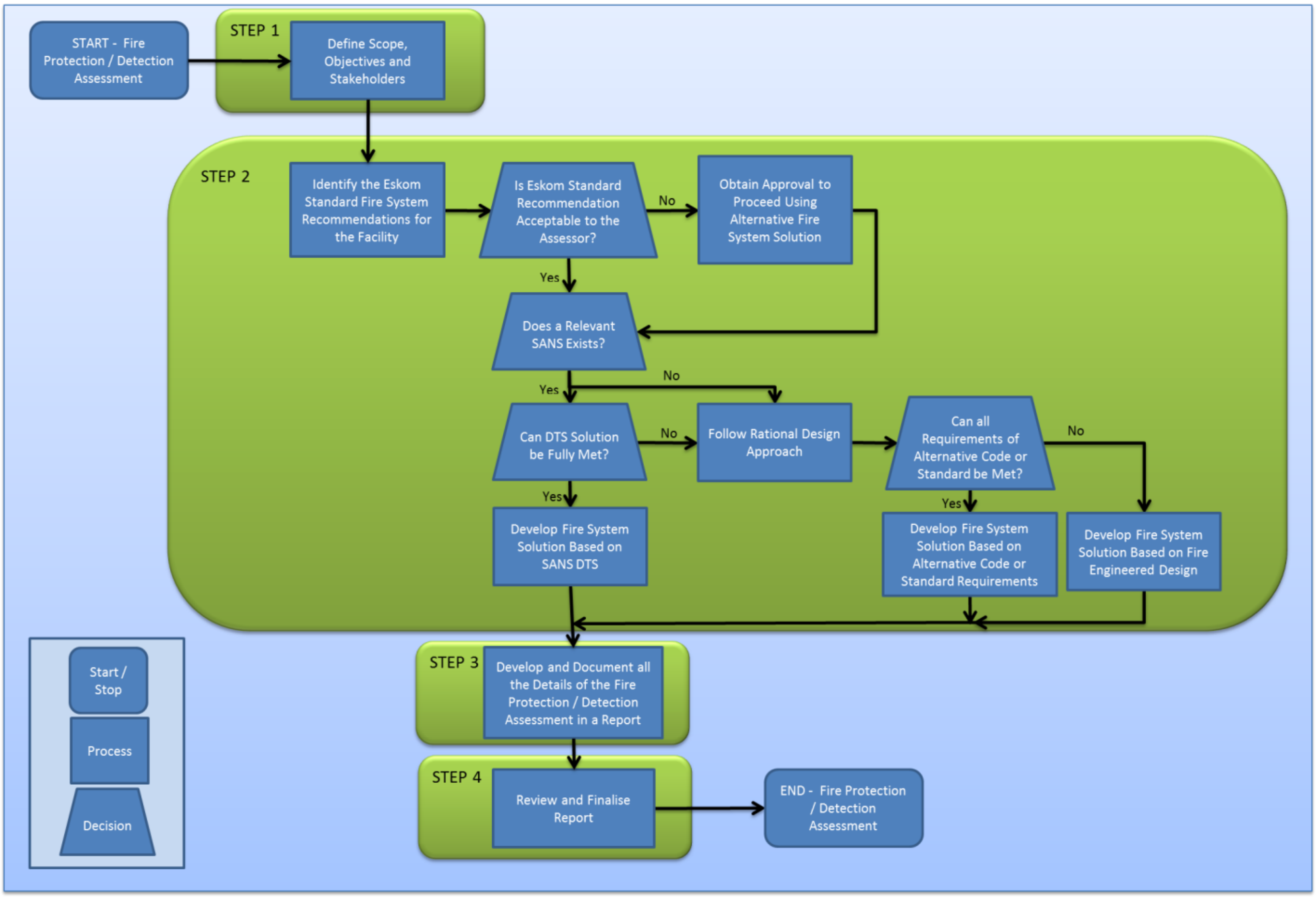

Figure 2: Fire Protection/Detection Assessment Process

3.2.3 STEP 3: Assessment Details

The FPDA report must contain as a minimum the following information:

- Scope, objectives and stakeholders (this includes an overview of the area/s surveyed and the information of all personnel involved).
- Risks and Vulnerabilities (which includes critical assets, critical processes and activities, critical services and people exposure).
- All assumptions made during the process.
- Document all source documentation which was used as input to the FPDA.
- Previous fire and explosion related disruption history and details, if available.
- Identified hazards/risks with probable ignition sources and possible consequences as well as identify which fire prevention/protection features are to be provided.
- Identify all fire prevention and mitigation measures that are in place.
- Identify where operational and administrative controls are assumed to be in place to mitigate the need for fire protection features.

- Fire protection and fire detection strategy (which includes the decision-making process of the design approach). This should also indicate if the main considerations are related to life safety or business continuity.
- Conclusion.
- Recommendations.

The final authorized and signed assessment that is compiled must be saved with the following name convention:

- "Document number" "Fire Protection/Detection Assessment" – "Name of Facility" – "Plant Area being assessed" - "Revision of document", for example:
  - "*PWT002HG234 Fire Protection-Detection Assessment - Camden Power Station - Outside Plant Substations - Rev1*"

Completed FPDA's that can be used as examples and guidance. Links to completed FPDA's can be found in Appendix D.

3.2.4 STEP 4: Review and Finalise

The task of FPDA is an on-going activity. If at any time the work environment, conditions or scope changes the FPDA needs to be updated and the fire protection/detection strategy re-evaluated. A FPDA is most useful if it is never considered finished. Instead, think of it as a draft document that needs to be up-dated as things change.

The interim design review process (as described in the Design Review Procedure [9]) will be followed for the review and finalisation of every revision of the FPDA.

4. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Cobus Dippenaar	Fire and Life Safety Care Group
Katlego Masha	Fire and Life Safety Care Group
Mbali Mathebula	Fire and Life Safety Care Group
Jorge Nunes	Fire and Life Safety Care Group
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5. REVISIONS

Date	Rev.	Compiler	Remarks
February 2013	0	M D Collier	First draft issued for comment
March 2013	1	M D Collier	Final Document for Authorisation and Publication
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March 2018	2.1	W O Erasmus	Standard Rewritten
February 2018	2.2	W O Erasmus	Final Draft Document for Business Review
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January 2024	3.1	M. André	Minor updates done – mainly related to standard references.
August 2024	3.2	M. André	Final Draft After Comments Review Process
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October 2024	4	M. André	Final Rev 4 Document for Authorisation and Publication

6. DEVELOPMENT TEAM

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

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7. ACKNOWLEDGEMENTS

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APPENDIX A: ASSESSMENT EXPLANATORY INFORMATION

1. ASSESSMENT TECHNIQUES

Various risk assessment techniques exist. While the risk assessment methodologies vary, they are likely to include the following steps:

- Identify the hazards;
- Identify the possible consequences and estimate their likelihood;
- Evaluate the risk;
- Decide on the action to take to reduce risk to as low as reasonably practicable;
- Record the findings;
- Monitor and review as appropriate.

In Eskom, if the FPDA process requires further motivation or additional supporting documentation the Eskom Integrated Risk Management Standard [11] will be applied.

2. OTHER ASSESSMENT CONSIDERATIONS

a) Societal Concern

Where a significant number of persons could be affected by the consequences of a particular fire hazard in the premises, or where those persons might be regarded as particularly 'vulnerable' in case of fire, consideration should be given to possible societal concern about the risk or the measures proposed to reduce the risk. The factors to be considered within this determination should include those where:

- The extent to which the risk arises from a failure that could result in a major accident, which the general staff at a facility or required area of a facility would be unaware of, or would assume was already well controlled;
- There might be staff aversion to the scale of the injuries should the risk be realised;
- General staff anxiety and loss of confidence that would arise from a key failure occurring within the accident sequence, even if not leading to serious consequence (e.g. a near miss);
- The risk is inequitably shared, particularly where a vulnerable group (such as the elderly or persons with a disability) may be involved;
- The decision may lead to loss of public trust in Eskom's ability to learn from serious incidents and/or adopt good practice;
- The adoption of the risk reduction measure would have a significant adverse effect on Eskom's operations, which the staff may perceive as being disproportionate to the safety risks.

b) Risk to Fire Fighters

It is expected that fire fighters are likely to be exposed to risk (when carrying out their fire and rescue duties) that would be comparatively intolerable for members of the public.

Fire and rescue operations are normally undertaken on the basis of a dynamic risk analysis upon arrival at the incident (based upon the affected area of plant, the severity of the fire and whether it is believed that there are persons at risk from the fire), coupled with appropriate PPE (e.g. heat-resistant clothing and/or breathing apparatus). It is not, therefore, either practicable or necessary to control risk to fire fighters during their operations to levels equivalent to those for other occupants.

Having said the above, the risk to fire fighters undertaking their duties during a fire should be considered when designing a building. It is not acceptable to ignore the fact that their duties under law are likely to include doing all that is reasonable to protect both life and property in case of fire. The fire risk prevention measures should aim to be such that these duties can be undertaken without exposing the fire fighters to intolerable risks. In practice, this will usually mean ensuring that works either comply with good industry practice and/or offer an equivalent level of fire risk (to the fire fighters) by other means.

3. ASSESSMENT PITFALLS

a) Considering only the probability of fire

It is unlikely to be legitimate to conclude that fire hazard is so low that the probability of having a fire that can cause harm is negligible. It is expected that, where a low frequency but serious consequence event such as a large fire is concerned, it should be assumed that a fire could occur and the risk should be assessed on that basis. The management controls that would be required to reduce to negligible the probability of a significant fire starting are so demanding that, in most industries, it is not sensible to rely upon them being applied throughout the life of the facility or required area of the facility.

b) Reverse ALARP

It might be attempted to justify the removal of existing fire protection measures on the basis that the cost of on-going maintenance or renewal is grossly disproportionate to the fire risk reduction benefit that they achieve. This is not acceptable because there is a legal responsibility to maintain existing fire protection measures and those existing measures reduce risk to what must have been regarded (when they were implemented) as an acceptable level. By providing those measures, Eskom has demonstrated that it is reasonably practicable to do so, and by so doing it is reasonable to achieve the resulting level of risk. Increasing that level of risk can therefore not be ALARP. This unacceptable form of argument is commonly known as 'reverse ALARP'.

This does not mean that fire protection can never be removed; if one can reasonably argue that fire risk has not been increased at all by that removal, then it may be acceptable to do so. This might be by applying one or more of the following criteria:

- The risk reduction measure to be removed or modified addressed a hazard that is no longer present;
- Alternative risk reduction measures no less effective than the measure being removed will be applied and maintained, so resulting in risk not being increased;
- In all cases the removal of the risk reduction measure does not increase risk beyond that which would be achieved by the application of relevant and current good practice.

c) Using the cost of remedial works in a Cost-Benefit Analysis (CBA)

It might be the case that works have been designed and implemented in an unacceptable manner. For example, it might be discovered that they do not comply with good industry practice nor do they offer an equivalent level of safety. In this case it has been known for CBA to be used (in either a qualitative or quantitative risk analysis) to justify why it is acceptable for those variations from acceptable risk to remain. It is often the case that those making the argument use the 'trouble' (i.e. cost, disruption and impact upon programme) of correcting the issue as the measure against which the risk reduction benefits are judged.

This is not good practice and should be avoided. When using CBA either qualitatively or quantitatively, the judgment should be made against the cost of the relevant works when they have been competently and correctly designed, supplied and installed, not against the cost of correcting works designed, supplied or installed incorrectly.

d) Incorrect reference to good practice

Some attempts to justify departure from relevant good practice refer to inappropriate guidance (e.g. standards written to address fire risk in plant areas with less significant fire hazards than those in question). It may be the case that the engineer refers to guidance on conveyors carrying ash, instead of guidance that addresses the risks encountered on conveyors carrying coal. It is important that those assessing risk are mindful that the guidance they use, either directly or as a 'benchmark', is appropriate to the environment that they are considering.

e) Not considering risk to particularly vulnerable occupants

When assessing fire risk, those undertaking the assessment should be fully aware of the occupancy profile of the facility or various areas of the facility. They should ensure that the assessment considers whether there are any occupants who are likely to be present whose response to a fire emergency in that premises might be delayed or their ability to make good their escape might be hindered by a sensory or physical impairment (whether permanent or temporary). Examples might include:

- The elderly;
- Persons with a sight and/or hearing impairment;
- Persons with restricted mobility (e.g. wheelchair users);
- External contractors unfamiliar with the plant layout.

In all cases, it will be important for the FPDA to consider the risk to each individual type of occupant and to conclude whether the existing or proposed risk reduction measures are adequate to control risk to an acceptable level.

It is normally very important to consider whether relevant good practice exists and it would be appropriate to apply that good practice wherever it is reasonable to do so. Where varying from that guidance, it is strongly recommended that those undertaking the FPDA are able to construct a robust case for the proposed risk reduction measures being equivalent to that good practice.

It is recommended that the assessors do not base the assessment only upon the current occupants of the premises. One should also consider whether it is foreseeable that vulnerable occupants might be in the premises even if they are not currently present. For example, if a building has step-free access to all or part of it, then it should be considered that wheelchair users might be found in all accessible parts of those premises, even if it is not evident that they are, or if there is no particular reason for them to be in that part of the premises.

The FPDA should therefore take into account the possible presence of wheelchair users, and appropriate procedures and/or physical protection measures should be provided to ensure that they can be safely evacuated.

It is unlikely to be acceptable to argue that, because few vulnerable people are likely to be in their premises, the probability of both having a fire of significant size and having a vulnerable person in the premises at the same time is so small as to render the cost of any fire risk reduction measure aimed solely at that group grossly disproportionate to the risk reduction achieved. This is not viewed as good practice, because it may place a vulnerable group at a significantly higher risk than other building occupants, and it fails to maintain risk at levels equal to or better than relevant good practice. Whether it can be claimed that individual risk is low or not, this approach is unlikely to satisfy the test of societal concern, which makes its acceptability highly questionable.

By making their premises accessible to those vulnerable groups, it is expected that Eskom takes steps to reduce their risk from fire to a level comparable to that for the rest of the occupants of that premises.

APPENDIX B: IDENTIFICATION OF IGNITION SOURCES, FUEL SOURCES AND OTHER RISKS

1. IDENTIFICATION OF IGNITION SOURCES THAT EXIST IN THE AREA

Ignition sources that may be categorised, for the purpose of identification, as:

- Fixed ignition sources:
  - Electrical equipment (Battery banks, generators, power line connection points, transformers, switchgear & breakers, electrical panels, cable connections, service outlets & fittings, motors, heaters)
  - Static Electricity (determine the means of static electricity generation/build-up, consider the energy of the spark discharge and the proximity of ignitable air/vapour mixture)
  - Process Ignition (Chemical reactions, pyrophoric materials, unstable materials such as explosives)
  - Building/Equipment (Shears, presses, compactors, furnaces/ovens/boilers/fired heaters, mills, HVAC systems)
  - Heat sources (e.g. boilers, hot steam pipes)
- Linear and Mobile exposures:
  - Mobile sources (Fork lifts/other vehicles, hot exhaust, cranes)
  - Linear (Cable runs, conveyors, steam pipes, process lines)
- Temporary ignition sources
  - Maintenance (welding & cutting, electrical exposure, spontaneous ignition from oily rags)
  - Rags, rubbish or aerosol cans, cigarette smoking
  - External sources (adjacent fires, veld fires, lightning)
- Incendiary Ignition exposure
  - Employees, visitors, outsiders with malicious intent. Although the latter could be listed as a possible ignition source, an analysis to determine why, by whom and how such ignition will be possible is beyond the purpose of the assessment.

Each of these sources has at least 1 possible cause of ignition (e.g. power cable connections could be inadequately connected), and a resulting ignition type (inadequately connected power cable becoming extremely hot or causing arching). It is useful to note the possible causes and ignition types for the retained ignition sources in the plant area.

2. IDENTIFICATION OF FUEL SOURCES IN THE AREA

This task is best done with a plant walk-down and interviews with the plant area supervisor and system engineers. In this task a list is compiled of all the combustible and flammable materials available in the plant area.

Similar to the identification of ignition sources, it is suggested to categorise combustible/flammable materials in the plant area into permanent and temporary materials.

- Permanent (fixed). This category considers materials that is not frequently introduced and removed in the area, and includes items like:

  - Flammable liquids, e.g. Hydrogen storage bottles or tanks, or Hydrogen gas being present in pipes or specific equipment, Acetylene, oil (include pressure and temperature, and if the oil is synthetic, mineral or FRF, LPG, etc.
  - Furniture (office buildings & control room)
  - Insulation
  - Coal dust

- Temporary or “transient” materials such as cleaning agents, rags, paint, wood, cabling, plastic containers, etc. The general status of the House Keeping of the plant area could be problematic, and should be listed. Once the House Keeping has improved, this item as a possible fuel source could be reduced in contribution or removed from the list.

With a reasonably complete list of ignition sources and fuel sources relevant to the plant area, the only remaining task to determine the ignition source strength is to evaluate the availability of Oxygen in the atmosphere of the plant or plant area.

3. OXYGEN

Oxygen is always present except in sealed tanks with N_2 blankets. Often the Oxygen supply is limited (no ventilation), but in these cases ignition could be so severe that the immediate combustion could result in a failure of the integrity of the containment, which then allows for a unlimited supply of Oxygen. With all three components for probable ignition (ignition source, fuel and Oxygen) being identified, the assessor may now make a judgement or a detailed analyses of the expected ignition strength. If the assessor does not venture into a detailed analysis, a conservative approach is adequate.

4. OTHER RISKS

Other risks may include unsatisfactory structural & services features such as:

- Un-compartmented roof spaces;
- Ducts and voids;
- Absence of fire stopping;
- Lack of ventilation/extraction;
- Insufficient separation distance between risks;
- Limited or no access for the fire-fighting teams;
- Limited or complicated escape routes;
- Poor or no emergency and fire signage;
- Insufficient emergency lighting;
- Poor security – leading to possible arson.

In general fires start in one of three ways:

- Accidentally, such as when smoking materials are not properly extinguished or when equipment is dropped onto operational plant;
- When something is not done as per procedure, such as when electrical or mechanical equipment is not properly maintained, or waste material is allowed to accumulate near to a heat source;
- Deliberately, such as an arson attack involving setting fire to external rubbish bins placed too close to plant or buildings.

Be as specific as possible when listing fire hazards and always mark up the hazards on a site plan or an accurately drawn hand sketch.

5. IDENTIFY ALL POSSIBLE PEOPLE THAT MAY BE AT RISK

These may include:

- Those unfamiliar with the plant and its layout;
- Those asleep (cable tunnels is a favourite spot);
- The elderly;
- Anyone with an injury or permanent disability;
- Those who might not speak or understand English;
- Those working alone or in remote places;
- People in large numbers.

APPENDIX C: ESSENTIAL INFORMATION AND OBSERVATIONS TO CONSIDER

Where is the Facility, its Geographical Location *(MWP, Power Station, EAL, etc.)*? Do you need special PPE for the area, or if it is restricted access? Date of Site Visit? All people *(personnel levels)* present during the walk-down (and if applicable, follow-up plant walks), and if it is restricted access arrange with someone to walk with you that has access.	
Describe the area that is being assessed *(Is it is base load unit or a peaking unit, What is it purpose and name, On which unit is it located, Where in the outside plant is it, What room(s) in a building, Layout of area assessed, How many people are there {operating, working, walking close-by, sleeping, smoking, etc.}, Is it manned 24 hours a day, etc.)*.	
What is the capability of the emergency responders *(Are they on site or external people, How quick will they be able to respond to the area, Is there space for a fire truck to get close enough to the area, etc.)?*	
What is the HAZLOC classification of the Building, Area, Room, Plant *(Refer to the HAZLOC standard)*?	
Take down the relevant KKS/AKZ number, or any other descriptions applicable	
General Observations inside	
1	Is it Critical according to the definition? Also state why it is critical or not critical *(Equipment Availability, Redundancy and Criticality)*
2	Is there a basement? Please elaborate
3	Are there multi storeys? Please elaborate
4	Are there ceiling voids? Please elaborate
5	Are there floor voids? Please elaborate
6	What are the possible ignition sources, heat sources and combustibles, mention all the hazards and risks, please note that there can be more than 1, and it includes all fuel types and volatility *(amount of these items, the quantities of these items, the plant arrangements, etc.)*? Please elaborate, see some examples below:
	Ash, Batteries, C&I Field Equipment, Coal and/or pulverised coal, Conveyor Belt, Deliberate Ignition , Electrical Equipment (Cables, Switchgear, Control Panel, Relays, Motors etc.), Flammable Liquids and/or Gasses (Diesel, Fuel Oil, Seal Oil, Lube Oil, Clean Oil, Dirty Oil,H2, O2, LPG, etc.), Oven/Stove (or 2 plate stove), Poor housekeeping, Smoking, Vehicles, Deliberate (Arson), etc.
General Observations outside	
7	Are any of the areas/ buildings/plant/rooms outside Critical according to the definition? Also state why it is critical or not critical, and how far it is located from the area/plant/building/room being assessed. Is there Redundancy?
8	Is there a basement in any of the areas? Please elaborate
9	Are there multi storeys next to the area being assessed? Please elaborate
10	Are there ceiling voids? Please elaborate
11	Are there floor voids? Please elaborate
12	What are the possible ignition sources, heat sources and combustibles, mention all the hazards and risks, please note

	that there can be more than 1, includes all fuel types and volatility *(amount of these items, the quantities of these items, the plant arrangements, etc.)*? Please elaborate, see some examples below:
	Ash, Batteries, C&I Field Equipment, Coal and/or pulverised coal, Conveyor Belt, Deliberate Ignition , Electrical Equipment *(Cables, Switchgear, Control Panel, Relays, Motors etc.),* Flammable Liquids and/or Gasses *(Diesel, Fuel Oil, Seal Oil, Lube Oil, Clean Oil, Dirty Oil,H2, O2, LPG, etc.)*, Oven/Stove *(or 2 plate stove)*, Poor housekeeping, Smoking, Vehicles, Deliberate *(Arson*), etc.
General Observations <u>Inside & Outside</u> <u>*{Try to get as much information as possible}*</u>	
13	System description of area assessed as well as surrounding areas/plant/etc.
14	Operating philosophy of area assessed as well as surrounding areas/plant/etc.
15	Drawings of area assessed as well as surrounding areas/plant/etc. *(Piping and Instrumentation Diagrams (P&ID's))*
16	Drawings of area assessed as well as surrounding areas/plant/etc. *(General Arrangement (GA))*
17	Drawings of area assessed as well as surrounding areas/plant/etc. *(Isometric)*
18	Drawings of area assessed as well as surrounding areas/plant/etc. *(Other types available)*
19	Data Sheets of equipment in the area assessed.
20	Data Sheets of equipment in the surrounding areas/plant/etc. of the area assessed
21	Can any Hazards be removed, specify if any *(plant arrangement, design, etc.)*
22	Are there any future plans for the assessed area, or its surroundings, specify if any
23	Any history wrt fire incidents on the assessed area or its surroundings, specify if any *(Historical loss information, incident reports.)*
24	Are there any issues wrt maintenance on the assessed area, speak to the maintenance department
25	Are there any issues wrt operating on the assessed area, speak to the operating department
26	Other issues applicable to the project and/or areas
<u>Passive</u> Protection Observations <u>inside</u> and/or <u>outside</u> of the Area being assessed *{Please elaborate, state the condition, the size, area, volume where applicable, also state the amount of items, etc.}*	
27	Separation Distances between areas *(plant/equipment / buildings/ etc.)*
28	Fire Barriers *(Fire Doors, Walls, Windows, Floors, Roofs and/or Ceilings, fire rating: integrity, stability, and insulation (for example 2 hours))*
29	Fire Stopping and Intumescent Coating of Cables
30	Building Construction Materials and Surface Finishes
31	Drainage
32	Lifts
33	Escape Routes and Travel Distances

<u>Fire Detection Observations</u> <u>inside</u> and/or <u>outside</u> the building:	
34	Detectors *(Smoke {Agitating or point type}, Heat {Linear or Point type}, Combination Heat & Smoke, Laser, Video Based {Smoke, Heat, Flame})*
35	Alarms *(Sounder, Strobe Lights, Combination Strobe Lights & Sounder)*
36	MCP (Manual Call Point)
37	Emergency Door Release
38	Signals from Pressure and/or Flow Switches
39	Interfaces *(HVAC, SCADA, etc.)*
<u>Active</u> Protection Observations <u>inside</u> and/or <u>outside</u> the Building/Plant/Area/Room:	
40	HVAC *(Air Distribution/Air Intakes, Ventilation, Fire System Interface Control, Fire Dampers, Damper Access Panels, Smoke Control & Ventilation Systems, Smoke Control Dampers)*
41	Manual Fire Protection *(Foam Trolley, Hose Reels, Fire hydrants, Fire Extinguishers: {DCP 9kg/4.5kg, CO_2 10kg/5kg, other})*
42	Sprinkler System (colour of bulbs)
43	Deluge System
44	Gas Suppression System
45	Aerosol System
46	Foam System *(with Compressed Air or Water)*
47	Water Mist Systems
48	Fire Water Supplies *(Storage, Availability, Pipes, Pipe Supports, Flanges & Bolting, Valves, etc.)*
49	Pressure and/or Flow Switches *(interface to C&I amount of ports)*
50	Fire Water Pumps *(Jockey, Diesel & Electric and Pump curves for each)*
51	Operating and Control Philosophy of fire system
52	Signage
<u>Other Observations</u> <u>inside</u> and/or <u>outside</u> the Building/Plant/Area/Room:	
53	Emergency Lighting
54	Radio communication Equipment & Back-up Power Supply *(Refuge Area)*
55	Other *(This applies to anything else that might not be mentioned in Appendix C)*

APPENDIX D: EXAMPLE FIRE PROTECTION / DETECTION ASSESSMENTS

- 474-9729 Fire Protection/Detection Assessment: Komati Power Station **Hydrogen Plant**
- 474-10244 Fire Protection Detection Assessment Grootvlei Power Station **Bulk Fuel Oil Plant**
- 375-LET-AABB-D00138-23 Lethabo Power Station Fire Protection/Detection Assessment Station **Control Rooms**
- 474-11058 Fire Protection/Detection Assessment Report Kendal Power Station **Fire Detection**
- 474-12915 **Eskom Bellville Offices** Fire Protection Detection Assessment Report
- 474-13082 **Komati Water Scheme** Fire Protection Detection Assessment Report

**If for some reason you cannot access the examples, contact the compiler of this Fire Protection – Detection Assessment Standard*

*** More examples of Fire Protection-Detection Assessments are also available on the Gx Engineering Document Management Portal (Master Document Index) -* Gx Engineering Document Management - Home (eskom.co.za).